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Review

Contributions of the 5G Network with Respect to Poverty (SDG1), Systematic Literature Review

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Abstract: Poverty is one of the biggest problems in the world caused by the lack of resources necessary to meet the basic needs of human survival. Ending global poverty is one of the main tasks of large organizations around the world, as well as the United Nations has established 17 Sustainable Development Goals (SDGs), the first goal being the "eradication of poverty". On the other hand, 5G technology has been considered one of the most important revolutions in the digital era and has been highlighted for its ability to improve people's quality of life. As this technology expands around the world, it is important to understand how it could contribute to poverty reduction, a major global challenge. To carry out this literature review work, various sources of information were used, with a total of 329 articles from which 49 relevant articles were obtained. It was identified that the sectors with the greatest contribution to poverty reduction are Government, Society, and Agriculture. It was also found that the most relevant 5G technology that influences poverty reduction on a larger scale is the Internet of Things and Artificial Intelligence. Being applied mainly in precision agriculture and Smart Cities. This review provides a reference point for the analysis of the use of 5G technologies in different sectors, with the aim of promoting equality and economic inclusion in rural areas and future research on the various factors that affect poverty reduction.

Keywords: 5G; poverty; technology; hunger; sustainability

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1. Introduction

Poverty is one of the major problems worldwide, which is caused by the lack of resources necessary to satisfy the basic survival needs of human beings [1]. According to the United Nations [2], poverty is more than a problem of lack of resources or income, it has become a human rights issue. Ending global poverty is one of the major goals of major organizations around the world, such as the UN, which has set 17 Sustainable Development Goals (SDGs) [3].

The goal "End Poverty" is positioned as the first of the 17 goals in the list, being named SDG1 [4]. Therefore, the goals set by global organizations have been gradually achieved to combat poverty over time. The World Bank in 2018 [5] indicated that poverty levels have made steady progress; however, they have been decreasing at a slower pace, and the figure before the pandemic was that the number of people living in poverty decreased by as much as 10%.

Over the last few years, poverty levels have been steadily declining in the region [6]; however, the arrival of the COVID-19 pandemic provoked a worldwide economic crisis, which has caused great irreversible damage to the entire population [7], even interrupted and damaged the progress achieved by the SDGs, with SDG1 being one of the most affected, as the world economy suffered the worst recession in the last 90 years, with people in the most vulnerable sectors being the hardest hit [8]. The World Bank [9] indicated that poverty levels increased disproportionately over the last 20 years.

According to the investigation of [10], as a result of the pandemic, the most affected countries in the world have been the developing countries in regions such as the Caribbean

and Latin America, which have been among the worst affected, with a poverty level of 13.6% for the entire population of the region.

In 2020, the United Nations stated [11] that millions of people in Latin America and the Caribbean would fall into extreme poverty due to the impact of the pandemic, affecting food security and social welfare, which is why institutions such as the Food and Agriculture Organization of the United Nations (FAO) and the Economic Commission for Latin America and the Caribbean (ECLAC) have been working on it, seeking solutions that can counteract this damage and avoid a food crisis and reduce the levels of extreme poverty [12].

The United Nations Development Program (UNDP) has decided to implement intelligent robots against epidemics in Kenya [13], using technology as a fundamental tool to combat and solve the damage caused by the pandemic. However, the existing digital divide had a greater impact in times of the pandemic [14] because this led to high unemployment, loss of job opportunities, and lack of accessibility to education and public services due to the lack of technological resources and Internet, which increased poverty rates [15]. As a result, UNDP began to implement technology-driven projects [16], promoting online learning, creating virtual learning spaces, creating work-from-home jobs, etc. The incorporation of mobile technologies has provided a number of economic, social, and environmental advantages [17], enabling the achievement of the 17 SDGs. This is why the implementation of measures with innovative approaches will allow progress in achieving the SDGs [18].

The combination of various technological enablers (AI, 5G, IoT, Blockchain) makes up "smart connectivity" [19], which is considered the most impactful technology to help achieve the SDGs [20]. Mobile technologies make a major contribution to SDG1 [21] because they provide humanitarian assistance and boost sustainable economic growth, as well as enable the expansion of businesses and thus produce more jobs [22]. Among these technologies is the 5G network, which plays a key role in global sustainability [23].

5G technology refers to the fifth generation of wireless mobile networks, which represents a significant advance compared to previous generations (2G, 3G, and 4G). It is characterized by offering much faster connection speeds, higher capacity, lower latency, and the ability to connect a large number of devices simultaneously [24].

5G technology will have the capacity to create social value in eleven SDGs [25]. According to the article [26], the 5G network will make a major contribution to the achievement of SDG1 by 2035, as it will provide greater Internet connectivity, generating an economic output of USD 3.6 trillion and creating 22.3 million jobs [27]. The enhanced capacity of 5G enables the connection of a large number of devices simultaneously, which is essential for the development of the Internet of Things (IoT) [28]. With 5G, billions of devices are expected to be connected, enabling the automation and interconnection of various sectors, such as industry, agriculture, healthcare, and the Smart City [29].

This research focuses on analyzing the impact of the use of 5G network-based technologies and their contribution to poverty alleviation, in order to promote equality and generate sustainable jobs. This review aims to highlight the importance of using 5G network-based technologies to combat poverty by improving access to basic services, boosting economic development [30], fostering digital inclusion, and improving efficiency in key sectors. By providing disadvantaged communities with the necessary tools and opportunities, 5G network-based technologies have the potential to transform lives and contribute to poverty reduction around the world.

The study consists of five parts. Section 1 corresponds to the introduction, which contains background information and the importance of the study. Section 2 provides an overview of the literature review, which includes previous and related studies on the impact of 5G technology on poverty alleviation. Section 3 contains the research methodology, which contains the scope of the study, the use of bibliometric tools, and the process of data collection and analysis. Section 4 shows the results corresponding to the bibliometric analysis, which allows answering the research questions, and finally, Section 5 shows the findings and discussion of how 5G network-based technology applications reduce/contribute to

poverty, and Section 6 provides the conclusion of the study along with main findings and leads to future research.

2. Literature Review

2.1. Previous Definitions

According to the United Nations World Economic Situation and Prospect (WESP), countries worldwide are divided into three categories based on their economy: developed economies, economies in transition, and developing economies [31]. Most countries in Europe, North America, and Australia are classified as developed countries, while countries in Africa, Asia, and Latin America are considered developing or transition countries or "global south". While countries in the global north are leaders in the development of technology and have high standards of living.

Current evidence shows that technology can play an important role in achieving many Sustainable Development Goals, and its proper application can help close the gap between countries in the North and South as well as the impact on national agricultural markets [32,33].

2.2. Previous Studies on Poverty Reduction and Access to 5G Technology

The relationship between 5G technology and poverty reduction has been the subject of debate and discussion in the academic literature and in reports by international organizations. Some relevant background and previous definitions are presented below.

The United Nations Economic Commission for Africa (UNECA) report on the digital revolution in Africa [34] highlights the potential of 5G technology to boost digital inclusion and reduce the digital divide between countries and regions. It also notes that 5G technology can have a significant impact on sectors such as agriculture, health, and education, which can contribute to reducing poverty and inequality in Africa.

A study conducted by the World Bank on the impact of 5G technology on development [35] concludes that 5G technology can be an engine of economic growth and social development and can help improve the quality of life of people, including the poorest communities.

