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Jover Jabagat

jover.jabagat@ustp.edu.ph

University of Science and Technology of southern Philippines

Rudy Camay

University of Science and Technology of southern Philippines

Research Article

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Global Research Trends on Antimicrobial Resistance Transmission in Broiler Chickens and Poultry Products—A Bibliometric and Scientometric Analysis

Jabagat, Jover[1] Jover.jabagat@ustp.edu.ph, Rudy M. Camay[2] *0000-0003-0756-2412-ORCID*

Department of Animal Science, College of Agriculture,University of Science and Technology of southern Philippines, Claveria, Misamis Oriental, Philippines

Abstract

Antimicrobial resistance (AMR) in broiler chickens and poultry products is an important research concern at the intersection of veterinary medicine, food safety, microbiology, and public health. Despite increasing scholarly attention, the development, intellectual structure, and collaborative patterns of this research area remain insufficiently characterized. This study examines global research trends on AMR transmission in broiler chickens and poultry products through a bibliometric and scientometric analysis of Scopus-indexed literature published between 1984 and 2025. A total of 451 documents from 234 sources were analyzed using performance indicators and science-mapping techniques to examine publication growth, citation patterns, authorship, geographical and institutional contributions, journal distribution, and thematic relationships. Results revealed an annual publication growth rate of 12.07%, an average of 67.98 citations per document, and an international co-authorship rate of 45.68%. Research production was predominantly collaborative, with an average of 5.98 co-authors per document. The United States and the United Kingdom led in total citations, whereas Sweden, Switzerland, South Africa, and Pakistan demonstrated comparatively high citation intensity relative to their publication output. Journal distribution followed Bradford's Law, identifying 19 core sources among 234 publication outlets. Overall, the findings provide a structured overview of the evolution, scholarly influence, and intellectual organization of research on poultry-associated AMR. This study offers a bibliometric foundation for identifying established research areas, strengthening international collaboration, and guiding future interdisciplinary investigations. The findings represent the Scopus-indexed literature and do not directly measure AMR prevalence or establish biological transmission pathways.

Keywords: *Antimicrobial resistance; broiler chickens; poultry products; bibliometric analysis; scientometric analysis; research trends; science mapping*.

I. INTRODUCTION

Antimicrobial resistance (AMR) is a major global concern for animal health, food safety, and public health. The increasing occurrence of resistant microorganisms threatens the effectiveness of antimicrobial treatments and creates challenges for the prevention and control of bacterial infections. Food-producing animals, including broiler chickens, are important to this concern because antimicrobial use in animal production can contribute to the selection and persistence of resistant bacteria. These organisms and associated resistance determinants may enter the food chain and create potential exposure pathways for humans (Saraiva et al., 2022). Consequently, AMR in poultry production requires attention not only from veterinary and agricultural sectors but also from microbiology, epidemiology, food safety, and public health disciplines.

Broiler chickens are particularly relevant because poultry meat is an important and widely consumed source of animal protein. Research in this sector has examined resistant bacteria, antimicrobial susceptibility, resistance genes, and the potential movement of resistant microorganisms through poultry production and food-handling systems. The relationship between animal production, food products, and human health highlights the importance of a One Health perspective, which recognizes the interdependence of human, animal, and environmental health (Saraiva et al., 2022). Evidence from antimicrobial resistance monitoring has also documented resistant zoonotic and indicator bacteria in food-producing animals, including broilers, and in derived meat products (European Food Safety Authority [EFSA] & European Centre for Disease Prevention and Control [ECDC], 2025). In Southeast Asia, the review by Gongal et al. (2023) further identified the need to strengthen antimicrobial-use regulation and surveillance in food-animal production.

Despite the expanding literature, research on poultry-associated AMR covers several interconnected topics and is distributed across different countries, institutions, journals, and scientific disciplines. Individual empirical studies provide important information about particular bacterial species, resistance profiles, and production settings; however, they do not necessarily reveal how the broader research field has developed or how its knowledge base is organized. A field-level assessment is therefore useful for identifying publication trends, influential contributors, patterns of collaboration, and the themes receiving scholarly attention. Previous research has also emphasized the value of mapping the scientific knowledge of AMR in food-producing animals to identify research patterns and areas where surveillance remains limited (Torres et al., 2021).

Bibliometric and scientometric analysis offers a systematic approach to examining these dimensions. By integrating publication and citation indicators with science-mapping techniques, researchers can assess the development of a research field, identify influential sources and contributors, and examine intellectual, social, and conceptual relationships within the literature (Donthu et al., 2021). These methods describe patterns in scholarly communication; they do not independently measure AMR prevalence, establish biological transmission, or determine the effectiveness of interventions.

Accordingly, this study examines Scopus-indexed research on antimicrobial resistance transmission in broiler chickens and poultry products published between 1984 and 2025. Specifically, it analyzes publication growth and citation patterns; examines the contributions of authors, countries, institutions, and publication sources; evaluates author productivity and journal concentration; and explores the intellectual and thematic relationships represented in the bibliographic dataset. Through these analyses, the study aims to provide a structured overview of the development and organization of this research field and a bibliometric foundation for identifying research directions and opportunities for interdisciplinary and international collaboration.

II. METHODS AND MATERIALS

Study Design

In line with my aims, my purpose was not to evaluate specific clinical efficacy, therapeutic interventions, or biological mechanisms of resistance, but to describe how the field has grown over time, how scholarly influence is distributed across countries, institutions, journals, and authors, and how major scientific themes have emerged and evolved within this segment of the literature. A scientometric and bibliometric approach was appropriate for this purpose because it enables large-scale, quantitative mapping of publication dynamics, citation trajectories, structural distributions, and thematic networks that are difficult to capture through traditional systematic or narrative reviews alone. To ensure rigorous analytical integration, I combined two complementary components. First, performance analysis summarized productivity and impact metrics using indicators such as author output distributions (Lotka's Law), source journal dispersion (Bradford's Law), annual publication trends, and citation density patterns over time. Second, science-mapping techniques—including source growth dynamics, non-linear publication lifecycle modeling, and three-field relational synthesis (linking cited references, contributing authors, and merged keywords)—were used to identify, trace, and relate the structural architecture, foundational knowledge bases, and conceptual pipelines of the field. Taken together, these elements provided a structured, evidence-driven account of how research on antimicrobial resistance transmission in broiler chickens and poultry products has developed and consolidated within the Scopus-indexed literature over the study period.

Data Source

All bibliographic data for this study were retrieved from Scopus. Scopus was selected because it offers comprehensive coverage of peer-reviewed literature across veterinary sciences, microbiology, agriculture, food safety, and public health, while providing standardized and reliable metadata on authors, affiliations, citations, cited references, and keywords necessary for rigorous bibliometric and scientometric modeling. In addition, its structured export formats are well suited for advanced analytical workflows, including productivity law testing, lifecycle curve fitting, and relational network mapping. Furthermore, it is recognized that Scopus is a single major bibliographic index; relevant studies published in regional indexing services or exclusively in other databases such as Web of Science or PubMed may not be fully captured. For this reason, my

analysis should be interpreted as mapping the Scopus-indexed segment of research on antimicrobial resistance transmission in broiler chickens and poultry products rather than as an exhaustive census of all published global literature on the topic.

I focused on peer-reviewed research articles indexed in Scopus and published in English up to the current literature baseline. This temporal and document-type scope reflected a deliberate emphasis on peer-reviewed empirical and theoretical scholarship positioned at the primary front of international scientific communication, for which bibliographic metadata were sufficiently complete and standardized to support reliable scientometric processing. However, this strategy also meant that non-indexed journal articles, non-peer-reviewed document types (e.g., conference proceedings, book chapters, dissertations, industry or governmental technical reports), and publications in languages other than English were excluded. These design choices reduced metadata heterogeneity and duplication but restricted the analytical perimeter. Consequently, when interpreting the findings—particularly regarding global research trends, productivity distributions, and systemic transmission concepts—it is essential to recognize that they represent an influential, highly standardized, but defined subset of the broader antimicrobial resistance literature.

Data Search and Extraction

A structured bibliographic search was conducted directly through the Scopus online publication-search interface to identify literature addressing antimicrobial resistance (AMR) in broiler chickens and poultry products. The study selection process was organized using the general reporting sequence of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), covering record identification, screening, eligibility assessment, and final inclusion. In this study, PRISMA was used as a framework for transparently presenting the bibliographic search and selection process; it was not intended to imply that the study was a systematic review of clinical or experimental evidence.

