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# COVID-19 and Food Systems-a Bibliometric review

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## ABSTRACT

The Coronavirus pandemic profoundly impacted the food systems because of various lockdown measures enacted across the world. Considerable case or review studies have been conducted on COVID-19 and Food systems, but there is no bibliometric review attempting to provide an objective, systematic and comprehensive analysis of the existing articles. In this study, we collected 84 research publications from Scopus and 259 from Web of Science. The data were merged using R and duplicates were filtered and removed until we are left with a sample of 280 documents. Additionally, the data were analyzed using the word cloud, thematic map, and conceptual map. The results show that areas such as "COVID-19", "Food systems" and "Epidemic" were heavily researched. This paper recommends that other researchers may also, gather data from the databases not included in this study.

*Keywords:* Coronavirus (COVID-19), food systems, bibliometrics, Web of Science, Scopus

## 1. INTRODUCTION

The COVID-19 pandemic has undermined the efforts of the United Nations in achieving the Sustainable Development Goal (SDG) number 2 [1], which aims at eradicating hunger by 2030 [2]. Prior to the Coronavirus pandemic, 2 billion people were subjected to either moderate or severe food insecurity, from 2014 the number of food-insecure people rose by 60 million. The Coronavirus pandemic heightened this number to between 82 and 132 million, of which about 80 million people are from low-income countries which rely heavily on imported food [3].

The Coronavirus pandemic profoundly disrupted the global food systems [4-5]. This is because of the lockdown measures enacted by the governments across

the world to contain the spread of Coronavirus [6-7], and these measures include social distancing, mandatory wearing of masks, closing of borders, businesses, schools, and universities [8]. However, this prospective study posed the following questions (i) what are the effects of COVID-19 on various elements of the food systems? That is food production, distribution, accessibility, affordability, and utilization. (ii) What are the policies employed across the world to cushion the effects of COVID-19 and their effectiveness?

COVID-19 refers to the Coronavirus of 2019, it is caused by SARS-CoV-2 the most recently discovered Coronavirus [9]. The pandemic started in Wuhan, Hubei Province, China and spread across the world affecting millions of people [6]. Furthermore, COVID-19 is defined

as primarily a respiratory infection, which can be asymptomatic, mild, or severe, resulting ultimately in the death of some people with severe acute respiratory distress syndrome [10].

The term 'food system' refers to the processes involving the provision of food, which go hand in hand with regulatory institutions and activities. A dynamic system, because is constantly changing due to a variety of exogenous and endogenous factors: demographic shifts, economic growth, changes in consumer lifestyles, changes in trade patterns, changes in the environment, and more [11]. Again, food systems are defined as systems that deal with the production, processing, distribution, and consumption of food to make sure that people are well-fed [12]. These food systems can be local, global, traditional, and advanced food systems.

There is a paucity of bibliometric research on COVID-19 and food systems. To the best of my knowledge, there is no bibliometric paper on this subject. The statistical analysis of publications focused on quantitative analysis of citations is known as bibliometric [13]. It has the potential to introduce a systematic, transparent, and reproducible review process based on the proper statistical measurement of science activity

[14].

Bibliometrics has been considered a standard tool of science policy and research management over the last two decades [15]. The paucity of the bibliometric studies on COVID-19 and food systems shows the significance of this study.

The Coronavirus pandemic started in Wuhan, China [6], and spread across the world disrupting the food systems [16]. This is because the governments of all nations were forced to enact stringent lockdown measures to contain the spread of Coronavirus. Some of these measures are the closure of borders, schools, and institutions of higher learning, shutting down the business, social distancing, masking, and sanitizing [17]. These measures were