The article [36] analyzes the role of 5G technology in reducing poverty and inequality in Latin America. It highlights that 5G technology can contribute to job creation and economic development in rural and remote areas, which can improve people's quality of life and reduce poverty.

In general, it is recognized that 5G technology has the potential to contribute to the reduction of poverty and inequality around the world, especially in the most marginalized regions with the least access to digital technologies. However, it is also emphasized that the adoption of 5G technology must be accompanied by appropriate policies and strategies to ensure its accessibility and benefits for all people, including the poorest and most vulnerable.

2.3. Asymmetric Advances of the Technological Frontier (Digital Divide)

The digital divide, also defined as the inequality in access to technology and the ability to use it [37], has become an increasingly important issue in the global development agenda. This gap can have multiple negative consequences, such as social exclusion, discrimination, and limited access to educational, employment, and personal development opportunities. The following is a general and specific overview of the digital divide and technological advances.

Overview: According to the Individuals Using the Internet (ITU) report [38], globally, 66% of the world's population uses the Internet, equivalent to around 5.3 billion people (see Figure 1). However, significant inequalities still persist in terms of Internet access, especially in less developed countries and rural areas. According to ECLAC, Internet access in Latin America has increased significantly in recent years [39], but there are still significant digital divides in terms of access to and use of information and communication technologies (ICTs). In developed countries, such as the United States, Internet access is relatively high, but there are still significant inequalities in terms of access to high-speed broadband, especially in rural areas. According to the Federal Communications Commission of the

United States [40], in 2020, 80% of the population had access to high-speed broadband, but only 46% of rural areas had this service.

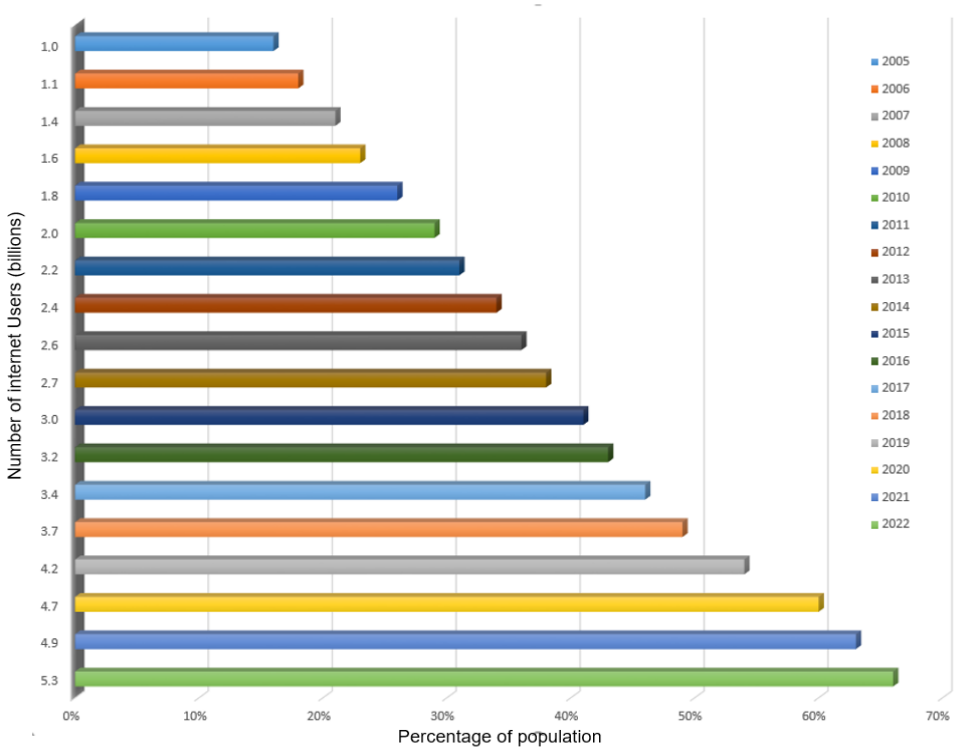


Figure 1. Individuals using the Internet [38].

Specific overview: The COVID-19 pandemic has accentuated existing digital divides, especially in terms of access to online education and virtual health care. According to UNESCO [41], during school closures due to the pandemic, around 60% of students worldwide did not have access to online education. 5G technology is seen as a potential solution to bridge the digital divide and improve access to ICT in rural areas and less developed countries [42,43]. According to the GSMA, the global association of mobile operators, 5G technology could reach more than one billion people in rural areas and achieve the goal of connecting all the world's citizens [44]. The report also highlights that the deployment of 5G networks in rural areas can improve the quality of life for residents and help drive economic growth. 5G technology is expected to offer opportunities for a wide range of applications, including smart agriculture, remote healthcare [45,46], and online education [47,48]. However, the report also notes that there are significant challenges to the deployment of 5G networks in rural areas, including the lack of network infrastructure and the scarcity of radio spectrum.

In this context, various initiatives have been developed to bridge the digital divide and promote access to and use of ICTs worldwide. These initiatives include public policies, education and training programs, partnerships between companies and social organizations, and the development of technologies and applications tailored to the needs of vulnerable and marginalized groups. The technological advances that are contributing to the reduction of the digital divide are the following:

(a) High-speed Internet access [38], according to data from the International Telecommunication Union (ITU), in 2020, around 51% of the world's population had access to high-speed Internet, a significant increase over previous years. However, the availability of and access to high-speed Internet varies by region, country, and social group [49]. According to ITU data, in 2020, high-speed Internet access was higher in high-income countries (82.2% of the population) than in low-income countries (19.9% of the population).

(b) Mobile connectivity has become a key element for access to the Internet and digital services worldwide. According to data from the GSMA (global association of mobile operators) in 2020, the number of subscriptions to mobile services in the world reached 8000 million, equivalent to a penetration rate of 107% [44]. However, as with high-speed Internet access, mobile connectivity also presents inequalities in terms of access and quality of service. According to the GSMA, in 2020, 41% of the world's population did not have access to mobile broadband services, and disparities were more pronounced in rural areas and low-income countries.

(c) Artificial Intelligence (AI). In recent years, AI has undergone rapid development [50] and has generated great expectations in terms of its potential to improve the efficiency, quality, and accessibility of various services and applications. However, it also poses significant challenges in terms of ethics [51], privacy [52], and safety [53], as well as in terms of possible impacts on employment and social inequalities [54,55]. To address these challenges and take advantage of the opportunities offered by AI, various initiatives and regulatory frameworks have been developed around the world. Among the main initiatives are the European Union's Artificial Intelligence Strategy (AI Strategy) [56], the U.S. National Artificial Intelligence Plan [57], and the National Artificial Intelligence Development Plan of China [58].

(d) Virtual and augmented reality. Virtual reality (VR) and augmented reality (AR) are technologies that make it possible to create immersive and enriched experiences for users [59]. VR involves creating a computer-generated virtual environment in which users can interact using devices such as VR goggles or headsets, while AR overlays digital information on top of the real world using devices such as smartphones or tablets [60]. These technologies have great potential for a wide variety of applications, including training and learning [61–64], entertainment [65,66], advertising [67] and marketing [68], simulation of dangerous situations [69], and aid in the treatment of diseases [70–73]. Currently, VR and AR are experiencing rapid growth and expansion [74], driven by the development of ever more advanced technologies and the popularity of video games [65,66] and mobile applications [75,76].