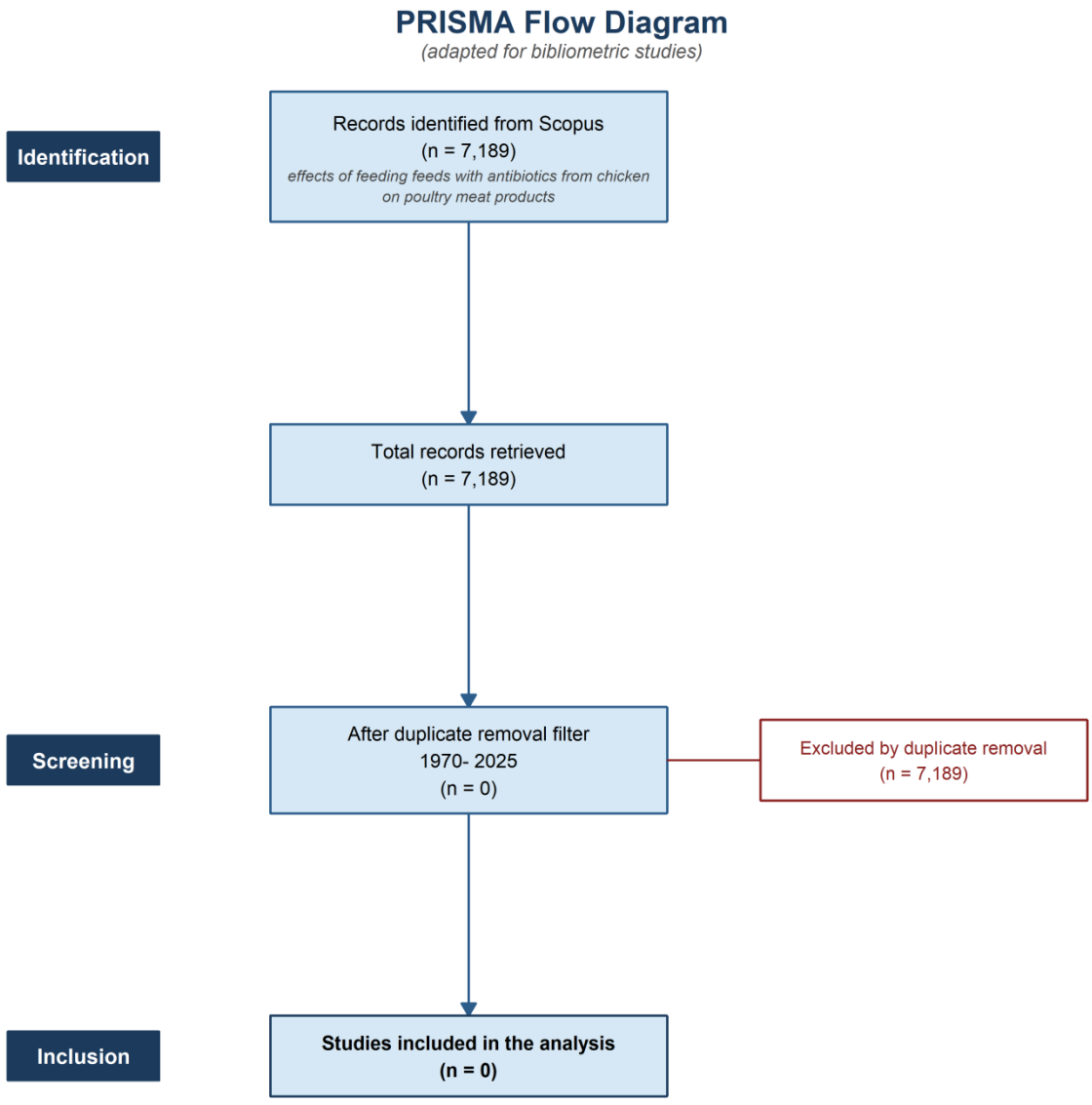
The search covered publications from 1984 to 2025. Following the selection process, the final dataset comprised 451 Scopus-indexed documents distributed across 234 sources. The included records consisted of 262 research articles and 189 review papers. Both document types were retained to capture the breadth of scholarly contributions to the research area and to support the subsequent bibliometric and scientometric analyses.

After the final records had been identified, bibliographic information was extracted from the Scopus dataset. The extracted metadata included publication year, document type, source title, authors, institutional affiliations, countries of affiliation, author keywords, Keywords Plus, citation information, and cited references, where available. The resulting dataset contained 77,732 cited references, 3,692 Keywords Plus terms, and 1,436 author keywords. These metadata formed the basis for examining publication growth, citation patterns, authorship and collaboration, country and institutional contributions, source productivity, and the intellectual and thematic structure of the field.

The final corpus was subsequently used for performance analysis and science mapping. The selection process and final number of included documents are presented in Figure 1. The results should be interpreted as representing the Scopus-indexed literature retrieved within the study's search scope and publication period.

Figure 1. PRISMA flow diagram illustrating the systematic selection and screening process of studies included in the bibliometric and scientometric analysis

PRISMA Flow Diagram of Study Selection



III. RESULTS

Table 1. Main Information

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	1984:2025
Sources (Journals, Books, etc)	234
Documents	451
Annual Growth Rate %	12.07
Document Average Age	4.54
Average citations per doc	67.98
References	77732
DOCUMENT CONTENTS	
Keywords Plus (ID)	3692
Author's Keywords (DE)	1436
AUTHORS	
Authors	6
Authors of single-authored docs	1
AUTHORS COLLABORATION	
Single-authored docs	2
Co-Authors per Doc	5.98
International co-authorships %	45.68
DOCUMENT TYPES	
article	262
review	189

The bibliometric profile reveals a research domain characterized by sustained expansion, substantial international collaboration, and a considerable orientation toward knowledge synthesis. The coexistence of a relatively recent publication profile with a high average citation count suggests that research on antimicrobial resistance (AMR) transmission in broiler chickens and poultry products has attracted considerable scholarly visibility while continuing to generate new contributions. More importantly, the authorship structure indicates that knowledge production in this area is predominantly collaborative rather than individually driven.

The substantial proportion of international co-authorship suggests that the research domain has developed through cross-national scholarly engagement, consistent with the transboundary dimensions of foodborne pathogens, antimicrobial use, and resistance dissemination across interconnected animal-production and food-supply systems. The relatively substantial representation of review publications alongside original research articles further indicates that the literature encompasses both empirical investigation and the synthesis of existing evidence. This combination suggests an expanding knowledge base in which primary investigations and secondary syntheses coexist. Nevertheless, citation density should be interpreted as evidence of scholarly visibility rather than research quality or demonstrated epidemiological impact. Similarly, international co-authorship establishes cross-border collaboration but does not independently demonstrate the degree of scientific or methodological integration among participating research groups.

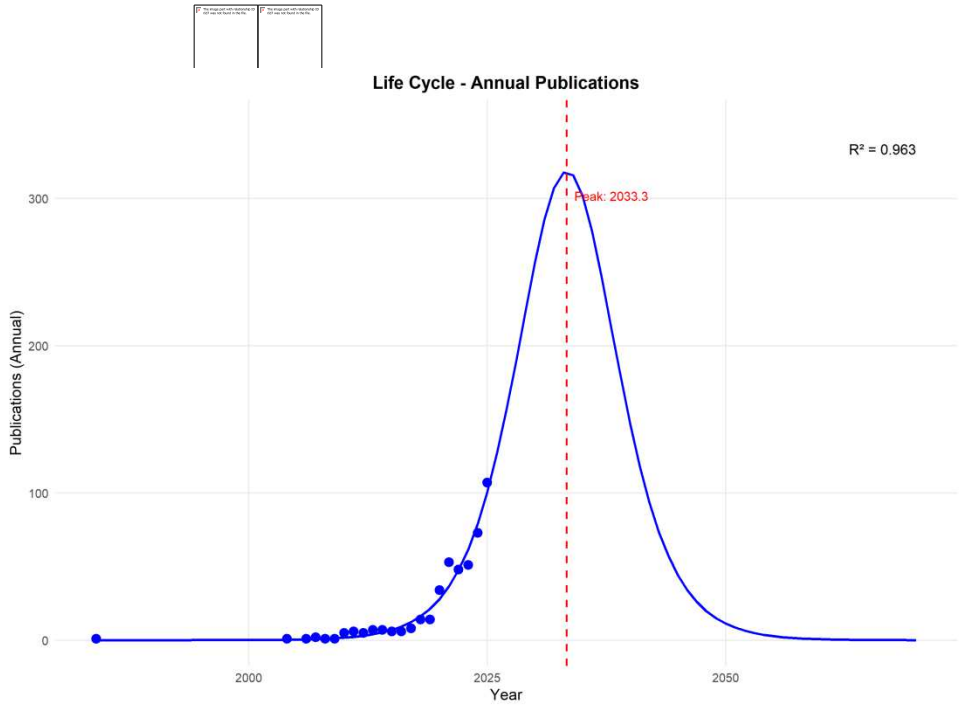


Figure 2. Life Cycle-Annual Publications

Figure 2 shows the life-cycle annual publication on AMR transmission in poultry, the modeled publication trajectory suggests continued expansion.

Temporal trajectory and citation dynamics

As shown in Figure 2, the temporal distribution of publications indicates that research on AMR transmission in poultry has entered a period of intensified scholarly activity, although publication growth and citation accumulation exhibit different temporal patterns. The modeled publication trajectory suggests continued expansion, whereas the relatively elevated citation density of earlier publication cohorts contrasts with the lower average citation rates observed in more recent years. This divergence is analytically important because it indicates that the increasing volume of

contemporary research has not yet translated into comparable citation accumulation at the individual-document level. A plausible explanation is the unequal citation exposure available to older and newer publications, with earlier studies having had more time to accumulate citations. The pattern may also reflect the distribution of citations across an expanding literature base. The Gaussian model's estimated future publication peak should therefore be treated as a model-dependent extrapolation rather than an established forecast of future research activity. Overall, the temporal evidence suggests a field undergoing quantitative expansion while its accumulated citation influence remains more strongly represented in earlier publication cohorts.

