

A Bibliometric Analysis of Research on Risks in the Poultry Farming Industry: Trends, Themes, Collaborations, and Technology Utilization

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Abstract—This paper explores the risks prevalent in the poultry farming industry, drawing upon an extensive examination conducted by researchers over the past decade. Employing a bibliometric analysis approach, a comprehensive search of the Scopus database was conducted using relevant keywords related to poultry farming risk and technology utilization. The search spanned from 2002 to 2022, yielding 345 pertinent documents. This study presents an overview of the current state of publications concerning poultry farming risk and its intersection with technology utilization. It delves into citation patterns, prevalent themes, and authorship analysis, focusing on the role of technology in mitigating risks. The comprehensive citation analysis highlights the impact of technology-related studies in the field. Frequency analysis employed Microsoft Excel, while VOSviewer facilitated data visualization. Harzing's Publish or Perish software was used for citation metrics and analysis. The findings reveal a consistent increase in publications on risk in poultry farming since 2002, particularly in relation to technology utilization. The United States emerges as the most active country in this area of research, with Wageningen University from the Netherlands identified as the most prolific institution contributing significantly to risk in poultry farming research, including technology applications. The research involved 32 scholars from 70 different countries and 32 distinct institutions, reflecting the multi-authorship and multicultural nature of the research. It is important to note that this paper focuses solely on the Scopus database, while future researchers may consider alternative databases for new studies, recognizing the expanding role of technology in addressing risks in the poultry farming industry.

Keywords—Poultry farming risk; poultry farming industry; bibliometric analysis; Harzing's Publish or Perish; VOSviewer

I. INTRODUCTION

Poultry farming is the practice of raising domesticated birds such as chickens, turkeys, ducks, and geese for their meat, eggs, and feathers [1]. The poultry farming industry refers to the commercial production of these birds on a large scale to meet the demands of the market [2]. In this industry, chickens are the most farmed bird due to their fast growth rate and high meat and egg production [3]. The industry involves breeding, hatching, raising, and slaughtering poultry birds in large numbers using modern farming techniques, equipment, and facilities. Poultry farms can be categorized into two main

types: broiler farms and layer farms. Broiler farms focus on raising chickens for meat production, while layer farms focus on raising chickens for egg production [4]. In both types of farms, the birds are kept in large sheds or cages, which are designed to provide them with the ideal conditions for growth and development. Poultry farming has become a significant industry worldwide, with billions of birds raised each year to meet the demands of the global market. The industry has seen significant growth in recent years due to advancements in technology, improved genetics of the birds, and increased demand for poultry products. In general, there are three types of households where poultry are raised: close farming systems, semi-intensive farming systems, and intense farming systems [5]. The backyard poultry industry has transformed into a significant supplier of poultry meat and eggs by embracing modern breeds, advanced housing and equipment, and efficient marketing systems. In the past, backyard poultry solely relied on local, low-yield, and unremarkable poultry breeds, which had limited productivity [6].

As increasing demand for food by the world's population has resulted in tremendous growth in agricultural productivity in recent years [7] and this will cause a lot of issues or risks for this industry that need to be controlled to ensure production can be maximized. Moreover, farmers need to increase their work efficiency to improve the quality of the poultry product while still focusing on animal welfare, environmental sustainability, and public health [8]. According to [9], livestock sector faces numerous challenges, including diseases, climate change, inadequate management practices, genetic issues, farmer capacity and skills, marketing challenges, infrastructure limitations, and a lack of information for effective decision-making. Consequently, the current production rate does not meet the projected demand. Conducting a bibliometric analysis allows us to observe the patterns and trends discussed by researchers regarding these issues. Furthermore, utilizing bibliometric analysis can serve as a valuable guide for farmers and researchers alike. It enables us to identify the key issues being discussed among researchers, shed light on the most prominent researchers who have published on the topic, and gain insights into the specific topics they have explored, including potential solutions and recommendations. This analysis offers a comprehensive overview of the scholarly landscape, providing guidance and

informing future directions for both farmers and researchers in addressing the identified challenges. Bibliometric analysis is frequently employed to evaluate trends and impact, encompassing factors such as publishing countries, subject categories, journals, and author keywords [10]. The objective of this study is to examine trends and advances to better inform researchers about the viewpoint of risk research in poultry farming. A forward-looking analysis that can anticipate the author's contribution, both presently and in the future, is imperative. This study serves as a heuristic tool to assess the literature on poultry farming risk to provide practitioners and researchers with the most recent developments in pedagogy. In order to shed light on the topic at hand, this study endeavors to answer the following research questions (RQs):