applauded for saving lives however; this was achieved against the backdrop of falling national output, spiking unemployment, and poverty [1]. COVID-19 would cause the global economy to fall by 4.9% in 2020 according to the International Monetary Fund (IMF) projections; it is more severe than the 2008-09 financial crisis [1]. Suppressive measures used to contain the spread of Coronavirus resulted in a global recession, which in turn affected the functioning of food systems [18]. As a result, a growing number of people are facing food shortages, posing a serious threat to food and nutrition security [3]. The coronavirus pandemic makes it impossible for the SDG number of eradicating hunger by 2030 to be achieved [2]. Despite, all stakeholders in the global community tirelessly working to curb hunger nonetheless the figures for undernourished people have been gradually increasing since 2015. The FAO stated that over 820 million people in the world suffer from hunger and over 2 billion people are facing mild to severe food insecurity [19]. The reason is droughts due to climate change and it has been worsened by the COVID-19 pandemic since farmers faced shortages of farming inputs such as labor, fertilizers, and seeds [9].

The agricultural food systems are highly internationally connected [20]. Hence, lockdown measures enacted to mitigate the spread of coronavirus negatively impacted food production in the current and preceding seasons [21]. In Fiji and Solomon Islands, lockdown forced unemployed urban dwellers to migrate to rural areas and engage in farming [9]. This enhances the availability of labor in farms. These authors noted an increase on food production in rural areas due to the de-urbanization process however, commercial, and semi-commercial farms experienced a drastic fall in agricultural production due to limited labor and access to inputs [9].

Again, it was noted that coronavirus affected farmers differently spatially and socially [22]. In Southern Africa, beans production was reduced by 62% while in Eastern

Africa fell by 27%. Moreover, in the Antilles, production was affected but, the huge impact was felt mainly by market gardeners and food producers [12]. This was attributed to challenges in movement and availability of labor, about 44% of farmers stopped production completely and 10% stopped only during the crisis [12].

Food distribution comprises companies and individuals that collect the food from the producers, store it in warehouses then distribute it to consumers through supermarkets, restaurants and more [3]. Coronavirus disrupted food distribution across the world [23]. The closure of airspace, the banning of international and domestic travel in countries such as South Africa, Zimbabwe, Kenya, Nigeria and more, resulted in difficulties in the distribution of food [24]. Consequently, importation and exportation of food were halted disrupting food supply chains, particularly in developing countries.

A survey done in Pakistan showed that 80% of food consumed is bought and 90% is purchased from Small-medium enterprises (SMEs) [25]. Therefore, any disturbance on the part of SMEs when distributing their products caused food shortages. Moreover, Coronavirus affected upstream food supply (processing, transportation and distribution) [26]. The restriction on the movement of people and goods affected the distribution of food to the most vulnerable groups in the society such as students who were fed through the school feeding program [3].

Food utilization is defined as the ability of individuals to make good use of the food they access. This will be achieved through adequate diet, clean water, sanitation, and health care, which will ensure all their nutritional and physiological needs are, met [27]. The major public health problem throughout developing countries is malnutrition [27]. They alluded that malnutrition is caused by consuming diets that are deficient in micro and macronutrients. Moreover, there is a prevalence of

poor health and disease and high child mortality in developing countries due to malnutrition [28].

The incidence of COVID-19 has exacerbated the negative effects of malnutrition especially to individuals that had a compromised immune system. Consequently, vitamin-rich, trace elements and fermented foods consumed could not boost the immune system to defend the body from viral and infectious diseases [24]. Again, fruits and vegetables recommended by the World Health Organization (WHO) for people to consume were in short supply during lockdown periods. Analysis of Caribbean experts' responses shows that the COVID-19 crisis has had a strong impact on household nutrition in the Caribbean. Sixty-four per cent of the experts cited a reduction in dietary diversity, as well as a reduction in quantity (57%) because of the crisis [12].

Food security is the concept that is used to talk about food affordability. It refers to a situation where all people, always, have access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for active and healthy life [29]. When the COVID-19 pandemic first broke out, various food items were quickly disappearing from supermarket shelves because people were in a panic over not being able to find these items or fearing that their price would increase. In developing countries with limited financial resources, this has exacerbated the challenges associated with food accessibility [12].