Intellectual foundations and conceptual integration

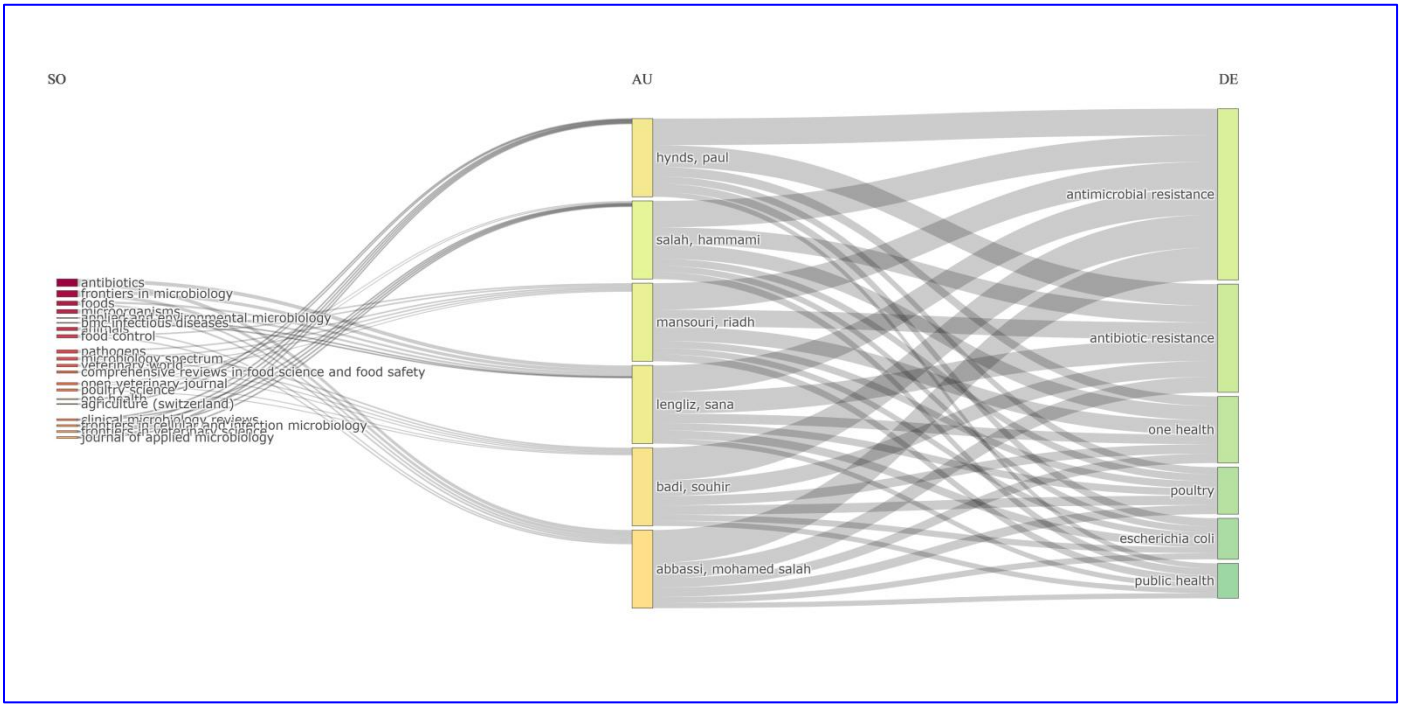


Figure 3. Three Field Plot

Figure 3 shows Three Field Plot relationship among various cited references, contributing authors and merged keywords.

As shown in Figure 3, the three-field relationship among cited references, contributing authors, and merged keywords indicates that the research domain is organized around connections between established scientific knowledge and contemporary thematic applications. The association of foundational references with authors and recurring conceptual domains suggests that current investigations draw upon an established body of methodological and scientific literature rather than developing as disconnected research contributions. Particularly significant is the apparent intersection of genomic and bioinformatics approaches with broader concepts relating to animal, human, and antimicrobial resistance. This configuration is consistent with an increasingly

interdisciplinary research orientation in which microbiological characterization and molecular investigation are considered alongside wider surveillance and public-health concerns. The prominence of these connections suggests that the intellectual organization of the field extends beyond the detection of resistant microorganisms in poultry and encompasses the investigation of resistance within interconnected animal–human–environment systems. Nevertheless, the three-field plot demonstrates bibliographic and keyword associations; it does not independently establish actual transmission pathways or confirm that resistant organisms have moved between poultry populations and humans.

Geographical distribution of citation influence

Table 2. Total Citations per Country

Rank	Country	Documents	Citations
1	United States	87	11,576
2	United Kingdom	49	6,469
3	South Africa	19	6,169
4	Canada	18	5,131
5	Sweden	9	4,828
6	India	22	4,754
7	Pakistan	15	4,754
8	Tanzania	14	4,402
9	Thailand	17	4,173
10	Switzerland	10	4,144

As summarized in Table 2, the geographical distribution of citation influence reveals an important distinction between national publication productivity and citation concentration. Although the United States and United Kingdom occupy prominent positions in cumulative citation output, several countries with comparatively smaller publication portfolios demonstrate substantially higher average citations per document. This divergence indicates that the geographical distribution of scholarly visibility cannot be adequately understood through publication volume alone. In particular, the strong citation representation of South Africa, Tanzania, Pakistan, and other Asian and African contributors demonstrates that research

originating outside the traditional high-output Western research systems also occupies a substantial position in the cited literature. The coexistence of high cumulative citation output in major research economies and elevated citation density in countries with smaller publication portfolios suggests a geographically differentiated knowledge structure. Importantly, these findings identify the distribution of citation recognition rather than the actual distribution of AMR prevalence, transmission intensity, or research quality. The representation of countries in the citation rankings should therefore be interpreted as evidence of their visibility within the indexed scholarly literature, not as a direct measure of their contribution to controlling antimicrobial resistance.

Institutional distribution of citation influence

Table 3. Total Citations per Organizations

Rank	Organization	Citations
1	Department of Microbiology, Pakistan	622
2	School of Veterinary Medicine, Ethiopia	343
3	Institute of Infection Veterinary and Ecological Sciences, United Kingdom	153
4	International Livestock Research Institute, Kenya	147
5	Center of Excellence in Fungal Research, Thailand	145
6	Department of Microbiology and Hygiene, Bangladesh Agricultural University	103
7	Department of Global Health and Development, London School of Hygiene and Tropical Medicine	89
8	International Livestock Research Institute, Ethiopia	73
9	National Microbiology Laboratory, Public Health Agency of Canada	66
10	Department of Applied Microbiology, Faculty of Science, Ebonyi State University, Nigeria	42

The institutional citation profile reveals a research landscape in which scholarly visibility is concentrated among specialized microbiology, veterinary, and public-health research units, with substantial representation from institutions in South Asia and Africa. The prominence of university-based microbiological and veterinary departments alongside international livestock and public-health organizations suggests that the knowledge base is distributed across institutions operating at different organizational and disciplinary levels. This pattern is particularly noteworthy because the leading institutional contributors are not exclusively located in traditionally dominant Western research environments. Instead, the citation profile demonstrates the visibility of regional academic institutions alongside transnational research organizations and specialized international laboratories. Their coexistence indicates a potentially complementary institutional structure in which locally situated research and internationally oriented scientific expertise both contribute to the development of the literature. However, institutional citation counts cannot establish the

direction or intensity of collaboration, nor can they demonstrate that individual institutions occupy formal bridging positions in the research network. Such conclusions would require supporting co-authorship or institutional network evidence. The observed concentration should consequently be understood as a distribution of citation visibility rather than a definitive hierarchy of institutional scientific capacity.

Author productivity and research concentration

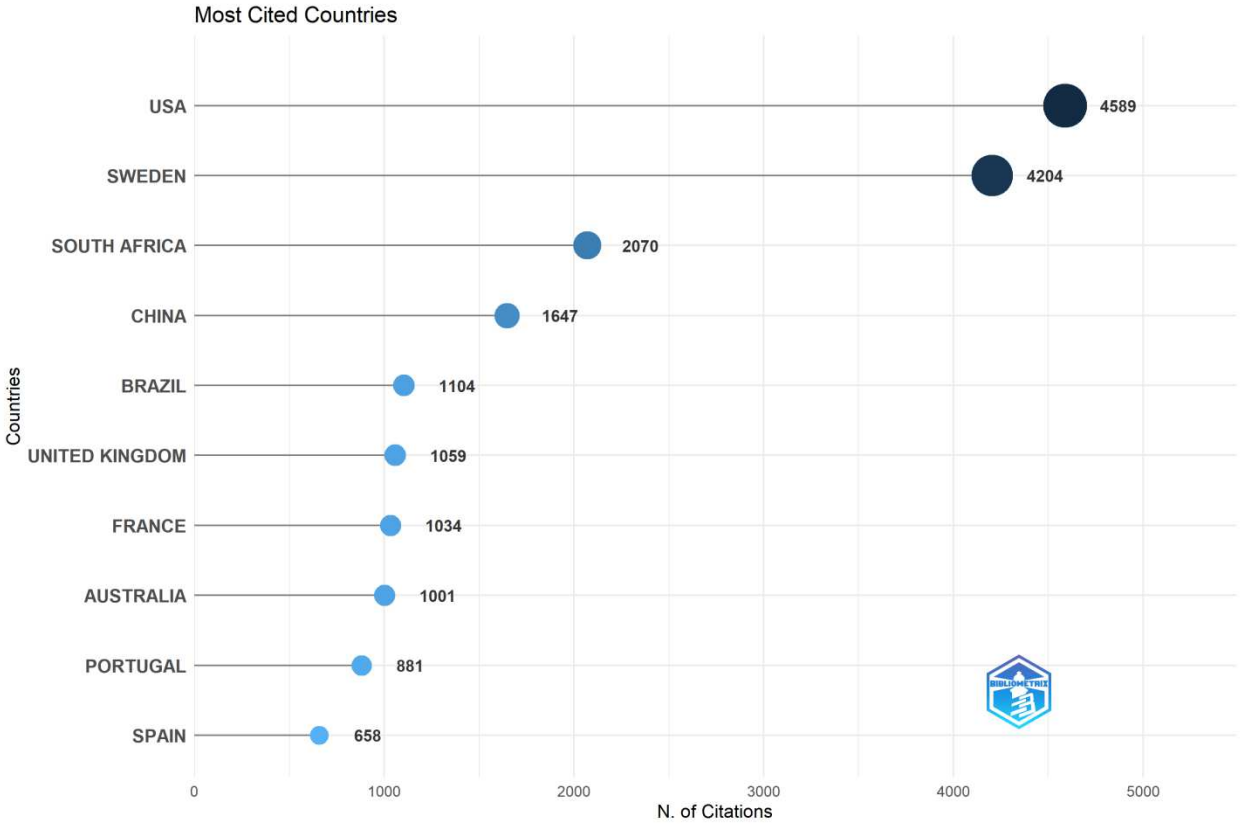


Figure 4. Top 10 most influential countries

Figure 4 shows the author productivity results that suggest a landscape that requires careful distinction