- RQ1: What is the current status of research publications on the topic of poultry farming risk?
- RQ2: How are publications on poultry farming risk being cited in current literature?
- RQ3: Which themes related to poultry farming risk are receiving the most attention and interest among scholars?
- RQ4: What patterns can be observed in terms of authorship in publications on poultry farming risk?

II. METHOD

This paper employs bibliometric analysis to examine trends and productivity in research on poultry farming risks. The study's methodology encompasses the data gathering and filtering processes, culminating in the analysis-ready dataset. The objective is to identify the topic and scope of the study, encompassing all available research on risk in poultry farming within the Scopus database. The paper presents various bibliometric indicators and utilizes network visualization techniques. The research protocol used to guide the selection of the documents acquired for this study was shown in Fig. 1.

A. Bibliometric Analysis

The aim of this study is to utilize bibliometric analysis as a quantitative technique to uncover the prevailing trend in poultry farming risk. Bibliometric analysis involves statistical measurements and enables the examination of published articles or bibliographic units, providing insights into the distribution and characteristics of the literature in the field [10], [11]. The analysis has the capability to identify descriptive patterns in the articles generated based on various factors such as domain, field, country, or time [12]. There are three categories of bibliometric study indicators include quantity, quality, and structural indicators [13]. The quantity indicator in bibliometric analysis refers to the productivity of researchers, which can be measured by factors such as the number of publications or citations per year [14]. On the other hand, quality indicators assess the performance of researchers based on metrics like the overall h-index, g-index, and citation score, which reflect the impact and recognition of their work. Structural indicators, on the other hand, focus on the relationships between publications, authors, and research fields, shedding light on the interconnections within the

scholarly landscape [15]. Additionally, employing a systematic methodology necessary for conducting bibliometric analysis can reveal valuable insight, including information about the authors, frequency of keywords and citations [16].

B. Source and Data Collection

The Scopus database was selected as the main data source that being used in this paper to achieve paper's objective since it is known for being the "largest single abstract and indexing database ever developed and the largest searchable citation and abstract literature search list." [17], [18]. Moreover, Scopus database also is the largest database of peer-reviewed literature, including books, journals, and conference proceedings [19] and the database has over 36 000 titles from nearly 11000 publishers, mostly from peer-reviewed journals, and it covers the social, physical, health, and biological sciences [16].

The search query of the poultry farming risk topic was applied in the Scopus data based within search by keyword and with the 345 documents were produced for the next further analysis. Besides, other tools also have been utilized for gathering the document for example, Microsoft Excel, Harzing's Publish and Perish software and VOSviewer.

The data was obtained from the Scopus database on November 6, 2022. The documents are restricted to the topic based on the poultry farming risk title. To fulfill our objective, we executed a query with the KEYWORD term 'poultry farming risk.' This query yielded a total of 477 documents. Through a thorough data cleaning process, we identified and eliminated 132 duplicate or irrelevant documents not pertinent to our topic. The data collected from the Scopus database was then exported into comma-separated values (.csv) and research information systems (.ris) formatted files, ensuring a standardized and organized dataset.