(e) 5G technology. This technology is expected to have a significant impact on a wide range of applications, from autonomous driving [77] to telemedicine [78–80] and industrial automation [81–83]. The 5G network uses advanced technologies, such as active array antennas, carrier aggregation technology, and advanced signal modulation techniques [84], to improve network efficiency and capacity. In addition, the 5G network also uses network virtualization techniques, allowing for greater flexibility and customization in network design. Despite its potential, the implementation of the 5G network also poses significant challenges, including the need to deploy new infrastructure, radio spectrum allocation, and regulatory challenges [85]. In addition, 5G network adoption may also create digital inequalities in areas where network infrastructure is insufficient or where network access costs are prohibitive.

These technologies offer new possibilities for communication, access to information, services and opportunities, and can improve people's quality of life and well-being in different areas, such as education, health, work, and leisure. However, it is important to note that access to and use of these technologies does not automatically guarantee the reduction of the digital divide, since there are multiple social, economic, and cultural factors that influence the ability of individuals and groups to take full advantage of them.

2.4. Magnitude and Trends

According to the World Bank, in 2020, approximately 9.2% of the world's population lived on less than $1.90 a day [86], which is considered the extreme poverty line. In South Asia, extreme poverty affected 13.6% of the population, and in Sub-Saharan Africa, 41% of the population was living in extreme poverty in 2020. On the other hand, in Latin America [87], poverty affected 32.1% of the population in 2021, according to the Economic Commission for Latin America and the Caribbean (ECLAC). It is important to keep in mind

that these figures are only a sample of poverty rates in different regions of the world and that there are multiple factors that influence the measurement and analysis of poverty [88].

According to a report by the GSM Association (GSMA) in 2021, 5G technology is expected to have a faster adoption rate than any other previous mobile technology [89]. It is projected that by 2025, there will be more than 1.8 billion 5G connections worldwide. In terms of 5G technology deployment, China is the global leader with more than 1 million 5G base stations by the end of 2020, followed by South Korea, the United States, and Japan [90]. Globally, 5G technology is expected to have a significant impact on the economy and society at large [91]. According to a 2020 report from research firm IDC, 5G technology is expected to generate a global economic impact of $8 trillion by 2030.

In summary, 5G technology is experiencing rapid adoption and deployment worldwide and is expected to have a significant impact on the global economy and contribute to different sectors in order to reduce poverty.

2.5. Research Purpose and Questions

Based on the literature review, this study will analyze the impact of the use of 5G technologies on poverty reduction and the ways in which these technologies are integrated in different sectors to contribute directly and indirectly to poverty alleviation. The research questions are as follows:

RQ1. Which sectors have the greatest impact on poverty reduction by making use of 5G technology?

RQ2. Which 5G network-based technologies contribute to poverty reduction?

RQ3. What are the applications technologies based on 5G networks with the greatest contribution to poverty reduction?

3. Methods

This section describes in detail the search for articles that allow us to address studies on the contribution of the 5G network to poverty; the type of study is a systematic literature review. The literature found allows us to compare the results using the PRISMA methodology [92] to select the relevant articles by means of the different inclusion and exclusion criteria, in order to carry out a better analysis of the results.

Complementary sources have been used as part of the review process of the articles collected and focused on the proposed literature review topic. The results are shown in Table 1.

Table 1. Classification of sources.

Database Source	Number of Related Items	Predominant Language
Scopus	8	English
IEEE Xplore	10	English
ScienceDirect	15	English
Dialnet	3	English
EBSCO Host	7	English
Others	6	English

This section is structured as follows: (1) Type of study, (2) Search strategy, and (3) Inclusion and exclusion criteria.

3.1. Type of Study

In order to prepare this article, a systematic literature review (SLR) was conducted as a research strategy that allows access to relevant information and synthesis of literature [93].

3.2. Search Strategy

The data collection method is based on the search of reliable sources, for which a review of articles was carried out, and among which the following databases stand out: IEEE Xplore,

Scopus, ScienceDirect, and EBSCOHost, among others. From these sources, it is possible to show the search terms and literary resources that will be used in the research [94,95].

The structure for the search of articles was based on the following keywords: 5G AND (Hunger OR Income OR poverty OR rural), 5G AND poverty AND technology. The words and phrases used yielded 329 articles of which 49 were evaluated on the basis of different criteria (Figure 2).

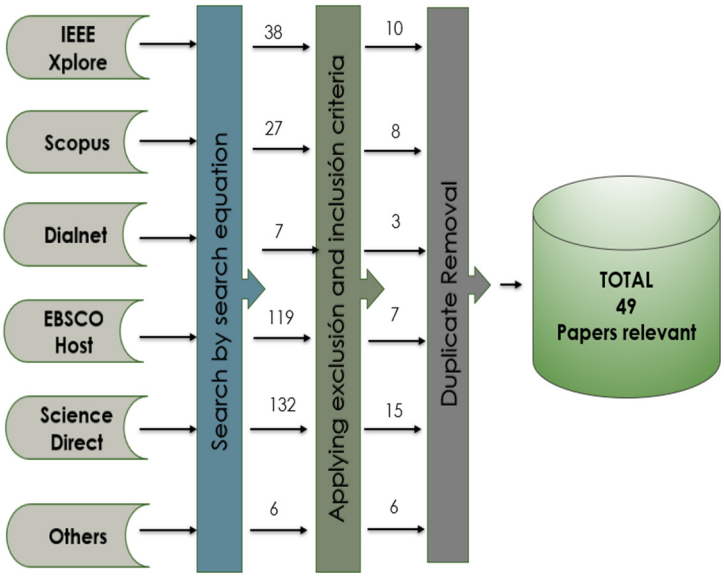


Figure 2. Item Inclusion Chart.

3.3. Inclusion and Exclusion Criteria

The search was carried out using the possible combinations within the following fields: "Article title, Abstract, Keywords" of the different databases selected. A series of filters were applied in order to select the most relevant articles contributing to the research conducted (see Table 2).

Table 2. Search strategy deployed.

Filter	Description
Article title	5G AND (Hunger OR Income OR poverty OR rural)
Keywords	5G AND poverty AND technology poverty reduction, sustainability
Document Type	Journal Article
Language	English, Spanish

Inclusion criteria:

- Poverty-related technology items;
- Articles that have implications with the main digital technologies and their relation to a sustainable economy;
- Articles related to the subject, mainly on the contribution of the use of 5G technology and its relationship with the reduction of poverty;
- We search for articles mainly related to the selected language, except for the titles that have to comply with the most important and pre-established keyword.

Exclusion or discard criteria:

- Items unrelated to technology and poverty;
- Articles that do not provide input on the use of digital technologies and the reduction of poverty;
- Articles that do not answer the research questions.

4. Results

This chapter shows the results, analysis, and synthesis of the data extracted from the selected articles, of which, based on the different inclusion and exclusion criteria, 49 articles were finally used for analysis and systematization. Figure 3 shows the selection procedure.