The author productivity results suggest a research landscape that requires careful distinction between individual productivity and collective knowledge production. The reported Lotka's Law model (Figure 10), characterized by a substantially flatter exponent than the conventional theoretical distribution, indicates that authorship may be more broadly distributed across contributors than would be expected under a strongly concentrated productivity structure. This pattern is consistent with a research domain in which participation is distributed across multiple research teams rather than being sustained exclusively by a small group of highly prolific authors. The reported goodness-of-fit statistics indicate that the fitted model describes the observed distribution well; however, the departure of the estimated exponent from the conventional theoretical value suggests that the underlying author productivity structure is atypical. This finding is particularly relevant when considered alongside the high average number of co-authors per document and the substantial international co-authorship rate. Together, these indicators suggest that the development of poultry-associated AMR research involves broad participation and collaborative knowledge production.

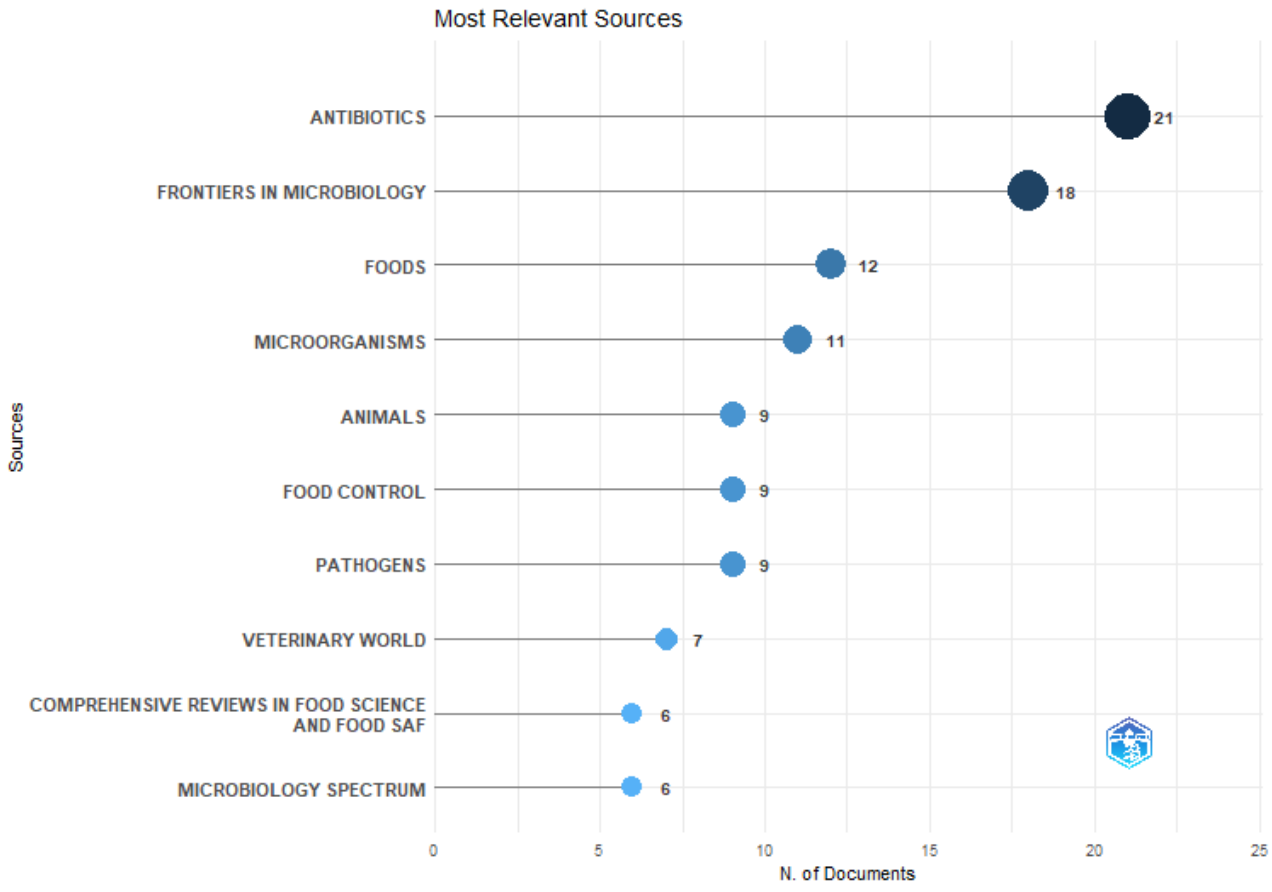


Figure 5. Top 10 Most Influential Sources

The figure 5 shows the most influential figure from the total documents used in the journal

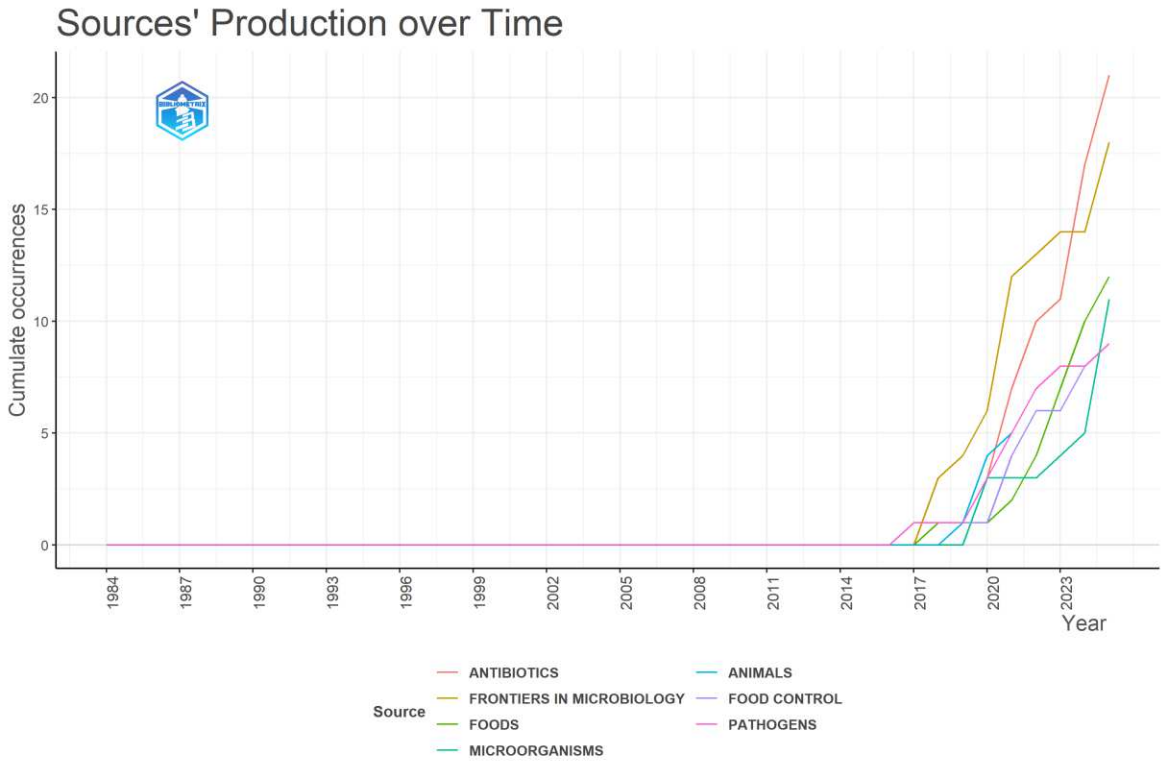


Figure 6. Sources Production Over Time

Figure 6 examined the various production sources over time of the different journal publications used in the review

The Bradford's Law results indicate that the dissemination of research on AMR transmission in broiler chickens and poultry products follows a recognizable pattern of journal concentration. The identification of a relatively small nucleus of core journals, surrounded by progressively larger groups of secondary and peripheral publication outlets, suggests that scholarly communication in this field is anchored in a specialized group of journals while extending into a broader multidisciplinary publishing environment. This distribution is analytically significant because it indicates that the field does not rely exclusively on a single disciplinary publication community. Rather, its research findings circulate across microbiology, veterinary science, antimicrobial resistance, and food-safety-related outlets. The reported goodness of fit further supports the applicability of Bradfordian concentration to the observed journal distribution. When considered alongside the reported acceleration in publication activity within specialized journals after 2017–2018, the findings suggest an increasingly identifiable publication infrastructure for this research area. However, journal concentration should not be interpreted as evidence that peripheral journals publish scientifically inferior research. Bradford's Law describes the distribution of publications across sources, not the relative quality or methodological rigor of individual journals or articles.