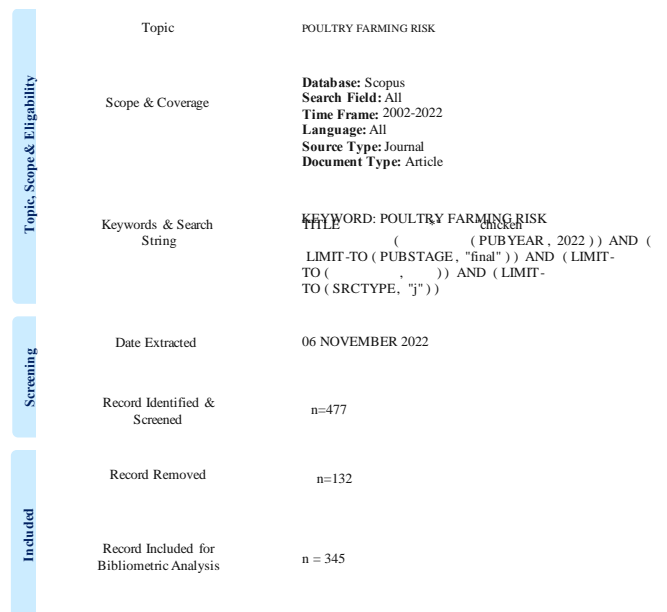


Fig. 1. Flow diagram of the search strategy.

This study utilized the bibliometric method to analyze the research trends in the field of poultry farming risk. The database provides a comprehensive range of publication details, encompassing information such as publication type, year, language, subject area, keywords, country, affiliation, citations, and authorship of the documents. Data analysis was conducted using Microsoft Excel and Harzing's Publish or Perish software, while VOSviewer software was utilized for data visualization. In this study, the VOSviewer software played a key role in conducting the mapping analyses [10]. When representing the nodal network, VOSviewer employs two uniform weights to create a graphical visualization: the quantity of connections and the collective strength they possess. The relevance and power of the links are reflected in the network size and network-connecting interlinking lines.

III. RESULT AND FINDING

To acquire an overview of the research related to poultry farming risk, data sets are provided. All articles that met the search query were evaluated for current publication such as year, language of publications, subject area, distribution of publications by countries, most active authorship, keywords, and citation analyses.

A. Current State of Publication in Poultry Farming Risk

In order to investigate RQ1 (What is the current state of publication in poultry farming risk?), a thorough analysis was conducted to examine the publication trends in this field. The analysis encompassed several key dimensions, including the total number of publications by year, document type, publication source title, country of publication, affiliated institutions, language, and subject area. To perform this analysis, we utilized the bibliographic data collected from the Scopus database, allowing for comprehensive calculation and evaluation of the relevant data.

- Publication by year

Examining documents by publication year allows the researcher to track the pattern and popularity of the research topic through time [27-33]. Table I summarises the total publications for poultry farming risk since 2002. In the early topic of poultry farming risk there were three articles about this topic that were published in 2002 that were written by [20]–[23]. Nevertheless, analysis of these papers revealed that in 2002 were justified as the pioneers of publication as these paper that was written by [21] was cited 259 times. According to the records, between 2005 and 2015, the number of publications had an inconsistent pattern, with fluctuations in both increases and decreases. However, starting from 2016, there was a noticeable growth in the number of articles being published. This trend continued, and in 2020, there was a record high of 35 publications, accounting for 10.14% of the total. This significant increase indicates a peak period in the practice of the poultry farming risk approach adopted by educators worldwide (Fig. 2). This observation becomes clearer when analysing the trends of countries participating in research.

TABLE I. YEAR OF PUBLICATION

Year	TP	%	NCP	TC	C/P	C/CP	h	g
2002	3	0.87%	3	777	259.00	259.00	3	3
2003	9	2.61%	8	288	32.00	36.00	5	9
2004	5	1.45%	5	740	148.00	148.00	5	5
2005	14	4.06%	13	326	23.29	25.08	9	14
2006	12	3.48%	11	282	23.50	25.64	6	12
2007	10	2.90%	10	348	34.80	34.80	7	10
2008	12	3.48%	12	589	49.08	49.08	11	12
2009	18	5.22%	18	440	24.44	24.44	14	18
2010	11	3.19%	11	674	61.27	61.27	9	11
2011	16	4.64%	16	533	33.31	33.31	11	16
2012	17	4.93%	17	621	36.53	36.53	12	17
2013	17	4.93%	17	640	37.65	37.65	12	17
2014	24	6.96%	24	446	18.58	18.58	12	20
2015	18	5.22%	17	377	20.94	22.18	11	18
2016	15	4.35%	14	238	15.87	17.00	10	15
2017	17	4.93%	15	461	27.12	30.73	9	17
2018	21	6.09%	19	382	18.19	20.11	12	19
2019	28	8.12%	25	363	12.96	14.52	9	18
2020	35	10.14%	34	387	11.06	11.38	11	18
2021	27	7.83%	20	112	4.15	5.60	6	9
2022	16	4.64%	7	23	1.44	3.29	2	4
Total	345							