Several countries around the world have taken measures to maintain internal stocks in the wake of the pandemic. As a result of these measures, the supply of fruits and vegetables to developing countries has already been negatively affected. Some agriculture and food processing companies reduced their workforce, especially in developing countries, to ease their financial burden during this current pandemic, which further contributed to the unemployment rate [24]. South Africa's cattle slaughter decreased by 36% and hog

slaughter decreased by 45% from March 2020 to May 2020 [30]. As a result, there was a surplus of market-ready livestock and meat shortages at grocery stores. Due to the decline in prices for market-ready livestock, farmers experienced a loss in profitability, while consumers experienced higher retail meat prices.

This bibliometric study will analyze the research output in COVID-19 and food systems. The aim of this study is to fill the research gap in this research area by using bibliometric methods.

## 2. METHOD AND MATERIALS

### 2.1. Selection strategy

The study retrieved publications on COVID-19 and food systems from the Clarivate Analytics Web of Science (WoS) and Scopus databases following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines [31]. The PRISMA procedure follows a checklist that describes the protocol adopted for selecting the collection of articles used in a systematic literature review, and it is commonly used to ensure replicability and transparency. The bibliometric data was collected to identify all publications related to the field of COVID-19 and food systems by defining the following search query "TITLE (COVID-19 OR CORONAVIRUS OR COVID 19) AND "Food systems" AND (LIMIT-TO 2019 - 2021) AND (LIMIT-TO [LANGUAGE, "English"])" on Scopus and Title (COVID-19 OR CORONAVIRUS OR COVID 19) AND "Food systems" and

English (Language) Timespan: 2019-01-01 to 2021-08-28 on Web of Science. The study followed the 5 stages search strategy as illustrated in table 1.

### 2.2. Data loading and converting

After merging the data that match the inclusion criteria, including all their metadata from the Clarivate Analytics of Scopus and Web of Science databases from our final collection. The data was loaded and converted into an R data frame using bibliometric [14].

### 2.3. Sample

The data were filtered, and were left with 280 publications with 2020 - 2021 timespan. These documents were authored by 1239 authors published in 101 journals. When it comes to authorship of these documents, author appearances are 1351, authors of single-authored documents are 47 and the authors of multi-authored documents are 1192. Again, when it comes to author collaboration: single author documents are 49, documents per author were 0. 226, authors per document are 4.42, co-authors per document are 4.83 and the collaboration index is 5.16.

### 2.4. Data analysis

The filtered data on R, was analyzed using the Word cloud, thematic map, and conceptual map. The word cloud is a visual representation of data, typically used to depict metadata from websites such as Web of Science

**Table 1:** Search strategy and inclusion criteria

| Stage | Inclusion criteria   | Documents retrieved from    |        |
|-------|--|-----------------------------|--------|
|       |  | WoS                         | Scopus |
| 1     | Select the Web of Science Core Collection Editions = A&HCI, BKCI-SSH, BKCI-S, CCR-EXPANDED, ESCI, IC, CPCI-SSH, CPCI-S, SCI-EXPANDED, SSCI           |                             |        |
| 2     | Search and select all documents that contain the word 'COVID-19 OR CORONAVIRUS OR COVID AND Food systems' in the title (i.e. title algorithm search) | 259                         | 84     |
| 3     | Select the time span 2019 - 2021   | 258                         | 84     |
| 4     | Select only documents written in English   | 254                         | 82     |
| 5     | Merge documents from WoS and Scopus and remove duplicates  | 286 (50 duplicates removed) |        |

and Scopus. It is important in perceiving most prominent terms and locating them alphabetically. It is used to show the Keyword plus and Author Keywords [32]. The Keywords plus are generated by an automatic computer algorithm, and they are words that appear more in the titles of an article's references and not necessarily in the title of the article or as Author Keywords [33]. Also, Author Keywords are given by the original authors and they are an important phrase which indicates the research themes and focus of the content [34].