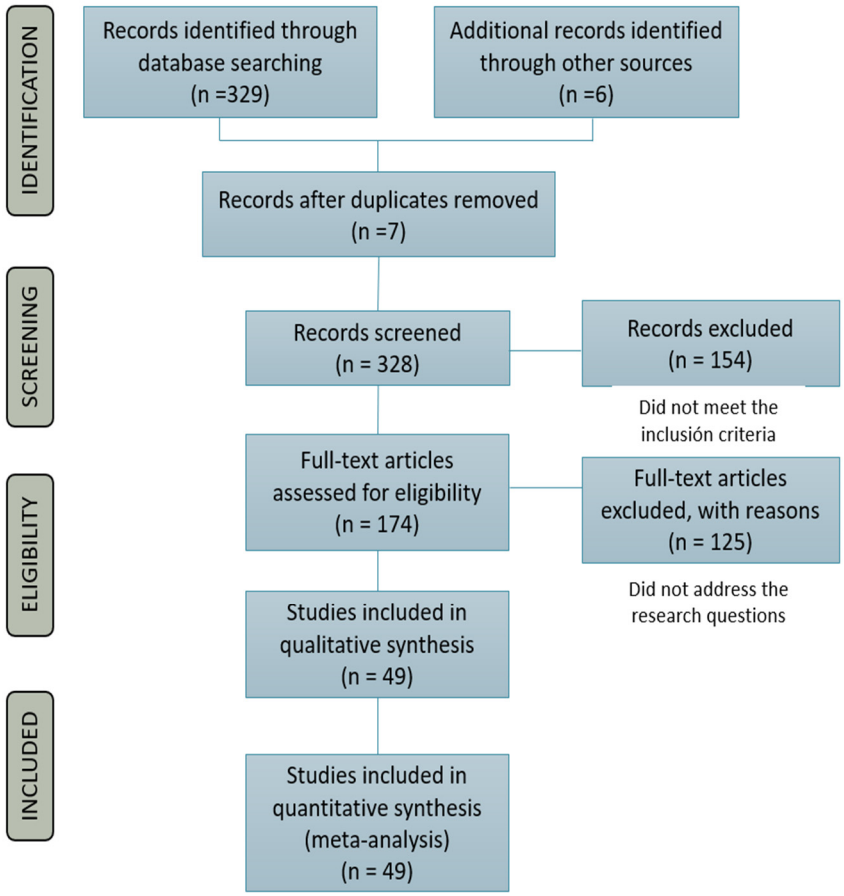


Figure 3. PRISMA diagram methodology.

The following graph (Figure 4) shows the number of articles published by year and database.

The analysis of the articles shows that the researches are pilot projects or future projects, compared to 26 researches implemented with the 5G network. Figure 5 shows the number of articles, 49, by implementation, broken down by continent. Research conducted in Europe comprises 11 articles, followed by Asia and the Americas, and showed higher implementation rates.

The methodology, or bibliometric analysis, allows us to extract the literature through the analysis and grouping of co-occurring words, thereby allowing us to identify patterns that correspond to the works of different authors [96]. Bibliometrics makes it possible to measure different aspects of scientific activity, such as the number of publications, citations received, collaboration between authors, institutional productivity, and research dissemination [97]. It is also used to identify trends and patterns in the development of a particular field of study. VOSviewer is a visualization tool used in bibliometrics to analyze and visualize co-authorship networks, citation networks, and other types of scientific networks [98].

From the following charts, you can get a more complete and objective view of the existing literature. This makes it possible to identify areas with knowledge gaps and to better understand the state of research in a specific field. It also helps to identify the Scopus and word cloud used in order to highlight relevant articles in the present research. It allows the structure of the relationships between authors, institutions, keywords, and scientific

documents to be graphically represented. From this, visualization maps were made as shown in Figures 6–8.

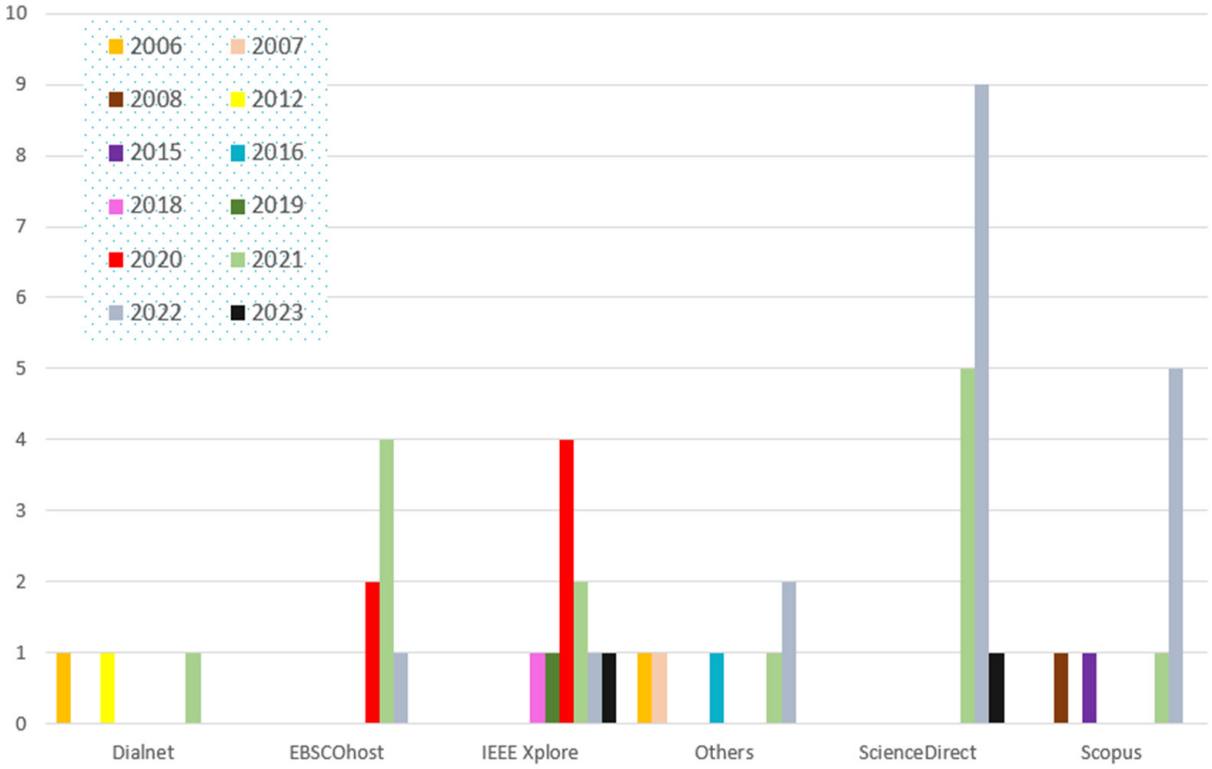


Figure 4. Articles by year and database.