TP total number of publications, NCP number of cited publications, TC total citations, C/P average citations per publication, C/CP average citations per cited publication, h h-index, and g g-index

- Document type

The term "document type" pertains to the categorization of documents into various categories, including conference papers, articles, book chapters, reviews, and books. Table II provides a summary of the distribution of documents published on poultry farming risk, classified into seven document types. Notably, a significant majority of the publications (84.06%) were classified as articles.

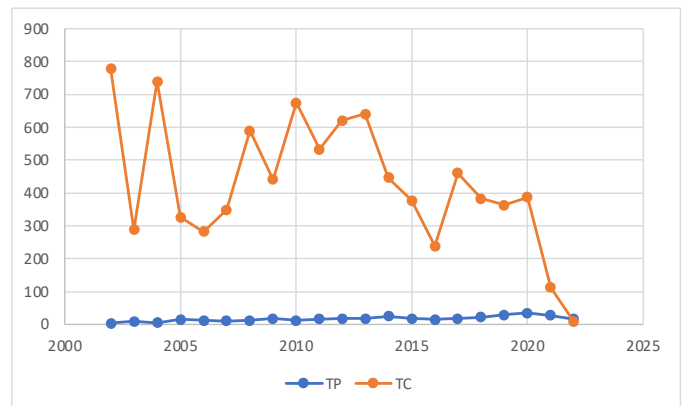


Fig. 2. Publication and citation trend of poultry farming risk.

TABLE II. DOCUMENT TYPE OF POULTRY FARMING RISK

Document Type	Total Publications (TP)	Percentage (%)
Article	290	84.06%
Review	23	6.67%
Letter	14	4.06%
Note	10	2.90%
Conference Paper	4	1.16%
Editorial	3	0.87%
Short Survey	1	0.29%

- Publication by country

There are top 10 listed as the most productive countries (see Table III). United States was dominated in publishing this topic with a total of 81 (23.48%) documents followed by United Kingdom (56: 16.23%) and China (50: 14.49%). The United States' leading position in poultry farming publications is unsurprising, as their publications have garnered the highest number of citations, indicating extensive recognition worldwide.

TABLE III. COUNTRY

Country	TP	%	NCP	TC	C/P	C/CP	h	g
United States	81	23.48%	76	2894	35.73	38.08	31	52
United Kingdom	56	16.23%	51	1688	30.14	33.10	25	40
China	50	14.49%	49	1439	28.78	29.37	18	37
Netherlands	28	8.12%	28	1428	51.00	51.00	16	28
France	26	7.54%	26	702	27.00	27.00	12	26
Australia	18	5.22%	17	401	22.28	23.59	9	18
Italy	18	5.22%	17	441	24.50	25.94	13	18
Germany	14	4.06%	14	414	29.57	29.57	9	14
Thailand	14	4.06%	12	262	18.71	21.83	7	14
Belgium	12	3.48%	12	601	50.08	50.08	11	12

TP total number of publications, NCP number of cited publications, TC total citations, C/P average citations per publication, C/CP average citations per cited publication, h h-index, and g g-index

- Publication by institution

Table IV depicts the top five institutions that publish on Poultry Farming Risk. Based on the result, it stated that Wageningen University is the highest institution that were publish in this topic with total 20 publications with the average citation per year 32.00. Even though it has the highest publication, National Institute for Public Health and the Environment that were in Netherlands has the highest citation per year (88.36) compared to other institution. When institutions were ranked according to h-index, the Wageningen University and Royal Veterinary College University of London top institutions that lead the publications on poultry farming risk.

- Languages of the document

There are four languages used for publications that were mostly published in English languages (342: 98.84%) (See Table V). The extensive use of a wide range of languages, including major ones, in publications signifies the diverse global involvement and breadth of research on poultry farming risks across nations.