A thematic map allows four typologies of themes to be defined according to the quadrant in which they are placed. Themes in the upper-right quadrant are known as the motor themes. They are characterized by both high centrality and density. This means that they are developed and important for the research field [35]. Themes in the upper-left quadrant are known as the high developed and isolated themes or niche themes. They have well developed internal links (high density) but unimportant external links and so are of only limited importance for the field (low centrality). Themes in the lower-left quadrant are known as emerging or declining themes. They have both low centrality and density meaning that are weakly developed and marginal. Themes in the lower-right quadrant are known as basic and transversal themes. They are characterized by high centrality and low density. These themes are important for a research field and concern general topics transversal to the different research areas of the field [35].

Also, the conceptual map can be applied in the form of analysis/factor analysis, multidimensional scaling (MDS), multiple correspondence analysis (MCA), and clustering algorithms. Analysis methods allow the extraction of useful knowledge from data and to represent it through intuitive visualizations or maps such as bi-dimensional maps, dendrograms, and social networks. Network analysis allows us to perform a statistical analysis over the maps generated to indicate different measures of the entire network or measures of

the relationship or the overlapping of the different clusters detected [14].

### 3. RESULTS AND DISCUSSION

#### 3.1. Word cloud

The word cloud in figure 1 below shows the words that occur frequently in papers that discuss COVID-19 and the Food system. The word cloud displays words in different sizes considering the number of times they appear. The most frequent word was "Health", followed by "nutrition", "security", "sustainability", and "Coronavirus". The words were placed in a random manner but, words that appeared more frequently appear in the middle because of the size so that it becomes clear to see them.

#### 3.2. Thematic map

Based on density and centrality, we generated a thematic map using R, a bibliometric application. The thematic map is divided into four topographical areas as shown in below (fig 2). A machine-learning algorithm was used to show deeper variations based on a review of keywords and reference titles. The upper right region contains motor themes such as "Covid-19", "Epidemic", "Food System", and "Insecurity". It is characterized by its high density and central location. As shown by the high density and low centrality in the upper left top region, there are direct themes under research, such as "ultrasound assisted extraction". Topics or themes in the lower left quadrant experienced a decline in research, such as "availability". Low density and centrality indicate this. The lower right region contains general themes, as evidenced by its high centrality and low density. Research topics include "health", "nutrition", and "sustainable development".

#### 3.3. Conceptual structure

Through regional mapping, a conceptual structure map was constructed, which shows the relationship between each word that often appeared in articles that addressed

COVID-19 and food systems during the research process (figure 3). Words are mapped according to their Dim 1 and Dim 2 values, Dim being diminutive particle, a term that is specific to bibliometric science, resulting in a mapping of words with similar values.

This map is divided into two parts: the red area and the blue area, each of which contains words related to the other. The red area above contains a high number and variety of words, which shows that many research papers presented connections between the words listed in the red area, which is home to the top three words

that appeared most frequently ("COVID," "food," and "epidemic").

Using R, a bibliometric app, a bibliometric analysis was presented. It focused on COVID-19 and food systems. Scopus and Web of Science (WoS) were used to search the data. Since Coronavirus (COVID-19) is a global pandemic, all world governments, media houses, and non-governmental organizations are focused on this deadly virus. The research on COVID-19 and food systems has increased significantly in recent months as well as researchers' interest in coronaviruses. The global and local food systems were disrupted by the Coronavirus. The fact that food systems are the backbone of economies is of utmost importance. As a result, any disruption of the food systems affects the economy.

According to the word cloud, the most frequently used words in papers dealing with COVID-19 and food systems are "health", "nutrition", "sustainability", and "coronavirus". Secondly, "food security", "vulnerability", "poverty" and "food assistance" are also covered. This is indicative of the fact that Coronavirus affected the elements of the food systems as shown by the words like food security, vulnerability, poverty.

One of the measures employed by the governments across the the world is provision of food parcels as shown by the word "food assistance".