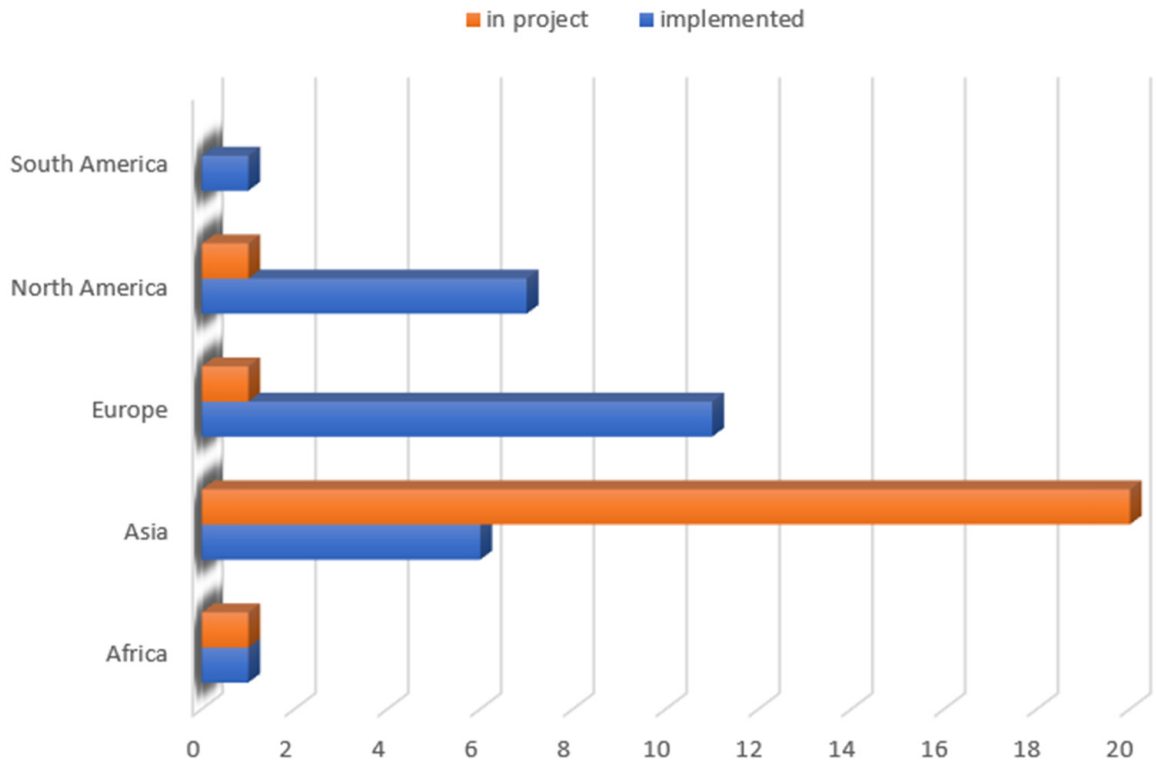


Figure 5. Distribution of articles by continent according to their implementation.

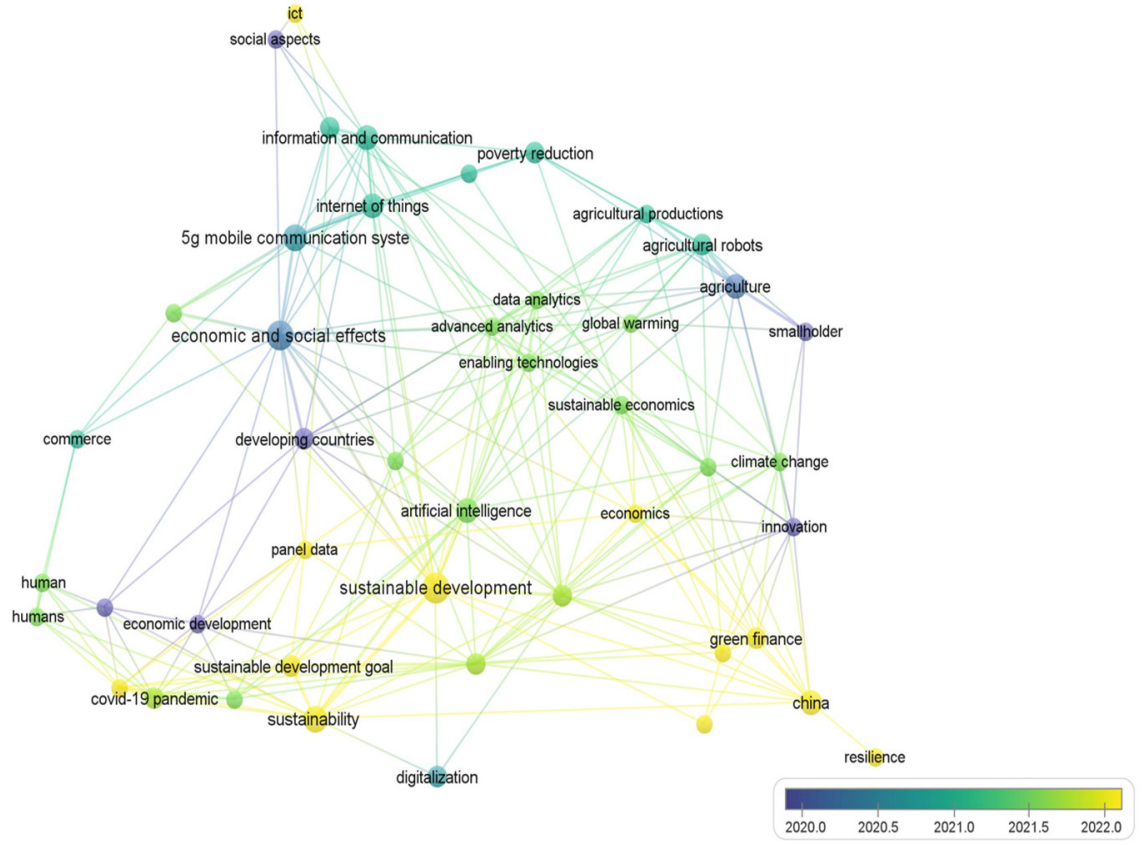


Figure 6. Network visualization of OSNFIM documents available in the Scopus database based on bibliometric analysis.



Figure 7. Overlay visualization of OSNFIM documents available in the Scopus database: Word cloud.



Figure 8. Visualization of the documents based on bibliometric analysis: TreeMap.

Figure 7 allows us to reflect the word cloud from the systematized articles, from which we can highlight: 5G, poverty, agriculture, green finance, and blue economy.

Figure 8 shows the Treemap based on a bibliometric analysis including the percentages of keywords with the highest recurrence.

5. Findings and Discussion

The review was carried out with the main objective of showing the impact of the use of 5G technologies on poverty reduction and their relationship in different fields. The results obtained can be used to answer the study's questions.

RQ1. Which sectors have the greatest impact on poverty reduction through the use of 5G technology?

The deployment of 5G technology has the potential to have a significant impact on various sectors to reduce poverty. The following are some examples:

Agriculture: Access to 5G connectivity can provide farmers in rural areas with real-time weather information [99], prices of agricultural products [100], pest management, and other agricultural practices [101,102], allowing them to make more informed decisions and increase the efficiency of their crops [103]. In addition, 5G technology can facilitate agricultural automation and the use of smart irrigation systems [104], which can improve productivity and reduce costs [105].

Health: 5G technology can improve access to healthcare in remote or underserved areas [106], enabling telemedicine [107,108] and telehealth [109]. Remote health services [110], such as remote medical consultations [111], patient monitoring [112], and online medical training [113], can be more effective and affordable with fast and reliable 5G connectivity [114]. This may allow for better diagnosis and treatment of diseases [115,116], especially in communities with limited access to health services.

Education: 5G connectivity can make online education easier [117,118] and access to educational resources for disadvantaged communities [119,120]. Online classes, distance learning, and access to digital educational content can provide learning opportunities for people in rural areas [121] or with limited access to conventional educational institutions. This can help close the educational gap [122] and improve employment and economic development prospects.

It is important to keep in mind that these are just a few examples of how 5G technology could influence poverty reduction, and that there are many other areas where 5G technology could also have a significant impact. In addition, careful and strategic planning is required to ensure that 5G technology is used effectively to reduce poverty and improve people's lives.

Figure 9 shows the grouping of articles and their analysis by sector according to the contribution that the use of 5G technology has on poverty reduction, of which it can be highlighted that the sectors: government/society, agriculture, economy/employment, and health have the greatest impact with 27%, 25%, 16% and 14% of articles, respectively.