Table 4. Top 6 Most Relevant Authors

ABBASSI, MOHAMED SALAH	449	74.83333333
BADI, SOUHIR	449	74.83333333
HYNDS, PAUL	449	74.83333333
LENGLIZ, SANA	449	74.83333333
MANSOURI, RIADH	449	74.83333333
SALAH, HAMMAMI	449	74.83333333
	2	2

Table 4 examined the most relevant authors and their contributions to the study, it shows that Abbassi, Mohamed Salah, Badi Souhir, Hynds Paul, Lengliz Sana, Mansouri Riadh and Salah Hammami showed 449 total citations.

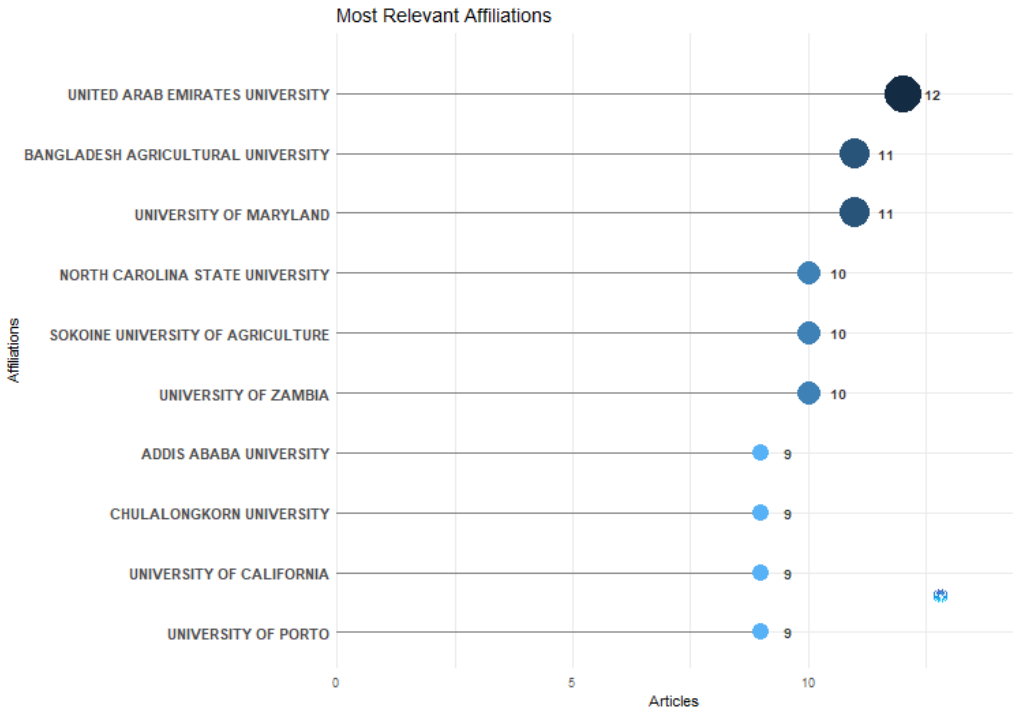


Figure 7. Top 10 Most Relevant Affiliations

Figure 7 examines the most relevant affiliations related to the different studies, it shows that United Arab Emirates University was among the top affiliations used by the study while the least is the University of Porto. .

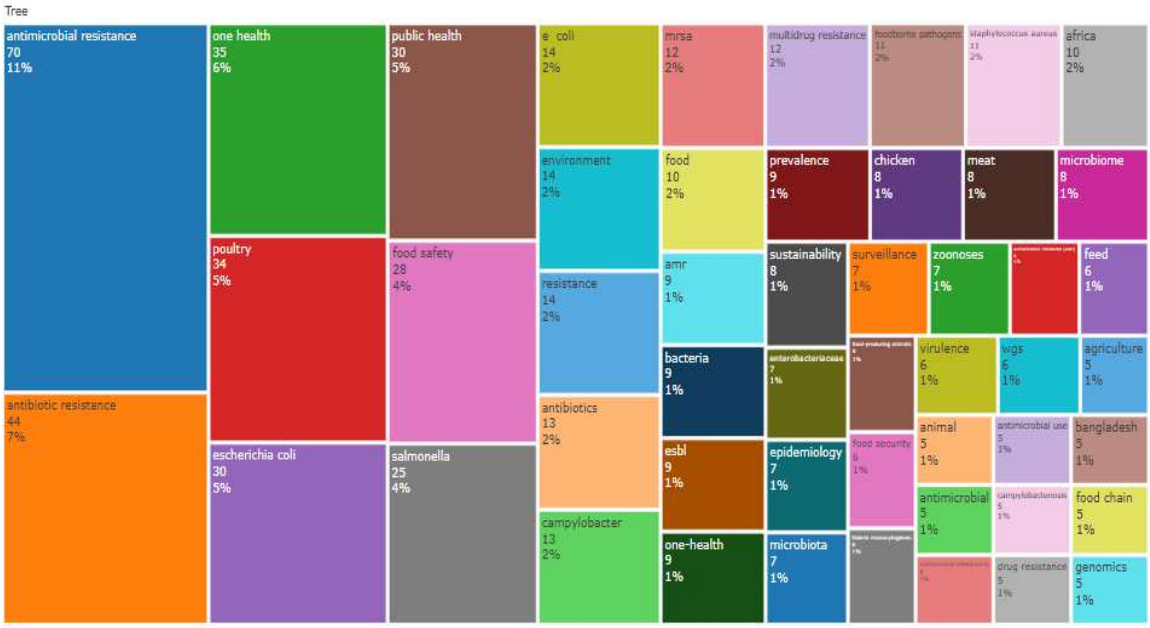


Figure 8. Tree Map

Figure 8. shows the keyword-based conceptual structure intended to reveal the principal subject areas on AMR transmission in poultry and poultry products.

The keyword-based conceptual structure is intended to reveal the principal subject areas organizing research on AMR transmission in poultry and poultry products. In this analysis, the relative prominence and grouping of keywords are important because they can indicate whether the literature is predominantly organized around microbiological characterization, antimicrobial resistance mechanisms, poultry production, food contamination, or broader public-health and surveillance concerns. The relationships among these terms would also help establish whether the research domain is conceptually concentrated around poultry-associated resistance or increasingly connected to interdisciplinary One Health perspectives. However, the supplied manuscript contains the Figure 8 caption without a readable representation of the TreeMap or its keyword frequencies. Consequently, the specific dominant terms, their relative prominence, and the relationships among conceptual categories cannot yet be established reliably. A substantive interpretation of the conceptual structure would require the actual figure or its underlying keyword-frequency results.

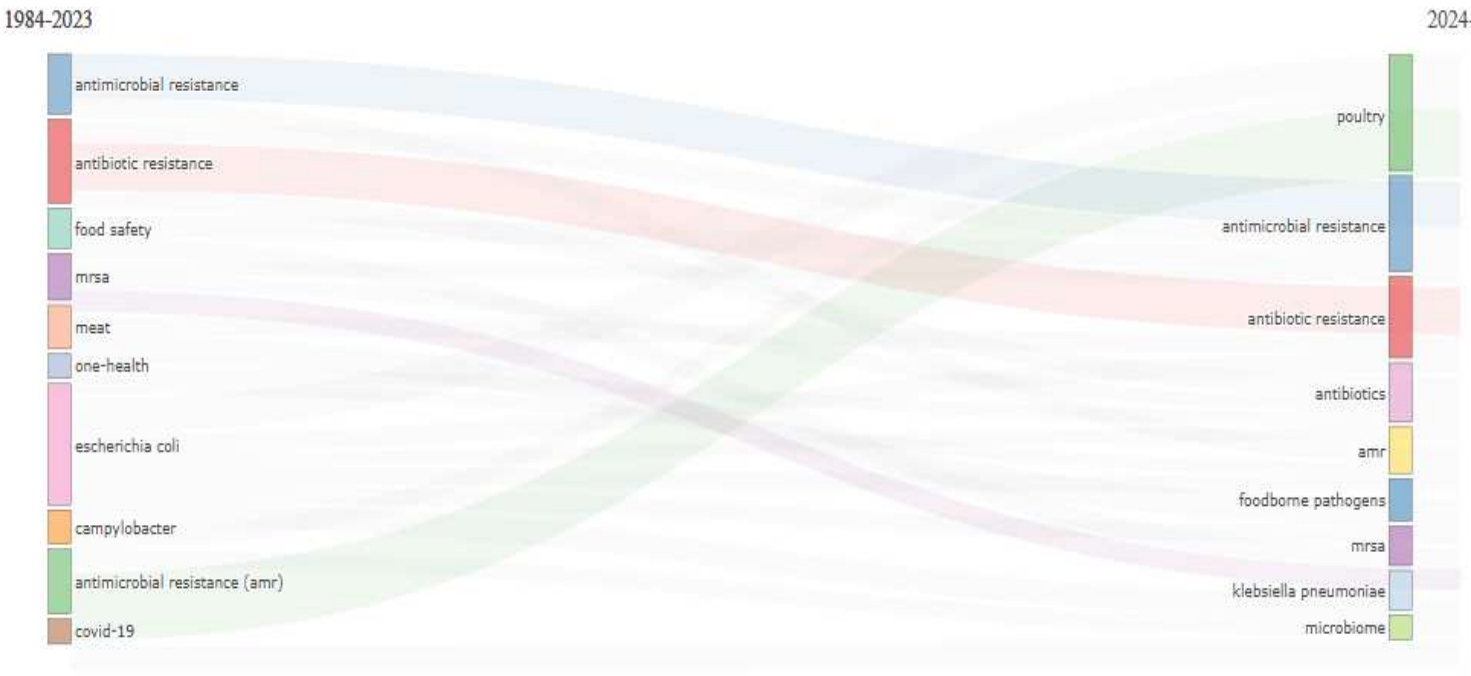


Figure 9. Thematic Evolution

Figure 9. shows thematic evolution analysis to distinguish research concerns from different topics that have emerged.