Furthermore, the thematic map provides an overview of the status of each topic within a quadrant by comparing the density and centrality of the topic. Therefore, it serves as a repository for collecting literature for colleagues to access when conducting research. The upper left quadrant is the most extensively populated. In the upper left quadrant, which shows topics that are rarely investigated, but whose development is quite rapid, we found the words "COVID," "food supply," "food insecurity" and "epidemic". The words here have developed rapidly, with low centrality but high density.

**Table 2.** Description of different sources

| Description                          | Results   |
|--------------------------------------|-----------|
| <b>MAIN INFORMATION ABOUT DATA</b>   |           |
| Timespan                             | 2020:2021 |
| Sources (Journals, Books, etc)       | 101       |
| Documents                            | 280       |
| Average years from publication       | 0.496     |
| Average citations per documents      | 5.993     |
| Average citations per year per doc   | 3.42      |
| References                           | 1028      |
| <b>DOCUMENT TYPES</b>                |           |
| article                              | 172       |
| article; book chapter                | 1         |
| correction                           | 1         |
| editorial                            | 4         |
| editorial material                   | 77        |
| letter                               | 3         |
| news item                            | 1         |
| note                                 | 1         |
| review                               | 20        |
| <b>DOCUMENT CONTENTS</b>             |           |
| Keywords Plus (ID)                   | 472       |
| Author's Keywords (DE)               | 754       |
| <b>AUTHORS</b>                       |           |
| Authors                              | 1239      |
| Author Appearances                   | 1351      |
| Authors of single-authored documents | 47        |
| Authors of multi-authored documents  | 1192      |
| <b>AUTHORS COLLABORATION</b>         |           |
| Single-authored documents            | 49        |
| Documents per Author                 | 0.226     |
| Authors per Document                 | 4.42      |
| Co-Authors per Documents             | 4.83      |
| Collaboration Index                  | 5.16      |

COVID-19 and food systems are therefore experiencing developments in research in these three areas.

In the lower right quadrant, which contains basic topics with low centrality but high density, words such as

"health," "nutrition," "sustainability," "coronavirus," and "food security" were present. Despite the lower level of development than for concepts in the upper left quadrant, these themes were widely used, suggesting that they can be developed through further research to



Figure 1: visualization of key words that appears in COVID-19 and food systems papers.

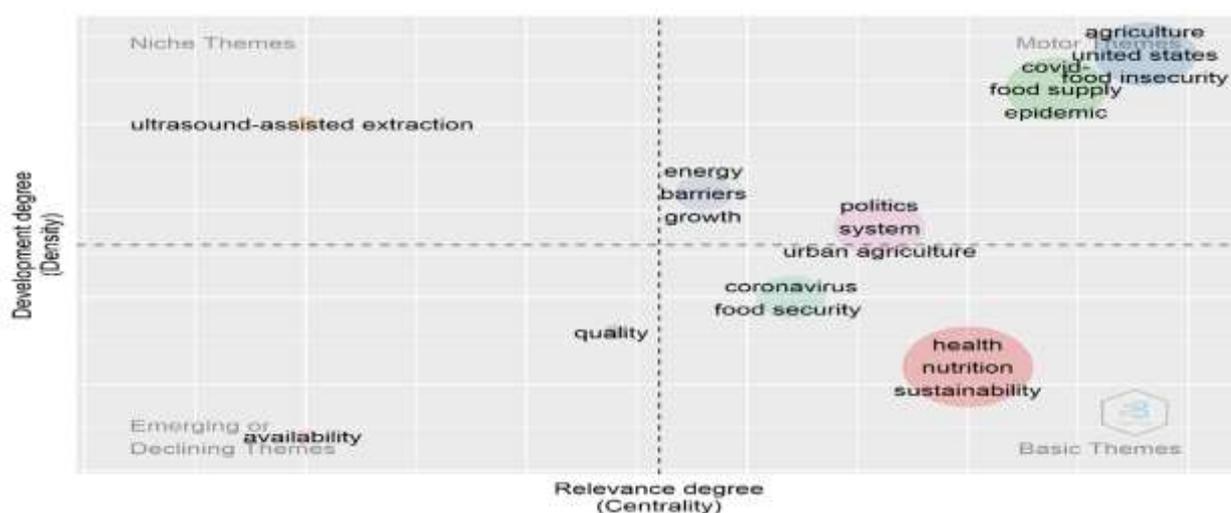


Figure 2: Thematic map based on density and centrality, divided into four topological regions