TABLE IV. INSTITUTIONS MOST AFFILIATED WITH POULTRY FARMING RISK

Institution	TP	%	Country	NCP	TC	C/P	C/CP	h	g
Wageningen University	20	5.80%	Netherlands	20	640	32.00	32.00	13	20
Royal Veterinary College University of London	14	4.06%	United Kingdom	13	546	39.00	42.00	9	14
Centers for Disease Control and Prevention	12	3.48%	United States	11	870	72.50	79.09	8	12
National Institute for Public Health and the Environment	11	3.19%	Netherlands	11	972	88.36	88.36	7	11
The University of Hong Kong	10	2.90%	Hong Kong	10	177	17.70	17.70	8	10

TP total number of publications, NCP number of cited publications, TC total citations, C/P average citations per publication, C/CP average citations per cited publication, h h-index, and g g-index

TABLE V. LANGUAGES USED FOR PUBLICATIONS

Language	Total Publication	Percentage
English	342	98.84%
German	2	0.58%
Chinese	1	0.29%
French	1	0.29%

TP total number of publications, NCP number of cited publications, TC total citations, C/P average citations per publication, C/CP average citations per cited publication, h h-index, and g g-index

- Subject Area

Based on all the documents gathered from the Scopus database, poultry farming risk covers almost all subject areas especially in medicine. Table VI shows that between this period (2002–2022), the most written subject in these topics is medicine (48.41) % as almost the half of the publications were published for this topic.

TABLE VI. THE MOST WRITTEN SUBJECT AREAS

Subject Area	Total Publication	Percentage
Medicine	167	48.41%
Veterinary	86	24.93%
Agricultural and Biological Sciences	79	22.90%
Environmental Science	69	20.00%
Immunology and Microbiology	63	18.26%
Biochemistry, Genetics and Molecular Biology	43	12.46%
Multidisciplinary	24	6.96%
Pharmacology, Toxicology and Pharmaceutics	18	5.22%
Engineering	7	2.03%
Social Sciences	7	2.03%
Chemistry	6	1.74%
Computer Science	5	1.45%
Nursing	5	1.45%
Earth and Planetary Sciences	3	0.87%
Chemical Engineering	2	0.58%
Economics, Econometrics and Finance	2	0.58%
Materials Science	2	0.58%
Arts and Humanities	1	0.29%
Health Professions	1	0.29%
Mathematics	1	0.29%
Neuroscience	1	0.29%

TP total number of publications, NCP number of cited publications, TC total citations, C/P average citations per publication, C/CP average citations per cited publication, h h-index, and g g-index

B. Citations Pattern on Poultry Farming Risk

Our second research question (RQ2) aims to identify the most influential articles on poultry farming risk and visualize the citation patterns using data obtained from the Scopus database. The analysis involved examining the citation metrics and networks of 345 articles to address RQ2. Citation analysis was conducted to measure the impact of documents on poultry farming risk using relevant citation metrics. Data analysis was performed utilizing Harzing's Publish or Perish and VOSviewer software. Table VII presents the citation metrics for the retrieved documents as of 06 November 2022. Among the 345 articles, an average of 452.35 citations per year was observed, with a total of 9,047 citations reported.

Table VIII displays comprehensive information, including the overall number of total citations and the average number of citations per year for all retrieved publications. Based on Scopus data, the top five most cited articles are listed. Notably, the article titled "Antimicrobial residues in animal waste and water resources proximal to large-scale swine and poultry feeding operations" by [20] has garnered the highest

number of citations, with 395 citations or an average of 19.75 citations per year.

Fig. 3 illustrates the network visualization map, which reveals the citation connections among countries. It is worth noting that "Citations attribute indicates the number of citations received by a document or the total number of citations received by all documents published by a source, an author, an organization, or a country" [23]. Out of the 71 countries considered, 68 have met the minimum thresholds for both the number of documents and citations attributed to an author. To interpret Fig. 3 effectively, it is essential to refer to the corresponding data in Tables VII and VIII, which provide specific information on the number of citations received by each country. Notably, the United States, United Kingdom, and China have received a substantial number of citations in the domain of poultry farming risk.