The thematic evolution analysis provides an important opportunity to distinguish persistent research concerns from topics that have emerged or gained visibility during the development of the field. Its principal analytical value lies in identifying whether contemporary investigations represent the continuation of established research streams or a reorganization of the literature around additional scientific priorities. In the context of poultry-associated AMR, the relationships among microbiological characterization, resistance determinants, antimicrobial usage, food safety, genomic surveillance, and One Health concepts would be particularly relevant to understanding the evolution of the research agenda. Nevertheless, the thematic evolution diagram itself is not sufficiently visible in the supplied document to establish which themes persisted, disappeared, merged, or emerged across the analyzed periods. Assigning specific temporal transitions without examining the actual thematic connections would risk introducing interpretations that are not supported by the available evidence.

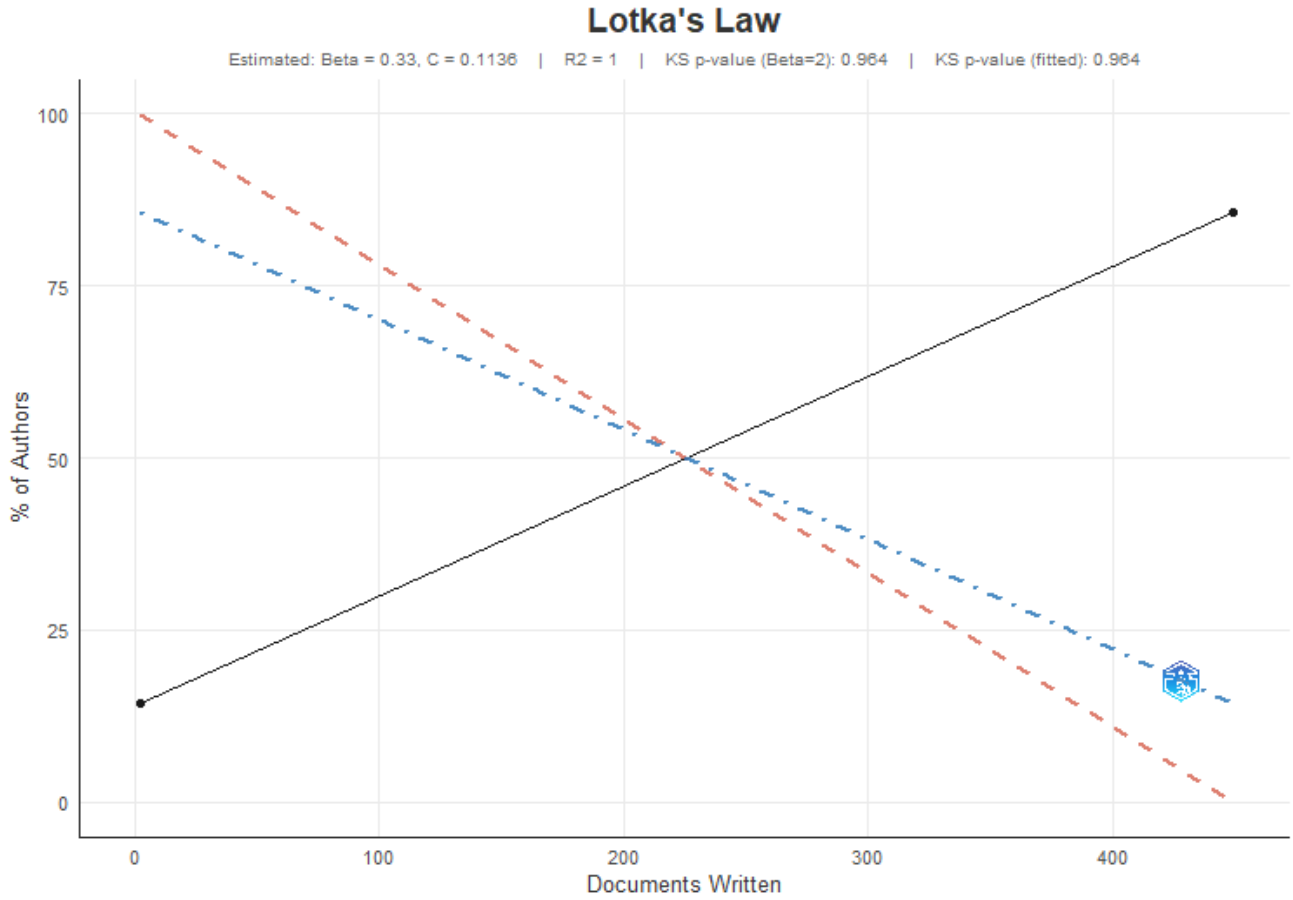


Figure 10. Lotkas Law

Author productivity exhibits a striking divergence from classic bibliometric empirical norms. The fitted Lotka's Law model demonstrates a flattened exponent (beta = 0.33, C = 0.1136) and high goodness-of-fit (R^2 = 1; Kolmogorov–Smirnov test p = 0.964), reflecting a substantial deviation from the theoretical power-law distribution (beta = 2.0) where a small minority of authors generate the vast majority of literature. This structural departure indicates that publication output is broadly distributed across a large, highly collaborative pool of transient or occasional contributors rather than dominated by a fixed cadre of prolific individual scholars.

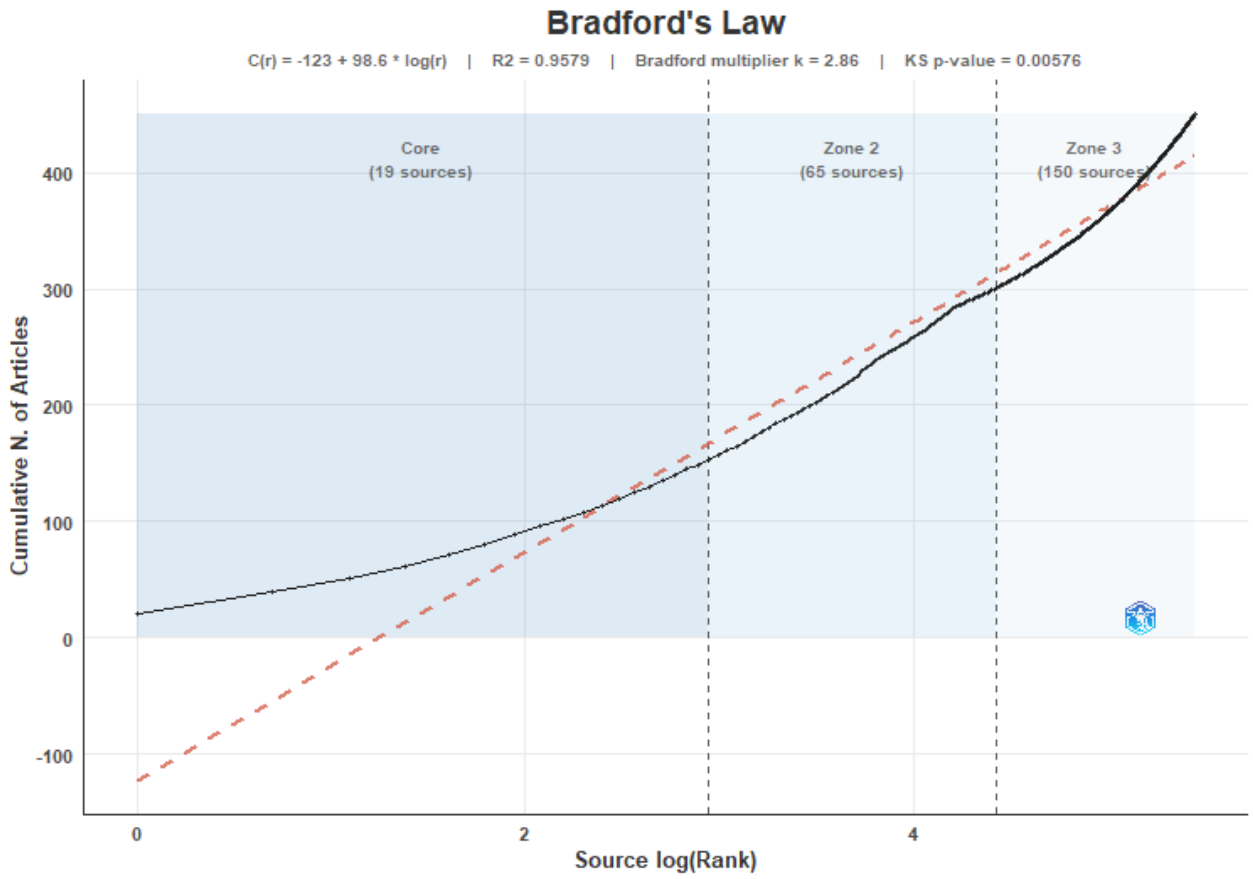


Figure 11. Bradford's Law

Figure 11 shows journal dispersion aligns closely with core Bradfordian concentration principles

Conversely, journal dispersion aligns closely with core Bradfordian concentration principles (R^2 = 0.9579; Bradford multiplier k = 2.86). The literature is anchored by a specialized nucleus of 19 core journals (Zone 1), followed by 65 secondary sources (Zone 2) and 150 peripheral outlets (Zone 3). Source growth trajectories demonstrate that key specialized journals—predominantly Antibiotics, Frontiers in Microbiology, Foods, and Microorganisms—experienced exponential cumulative publication acceleration starting around 2017–2018. This transition reflects the recent consolidation of AMR poultry research into dedicated open-access microbiological, veterinary, and food-safety vehicles.