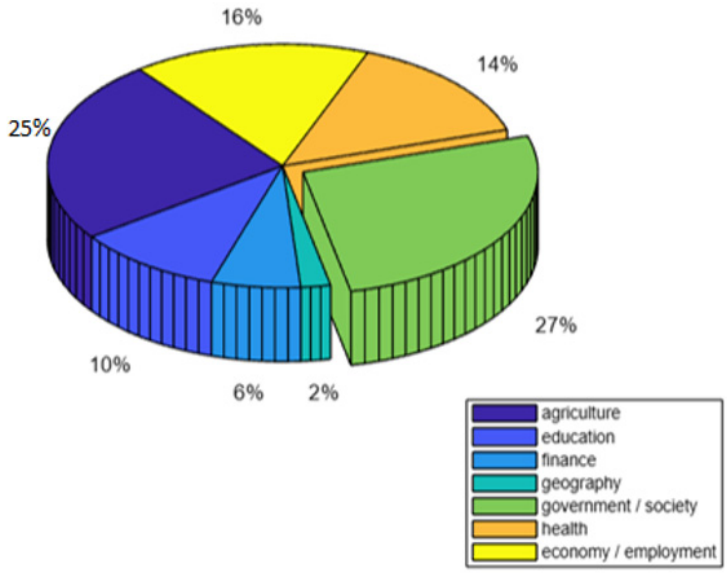


Figure 9. Articles by sector.

Table 3 shows in detail the articles' analysis of how 5G technology can influence poverty reduction in different sectors through the use of innovation and technology platforms.

In summary, the deployment of the 5G network can have a positive impact on different sectors and contribute to poverty reduction. By improving access to information, promoting entrepreneurship and employment, boosting agricultural productivity, and facilitating access to basic services, the 5G network can help bridge the digital divide and generate economic development opportunities for the most disadvantaged communities.

Table 3. 5G technology, with significant impact on poverty reduction.

Sector	Quantity	Articles
Health	7	[123–129]
Education	5	[130–134]
Agriculture	12	[135–146]
Finance	3	[147–149]
Economy/employment	8	[119,150–156]
Government/society	13	[157–169]

Below are some of the key contributions of the 5G network and its relationship with poverty reduction in different sectors (see Figure 10 and Table 4).

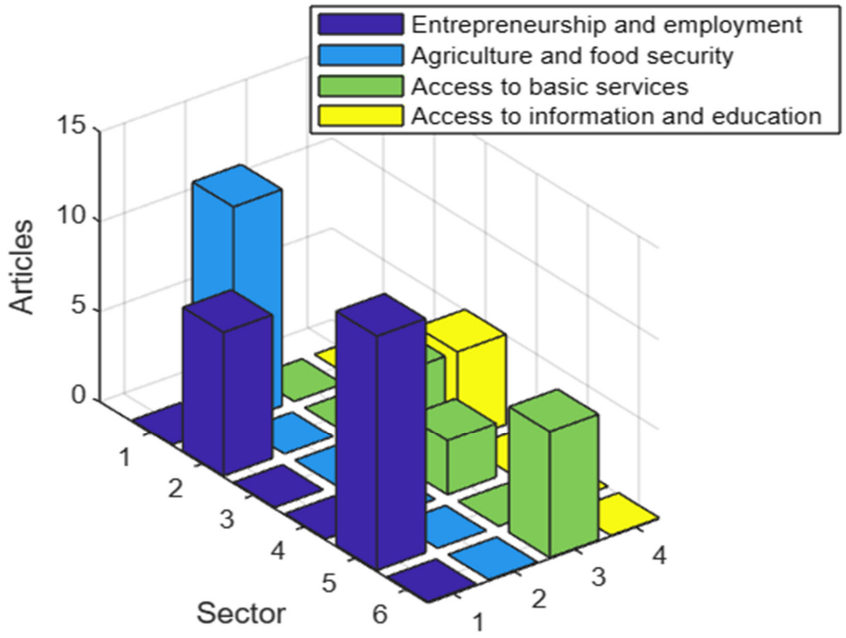


Figure 10. Articles by contribution.

Table 4. Contributions of 5G network-based technologies to poverty reduction in different sectors.

Contribution	Sector	Description	Articles
Entrepreneurship and employment	economy, government	The 5G network can drive job creation and entrepreneurship by enabling innovation in different industries. The low latency and high speed of the 5G network facilitate the adoption of advanced technologies such as virtual, augmented, and mixed reality, the Internet of Things (IoT), and Artificial Intelligence. These technologies can drive the development of new products and services, generate employment opportunities in emerging sectors, and foster the creation of new businesses, which in turn helps to reduce poverty.	[119,150–169]
Agriculture and food security	agriculture	Agriculture is a crucial sector for combating poverty, especially in rural areas. The 5G network can improve agricultural efficiency and productivity by enabling the use of advanced technologies such as connected sensors, smart irrigation systems, and remote crop monitoring. These solutions can help farmers optimize resource use, improve yields, and reduce production costs, which in turn can increase incomes and improve food security for vulnerable communities.	[135–146]

Table 4. *Cont.*

Contribution	Sector	Description	Articles
Access to basic services	health, education, finance	The 5G network can improve access to basic services such as energy, drinking water, and medical care in remote or hard-to-reach areas. The fast and reliable connectivity of the 5G network enables the deployment of smart solutions for energy distribution, water supply monitoring, and telemedicine. These solutions can improve the quality of life of disadvantaged communities by providing essential services more efficiently and affordably.	[123–133,147–149]
Access to information and education	education, society	Access to information and education is fundamental to overcoming poverty. The 5G network offers faster and more reliable connectivity, facilitating access to online educational courses, learning platforms, and digital content. This provides training and education opportunities for people in rural or low-income areas, which can improve their employment prospects and generate greater economic development.	[130,130–133,157–159,168–170]

RQ2. Which 5G network-based technologies contribute to poverty reduction?

5G network-based technologies have the potential to have a significant impact on global poverty reduction [35,171], although not directly. First, 5G network-based technologies can improve access to information and knowledge for people living in rural and remote areas [49], where high-speed Internet access is limited. The availability of online information can help people obtain a more complete education and improve their skills, which in turn can lead to greater employability and higher incomes [172].

In addition, 5G network-based technologies can also improve efficiency and productivity in agriculture [103,141] and other economic sectors, which can create employment opportunities and increase incomes in rural areas [54]. Improved connectivity can also enable small businesses to reach new markets and increase sales, which can help improve incomes and reduce poverty.

However, it is also important to keep in mind that the adoption of 5G network-based technologies may require significant investment [173], which may limit its availability to the poorest people. Therefore, a careful approach is needed to ensure that 5G network-based technologies are accessible and beneficial to all people, including the most vulnerable.

Figure 11 shows the most relevant articles based on 5G network-based technologies, of which it can be highlighted that the digital technology that has the greatest impact is the Internet of Things with eight articles, followed by Artificial Intelligence (6), mobile application (5), Blockchain (5), Machine learning, Big data, E-learning, and Telemedicine with four articles.

It is important to keep in mind that these are just a few examples of how 5G network-based technologies could influence poverty reduction, and that there are many other fields where 5G technology could also have a significant impact. In addition, careful and strategic planning is required to ensure that 5G network-based technologies are used effectively to reduce poverty and improve people's lives.

Table 5 shows the items grouped by 5G network-based technologies that have a significant impact on poverty reduction.

Figure 12 and Table 6 show the items based on 5G network-based technologies and their contribution to poverty reduction.