C. Theme in Poultry Farming

- To address RQ3 (Which themes involving poultry farming risk are the most popular among scholars?), we conducted co-occurrence analysis using the keywords data obtained from the Scopus database. Co-occurrence of keywords indicates the presence of a relationship between two concepts when they appear together in an article [26]. We performed the co-occurrence analysis and keyword evaluation based on the understanding that author keywords provide a meaningful representation of an article's content [27]."

TABLE VII. CITATION METRICS

Metrics	Data
Papers	345
Citations	9047
Years	20
Cites Year	452.35
Cites Paper	26.22
Cites Author	2016.29
Papers Author	91.13
Authors Paper	5.61
h index	46
g index	80

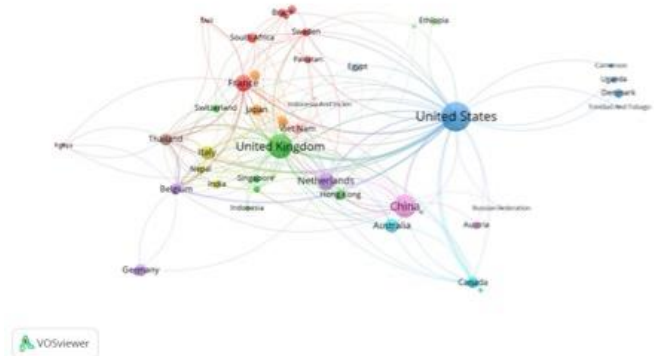


Fig. 3. Network visualisation map of the citation by countries.

TABLE VIII. HIGHLY CITED ARTICLE

No.	Author(s)	Title	TC	C/Y
1	[21]	Antimicrobial residues in animal waste and water resources proximal to large-scale swine and poultry feeding operations	395	19.75
2	[22]	Routes for salmonella contamination of poultry meat: Epidemiological study from hatchery to slaughterhouse	148	7.4
3	[23]	Risk of influenza A (H5N1) infection among poultry workers, Hong Kong, 1997-1998	234	11.7
4	[24]	A comparison between leg problem in Danish and Swedish broiler production	48	2.53
5	[25]	Survey of effects of radiofrequency electromagnetic fields on production, health, and behavior of farm animals	4	0.21

TABLE IX. TOP KEYWORDS

Keywords	TP	%
Poultry Farming	285	82.61%
Article	257	74.49%
Animals	234	67.83%
Nonhuman	217	62.90%
Poultry	205	59.42%
Human	168	48.70%
Animal	152	44.06%
Risk Factor	138	40.00%
Risk Assessment	135	39.13%

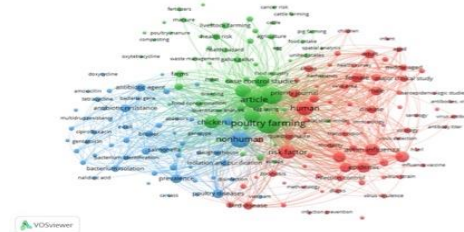


Fig. 4. Network visualisation map of all keywords.

D. Authorship Analysis

Besides, this paper also analyses the most active authors who published the documents on this topic as stated in Table X. All the data that was analysed, is based on the active author who published at least more than three documents on poultry farming risk. Even though there are four authors who have same total publications, author Gilbert, Marius is the most active author who published research article in this topic; as his article journal consists of the highest citation per year and h-index compared to others.

TABLE X. MOST PRODUCTIVE AUTHOR

Author's Name	Affiliation	Country	T P	NC P	T C	C/P	C/C P	h	g
Cowling, B.J.	The University of Hong Kong	Hong Kong	6	6	104	17.33	17.33	5	6
Gilbert, M.	Free Universities of Brussels	Belgium	6	6	300	50.00	50.00	6	6
Johnson, E.S.	University of Arkansas	United States	6	6	56	9.33	9.33	4	6
Wagenaar, J.A.	University of Gent	Netherlands	6	6	281	46.83	46.83	5	6
Carrique-Mas, J.J.	Oxford University	United Kingdom	5	5	175	35.00	35.00	5	5
Xiao, X.	University of Oklahoma	United States	5	5	216	43.20	43.20	5	5
Cui, B.	Yangzhou University	China	4	4	16	4.00	4.00	2	4
Fielding, R.	The University of Hong Kong Li Ka Shing	Hong Kong	4	4	62	15.50	15.50	4	4