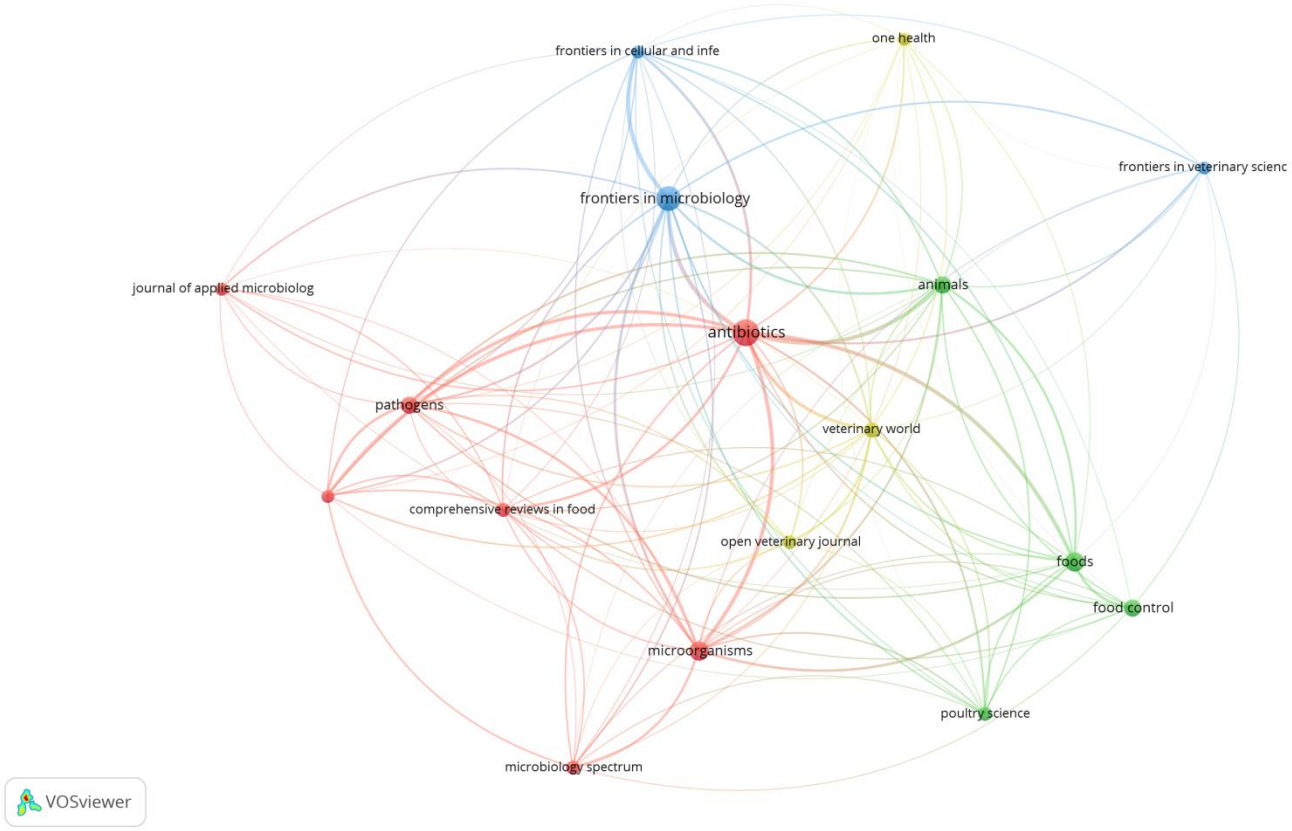


Figure 12. Fractional counting of sources using network visualization

Figure 12 illustrates the source-level collaboration structure using fractional counting, providing insight into how scholarly contributions are distributed across journals and how these sources are connected within the research landscape on antimicrobial resistance transmission in broiler chickens and poultry products. In contrast to full counting, which assigns the entire publication contribution to each participating source or entity, fractional counting adjusts the contribution according to the number of participating entities. This approach helps reduce the disproportionate influence of publications involving multiple contributors and provides a more balanced representation of source contributions. The network visualization further enables the examination of relationships among sources, highlighting the extent to which journals are connected through shared scholarly contributions or the relationships represented by the specific network configuration. Such connections may indicate overlapping research interests and the circulation of related scientific knowledge across publication outlets. In the context of this study, the visualization complements the Bradford's Law analysis by moving beyond the identification of core and peripheral journals to examine the relationships within the source landscape. It therefore provides a broader understanding of how research on poultry-associated antimicrobial resistance is disseminated across different scholarly outlets. Nevertheless, fractional counting reflects a method of allocating bibliographic contributions rather than the scientific quality, influence, or practical relevance of individual journals.

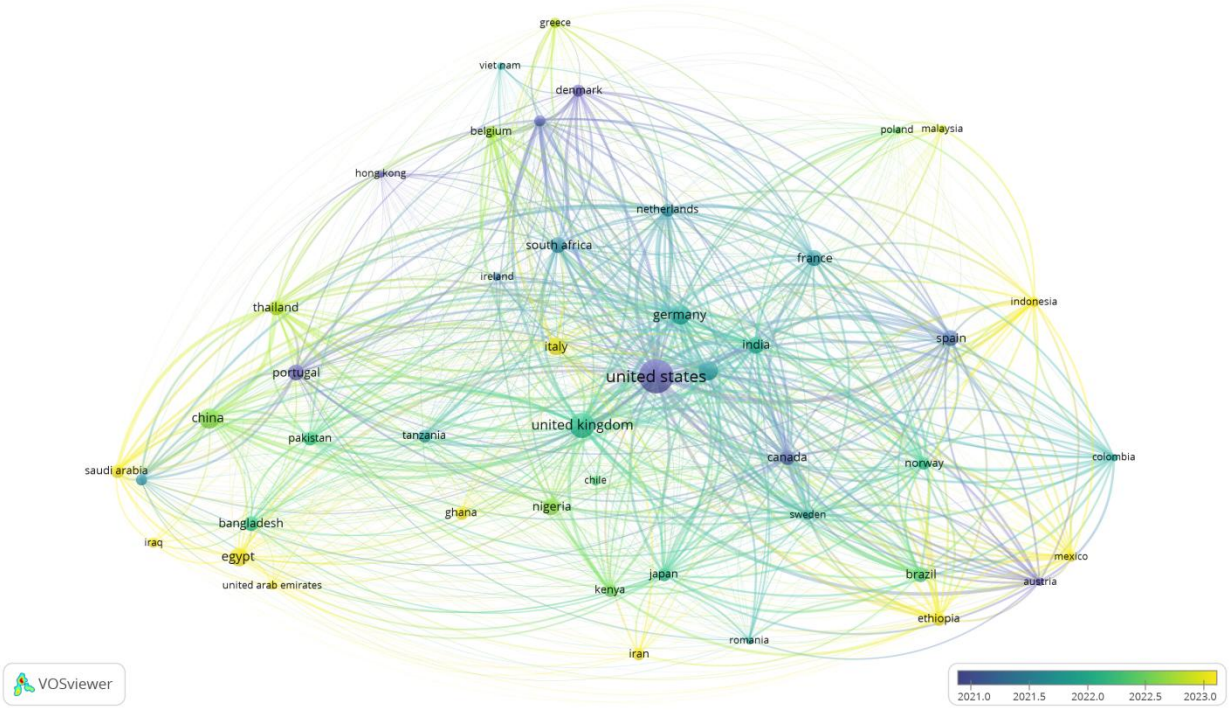


Figure 13. Overlay Visualization per Countries

Figure 13 presents the country-level overlay visualization, providing a complementary perspective on the geographical distribution of research activity and the relationships among countries within the literature on antimicrobial resistance transmission in broiler chickens and poultry products. Unlike the citation-based country rankings, which primarily indicate the volume of scholarly output and accumulated citation influence, the overlay visualization illustrates the connections among countries and the temporal dimension of their research contributions. The links between countries represent bibliographic collaboration or co-authorship relationships, while the overlay colors indicate the relative timing of their contributions, according to the visualization's color scale. This distinction is important because a country's high publication or citation count does not necessarily correspond to a central position in the international collaboration network. Rather, the visualization helps identify whether research activity is distributed across interconnected national groups or concentrated within a smaller number of collaborative clusters. In this context, the country-level network provides insight into the international organization of research on poultry-associated antimicrobial resistance and the extent to which national research communities are connected. However, these bibliographic relationships should be interpreted as evidence of scholarly collaboration, not as direct evidence of cross-border pathogen transmission, coordinated surveillance, or harmonized antimicrobial-resistance policies.