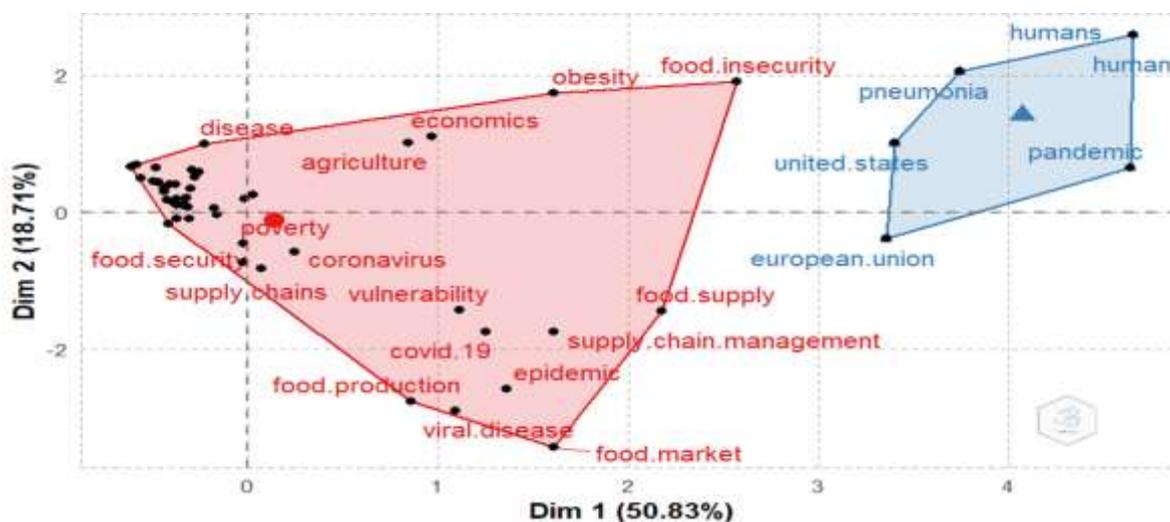


Figure 3: A conceptual structure map was generated, containing a visualization of the contextual structure of each word

address research gaps and provide more comprehensive insights.

#### 4. LIMITATIONS

This paper is having limitations which arise because the data was not taken from all data bases but, it was restricted to only two broad bases (Web of Science and Scopus). There are possibilities of many data being left out. Again, the data was taken ends in August 2021, this entails that the changes that happens after were not captured in this paper.

#### 5. CONCLUSION

Ultimately, the aim of this paper was to examine the nexus between COVID-19 and food systems in a bibliometric way. In this quest, data was extracted from two main data bases which are the Clarivate Analytics of the Web of Science and Scopus. The data was merged using R, a bibliometric app. By looking at the keywords, thematic maps, and conceptual structures it can be noticed that research on COVID-19 and food systems is being carried out intensively. The study aimed at answering the degree to which Coronavirus affected the food systems and the measures employed across the world to cushion its effects.

This study found out that COVID-19 impacted the elements of food systems such as food distribution as it becomes difficult to transport food due to lockdown measures. Also, the presents of keywords like “poverty” and “food security” shows us that food production was curtailed therefore, the number of people suffering from hunger rose thus high food insecurity. Additionally, the governments assisted their citizens with food.

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#### 7. CONFLICT OF INTEREST

The authors have declared that there is no conflict of interest.

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NA

#### 9. REFERENCES

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