TP total number of publications, NCP number of cited publications, TC total citations, C/P average citations per publication, C/CP average citations per cited publication, h h-index, and g g-index

Undoubtedly, author keywords are of great importance for researchers seeking to identify research trends. Additionally, [28] emphasize the significance of author keyword analysis in measuring the development of research topics. After eliminating duplicate keywords resulting from spelling variations (e.g., Poultry farming, poultry farm, poultry), our analysis reveals the top 10 frequently used author keywords in relation to this topic (see Table IX).

Subsequent analysis involved the mapping of all keywords using VOSviewer, a software tool specifically designed for constructing and visualizing bibliometric networks (refer to Fig. 4). For this purpose, a comprehensive approach was adopted, considering a minimum threshold of ten occurrences for each keyword out of a total of 3,716 keywords. Consequently, 188 keywords met the specified criteria. Employing these settings, VOSviewer generated the network visualization depicted in Fig. 4, where the colors, circle sizes, font sizes, and line thicknesses indicate the strength of the relationships between the keywords [26]. In Fig. 4, each color corresponds to a distinct cluster identified in the visualization map. Initially, four clusters were observed. However, by adjusting the cluster size criterion to include a minimum of 50 items in each cluster, three clusters remained. Cluster one, represented by red, comprises 60 items centered around the theme of avian influenza. Cluster two, depicted in green, encompasses 54 items associated with the non-human theme. Cluster three, highlighted in blue, includes 53 items related to the poultry farming theme.

IV. CONCLUSION

Bibliometric analysis can be used to analyze the trend in Poultry Farming research. It also can analyze the productivity of research and other specific research domains. According to [34] the insights obtained from bibliometric analysis can provide an understanding of the factors that influence the research output and contribution within different fields of study. These findings can guide researchers in conducting meaningful and impactful research. However, it is important to note that the scope of this study is confined to the publications related to poultry farming risk available in the Scopus database. Based on the results that had been conducted by using Harving's Publish or Perish software and VOSviewer we can see that all the research question have been answered. Overall, there were 345 total documents that were found from Scopus database using the defined search query. The author in [27] is the most active author who published research articles on this topic in six total publications and had 300 of total citation. Besides, English is the most common language that has been used in this topic and Medicine is the subject area that is the most written subject are covered for this research study. Regarding the country, the country with most publications, covered in this research, is United States as the total publications based on this topic were 81. Based on the analysis of the top five most cited articles, it can be inferred that a significant portion of the publications focused on the topic of diseases in the poultry farming industry. This finding suggests that despite advancements in management practices, disease outbreaks remain a critical risk that necessitates continuous monitoring and attention. Finally, there are still more opportunities for research related to this topic that can be conducted in future. Due to the distinctive nature of the bibliometric analysis, the study has limitations that should be addressed to provide readers with a clear understanding of the paper and to improve future research. First, the results were limited to a single keyword, such as poultry farming risk, based on the document's title. As a result, the results of the search query on other fields, such as article title and abstract, have been left out of this analysis. The main reason for this is because by using search query for article title, the documents are not enough to be analyzed using bibliometric. By using search query for keyword, even though some included a term linked to the search area yet might not be related with the topics, but by using data cleaning we manage to get at least certain amount of documents to analyze. But the only disadvantage is that there is a lot of filtering and cleaning to be done before the analysis can begin. It is likely that future research will be expanded into it. Finally, being the primary source of documents, this study is solely focused on the Scopus database. Web of Science, Google Scholar, and Dimensions are some of the other databases that could be used in future research. Combining all these databases will almost certainly result in more interesting and useful findings. Despite these limitations, this study has added to the body of knowledge by describing the current state of poultry farming risk. This study also uses a bibliometric technique to enhance and augment prior findings on poultry farming risk literature and provide valuable insights into the trend of previous publications.

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