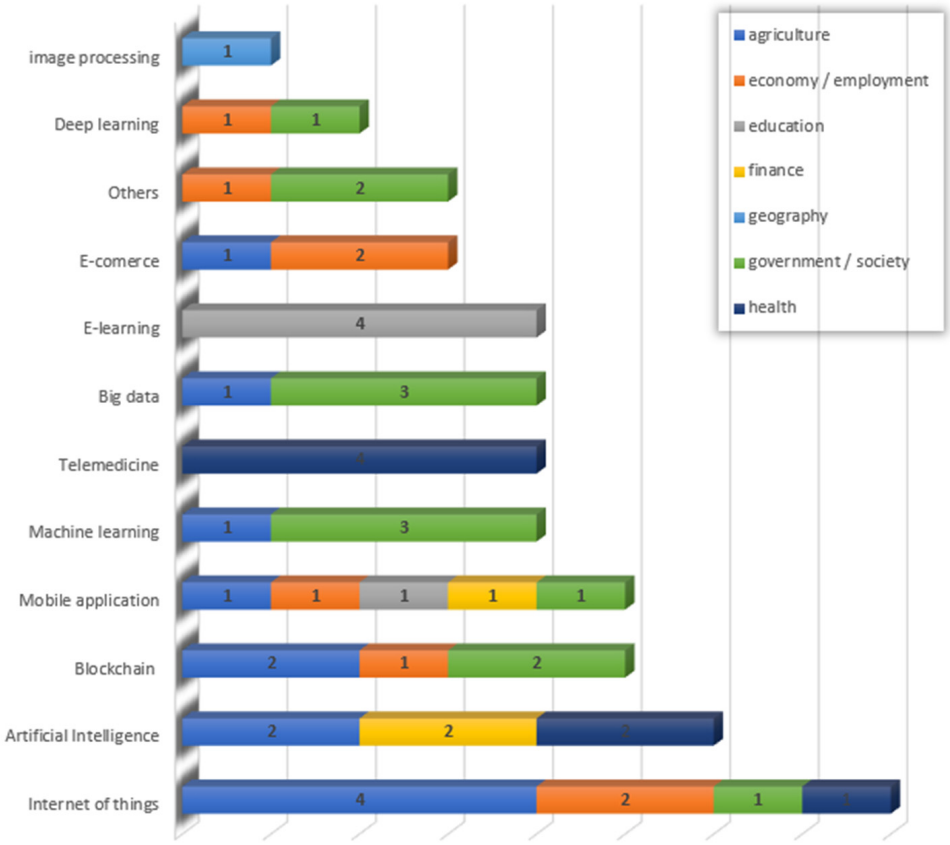


Figure 11. Articles on digital technologies based on the 5G network, classified by sector.

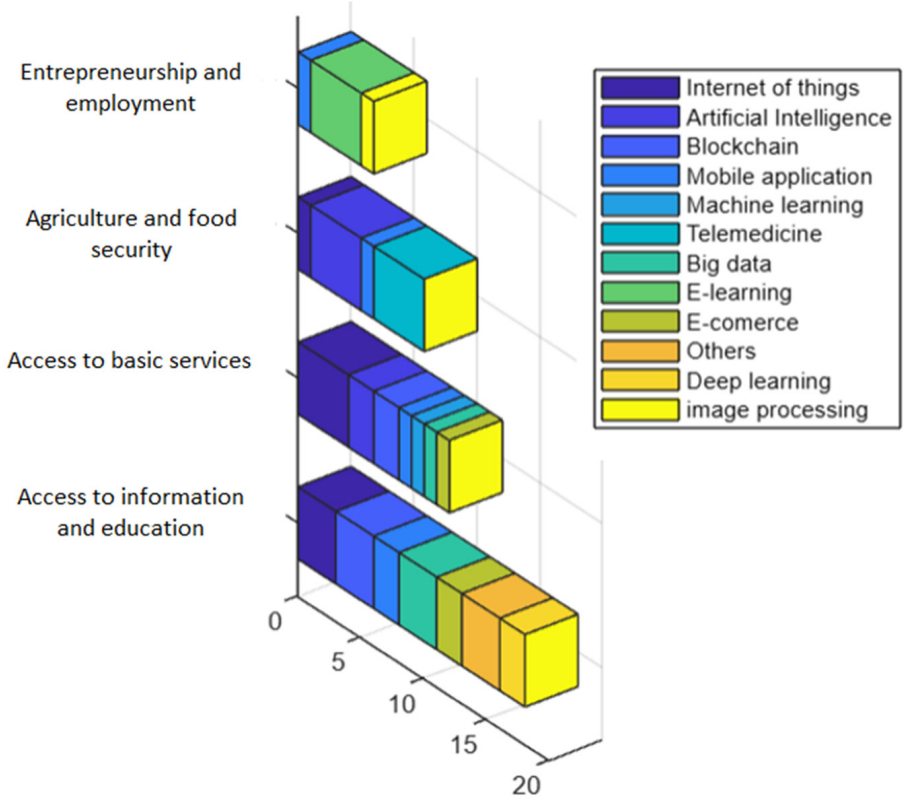


Figure 12. Articles on digital technology and their contribution.

Table 5. 5G network-based technologies, with significant impact on poverty reduction.

5G Network-Based Technologies	Quantity	Articles
Internet of things	8	[126,135,141,143,144,152,155,168]
Artificial Intelligence	6	[128,129,140,145,148,149]
Mobile application	5	[132,136,147,153,169]
Blockchain	5	[137,142,156,158,162]
Big data	4	[138,159,161,164]
Telemedicine	4	[123–125,127]
E-learning	4	[130,130,131,133]
Machine learning	4	[146,157,160,167]
E-commerce	3	[139,150,154]
Deep learning	2	[151,163]

Table 6. 5G network-based technologies and its contribution, with significant impact on poverty reduction.

Contribution	5G Technology	Articles
Entrepreneurship and employment	Big data	[159,161,164]
	Blockchain	[156,158,162]
	Deep learning	[151,163]
	E-commerce	[150,154]
	Internet of things	[152,155,168]
	Machine learning	[157,160,167]
	Mobile application	[153,169]
Agriculture and food security	Artificial Intelligence	[140,145]
	Big data	[138]
	Blockchain	[137,142]
	E-commerce	[139]
	Internet of things	[135,141,143,144]
	Machine learning	[146]
	Mobile application	[136]
Access to basic services	Telemedicine	[123–125,127]
	Artificial Intelligence	[128,129,148,149]
	Internet of things	[126]
	Mobile application	[147]
Access to information and education	E-learning	[130,131,133]
	Image processing	[170]
	Mobile application	[132]

RQ3. What are the applications technologies based on 5G networks with the greatest contribution to poverty reduction?

According to the analysis carried out and as shown in Figure 13, the technological application with the greatest implication and contribution to poverty reduction is Precision agriculture (8), whose pillar is the monitoring of crops and soils to improve productivity. In second place, we have Digital/Internet banking and Smart City with four articles and Precision Medicine and Online Education with three and Telesurgery with two articles.

Table 7 allows us to show the items with the technological applications that have the greatest significant impact on poverty reduction by making use of the 5G network.

It is important to keep in mind that these are just a few examples of technological applications that could have a significant impact on poverty reduction by making use of the 5G network and that there are many other possible uses of this technology. In addition, careful and strategic planning is required to ensure that 5G network-based technologies are used effectively to reduce poverty and improve people's lives. Figure 14 shows the technological applications analyzed for their contribution to poverty reduction through the use of the 5G network-based technologies. The subject of the Sustainable Development Goals (SDGs) is widely discussed in the literature, and their importance has experienced

a clear increase in recent years. This trend is evident in the reports published by the publisher [174], which show a notable increase in the number of articles related to the SDGs. Over the last four and a half years, approximately 27,910 articles have been published on this topic. Specifically, it is observed that 7510 articles were published in the year 2021, 8114 in the year 2022, and the figure continues to increase in the current year 2023. These data are based on the publisher's reports, which compile information from sources such as the Web of Science (WoS). In the studies conducted, specific keywords such as "Sustainable Development Goals" and "SDGs" were used to identify relevant articles related to this topic.

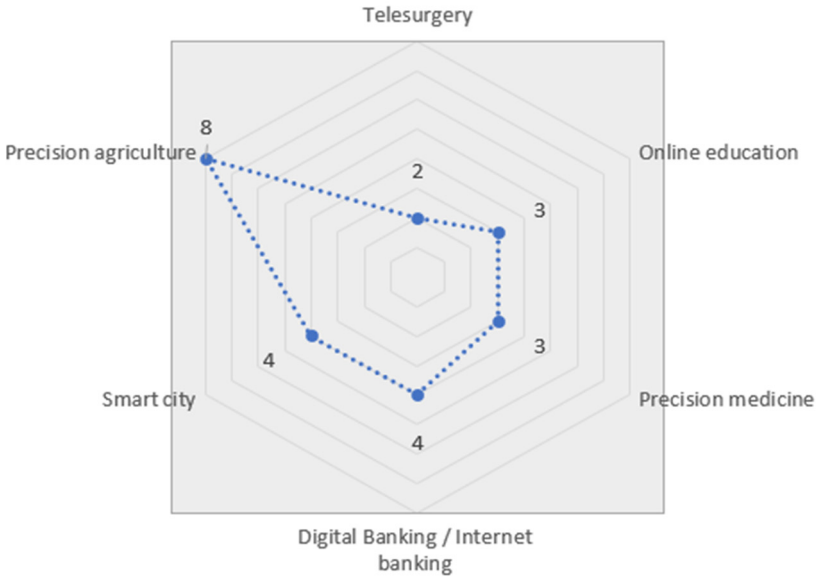


Figure 13. Articles by technological application.

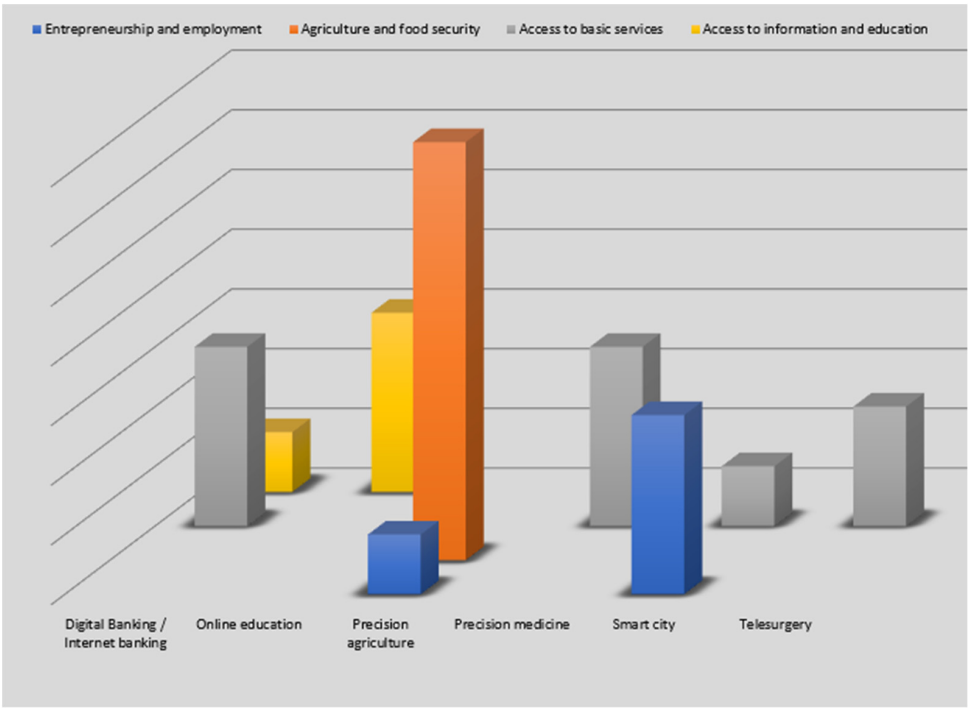


Figure 14. Articles by technological application and their contribution to poverty reduction.

Table 7. Technology applications with significant impact on poverty reduction.

Technological Application	Area of Application	Articles
Precision agriculture	Crop and soil monitoring for improved productivity.	[135–137,143–146,167]
Online education	Access to online education in remote areas.	[130,131,133]
Digital banking/internet banking	Access to financial and banking services in remote areas.	[134,147–149]
Smart City	Manage the proper functioning of public and private transportation systems.	[129,162,168,169]
Precision medicine	Improve the effectiveness and safety of treatments, as well as reduce long-term health care costs.	[126–128]

6. Conclusions

The deployment of 5G network-based technologies has the potential to bridge the digital divide and reduce inequality by providing high-speed Internet access in underserved rural and urban areas. It can improve productivity and efficiency in key sectors to reduce poverty. Being the most relevant in the government/society, agriculture, economy/employment, and health sectors, which mainly allows providing access to real-time information and enables automation.

5G connectivity allows improving access to basic services, such as health care and education, in marginalized communities, which contributes to improving the quality of life and economic opportunities by making use of different technologies, of which those that mainly stand out are the Internet of Things and Artificial Intelligence.

Likewise, the applications enabled by the 5G network-based technologies that considerably influence poverty reduction and have the greatest impact are Precision agriculture, Digital/Internet banking, and Smart City.

It is important to note that the actual impact of 5G on poverty reduction may vary depending on the context and policies implemented. The digital divide is a major barrier to poverty reduction. The deployment of the 5G network can bridge this gap by providing high-speed connectivity and Internet access in areas where communications infrastructure is limited. This enables disadvantaged communities to access educational opportunities, financial services, remote employment, and other digital resources that can improve their lives. The successful implementation of the 5G network is expected to have a positive impact on poverty reduction by improving access to basic services, fostering economic development, and bridging the digital divide in disadvantaged areas. However, that positive impact will only be achieved if the 5G network implementation is successful.

Although the 5G network has the potential to contribute to poverty alleviation, it also has some limitations that should be taken into account:

Limited infrastructure. Because it requires robust and expensive infrastructure, including base stations, antennas, and fiber optics. In rural and low-resource areas, there may be limitations in the availability and deployment of the necessary infrastructure, making it difficult for poorer communities to access the benefits of the 5G network.

High costs. Access to services and devices compatible with the 5G network can be costly, which can limit adoption and mainly benefit those with greater economic resources. This can widen the digital divide and hinder access to opportunities for poor communities.

Existing digital divide. The implementation of the 5G network may accentuate the existing digital divide between urban and rural areas, as well as between different socioeconomic groups. If these inequalities in access are not addressed, poorer communities may be left behind and may not fully benefit from the opportunities provided by 5G technology.

The results of this review allow for future research on the different factors that directly or indirectly influence poverty reduction, as well as provide a reference for the study and analysis of the use of 5G network-based technologies in different fields in order to contribute to the equity and inclusion of the economy in rural areas.

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