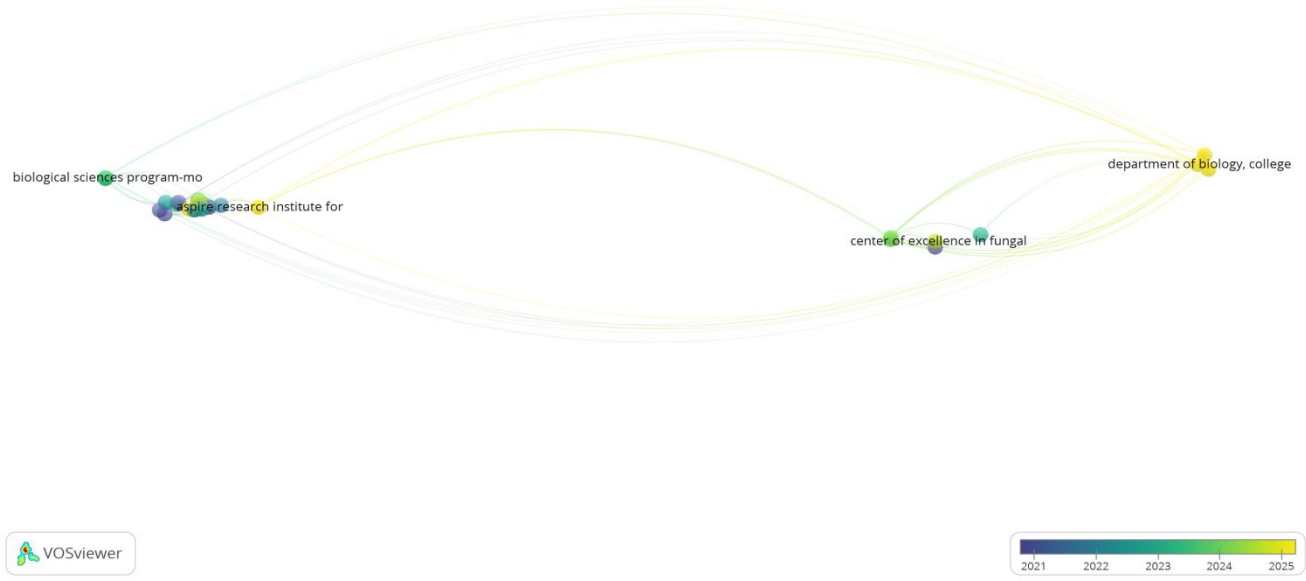


Figure 14. Overlay Visualization per Organization

Figure 14 extends the network analysis to the institutional level, illustrating the relationships among organizations contributing to research on antimicrobial resistance transmission in broiler chickens and poultry products. This perspective is particularly relevant because institutional collaboration can connect complementary research capacities, including microbiology, veterinary medicine, public health, and related disciplines. The links among organizations indicate the presence of collaborative publication relationships, whereas the overlay colors provide a temporal perspective on institutional research activity. The visualization therefore allows the institutional structure of the field to be considered beyond the citation rankings presented in Table 3. In particular, highly cited organizations are not necessarily those occupying the most central positions in the collaboration network; citation influence and network connectivity represent distinct dimensions of scholarly contribution. The institutional network can consequently help reveal whether research activity is organized around a limited number of well-connected institutions or distributed across multiple collaborative groups. Nevertheless, the presence of institutional links should not automatically be interpreted as evidence of formal research partnerships, shared laboratory infrastructure, or coordinated surveillance activities. Instead, the figure reflects collaboration as documented through co-authored publications and provides an indication of the institutional connectivity of the research field.

IV. DISCUSSIONS

4.1. Growth and development of research on antimicrobial resistance in broiler chickens and poultry products

The bibliometric findings demonstrate a sustained expansion of scholarly research on antimicrobial resistance (AMR) in broiler chickens and poultry products. The final Scopus dataset comprised 451 publications distributed across 234 sources over the period 1984–2025. An annual publication growth rate of 12.07% indicates that research activity in this area has increased considerably over the study period. This development reflects the growing scholarly attention given to antimicrobial resistance within poultry production, food safety, veterinary medicine, and public health. The increasing number of publications also suggests that poultry-associated AMR has become an established area of interdisciplinary research.

The composition of the dataset, comprising 262 research articles and 189 review papers, is particularly relevant when interpreting this growth. Research articles provide primary evidence and report empirical investigations, whereas review papers consolidate existing knowledge, identify recurring research concerns, and highlight areas requiring further investigation. The substantial representation of both document types suggests that the field has developed through the combined contributions of empirical research and scholarly synthesis. Nevertheless, differences in publication and citation practices between articles and reviews should be considered when interpreting overall citation performance.

The average document age of 4.54 years further indicates that a considerable proportion of the retrieved literature is relatively recent. This is consistent with the observed expansion of publication activity, although the precise timing and causes of this growth cannot be established through bibliometric indicators alone. The Gaussian publication curve, which produced an estimated peak around 2033 at approximately 303 publications per year, should likewise be interpreted as a model-dependent extrapolation based on the observed publication pattern. It is not a definitive forecast of future research output, since publication trends may be influenced by changes in research funding, scientific priorities, policy developments, database coverage, and other factors.

The citation pattern provides an additional perspective on the development of the field. The average citation count was 67.98 per document, indicating substantial scholarly visibility within the retrieved corpus. However, citation accumulation is strongly influenced by publication age, document type, and the length of time a publication has been available for citation. The relatively high citation activity observed for publications from 2008–2013, followed by lower citations per article per year among more recent publications, should therefore not automatically be interpreted as a decline in research relevance. Recent publications have had less time to accumulate citations. The findings instead illustrate the importance of considering citation windows and publication age when comparing scholarly influence across different periods.

4.2. Geographical distribution and international research contributions

The country-level findings reveal an uneven distribution of research productivity and citation impact. The United States ranked first in publication output, with 87 documents and 11,576 citations, followed by the United Kingdom, with 49 documents and 6,469 citations. These results indicate the substantial contribution of both countries to the indexed literature on AMR in broiler chickens and poultry products. Their leading positions in total publications and citations suggest established scholarly participation in this research area.

However, total citation counts alone do not fully reflect the citation intensity of a country's research output. When citations are considered relative to publication volume, several countries demonstrate comparatively high citation averages. Sweden recorded 536.4 citations per document, Switzerland 414.4, South Africa 324.7, Pakistan 316.9, and Tanzania 314.4. These values are higher than those of the United States and the United Kingdom, despite their smaller publication outputs. This distinction illustrates that research productivity and citation impact represent different dimensions of scholarly contribution.

The relatively high citation averages observed for countries with fewer publications should be interpreted cautiously. A small number of highly cited publications can substantially influence a country's average, and citation counts may also reflect international collaboration, publication age, document type, and the visibility of particular research topics. Consequently, these indicators should not be used as direct measures of national research quality or research capacity.

The participation of countries from different geographical regions, including South Africa, India, Pakistan, Tanzania, and Thailand, is also important. Their presence in the leading country results demonstrates that research on poultry-associated AMR is not restricted to a small group of high-output countries. It includes contributions from regions with different poultry production systems, research environments, and public health priorities. Nevertheless, publication and citation indicators cannot establish the extent of AMR occurrence or transmission in individual countries. Rather, they describe the distribution and scholarly visibility of research indexed in Scopus.

International co-authorship accounted for 45.68% of the retrieved publications. This finding indicates a substantial international dimension to research collaboration, although it also shows that not all publications involved authors from different countries. Given the transboundary relevance of antimicrobial resistance and the interconnectedness of food production and distribution systems, international collaboration can support the exchange of research methods, surveillance approaches, and scientific evidence. Continued collaboration may be particularly valuable for improving comparability among studies and strengthening research addressing AMR across different poultry production settings.

4.3. Institutional contributions and the concentration of research activity

The institutional citation results show that scholarly influence is concentrated among a relatively small number of institutions. The Department of Microbiology in Pakistan recorded 622 citations, followed by the School of Veterinary Medicine in Ethiopia, with 343 citations. Together, these

two institutions accounted for 965 of the 1,783 citations recorded by the ten leading institutions, representing approximately 54.1% of the top-ten citation total.

This concentration suggests that a limited number of institutional contributors have had substantial citation visibility within the retrieved literature. The presence of institutions from Pakistan, Ethiopia, the United Kingdom, Kenya, Thailand, Bangladesh, and Nigeria also demonstrates the geographical diversity of institutional contributions. In particular, the appearance of institutions associated with veterinary medicine, microbiology, infection research, and international agricultural research reflects the interdisciplinary nature of poultry-associated AMR research.

The contributions of institutions such as the International Livestock Research Institute (ILRI), the London School of Hygiene and Tropical Medicine, and the National Microbiology Laboratory of Canada further illustrate the involvement of organizations working across veterinary, agricultural, microbiological, and public health research areas. This institutional diversity is consistent with the One Health perspective, which recognizes the interdependence of human, animal, and environmental health.

Nevertheless, institutional citation counts should be interpreted as indicators of bibliographic visibility rather than direct measures of institutional performance. Differences in publication volume, author affiliation practices, institutional name variants, and collaboration patterns can influence institutional rankings. Moreover, the presence of multiple institutions in the same research area does not, by itself, demonstrate formal institutional partnerships. The institutional findings are therefore best understood as a description of the organizations represented in the retrieved publications and their associated citation records.

4.4. Authorship patterns and the structure of scholarly contributions

The authorship indicators suggest that research on AMR in broiler chickens and poultry products is predominantly collaborative. The reported average of 5.98 co-authors per document and the presence of 45.68% international co-authorship indicate that the field relies substantially on multi-author research and cross-country contributions. Such collaboration is relevant to a research area that draws on microbiology, veterinary medicine, epidemiology, food science, molecular biology, and public health.

The Lotka's Law analysis provides an additional perspective on the distribution of author productivity. The reported parameters were $\beta = 0.33$, $C = 0.1136$, $R^2 = 1.00$, and a Kolmogorov–Smirnov p-value of 0.964. These results describe the fitted author-productivity distribution within the dataset. However, the estimated parameter values and goodness-of-fit statistics should be interpreted in relation to the model specification, author disambiguation, and completeness of the authorship data. In particular, the reported author count in Table 1 requires verification because it appears inconsistent with the total number of publications and the reported average number of co-authors per document. Therefore, the Lotka analysis should be treated as provisional until the author records and underlying calculations have been checked.

This data-quality consideration is important because bibliometric interpretations of authorship depend on accurate identification of individual contributors. Variations in author names, initials,

spelling, and institutional affiliations can lead to incomplete or duplicated author records. A verified author dataset would provide a stronger basis for identifying highly productive researchers and examining the distribution of scholarly contributions.

4.5. Journal distribution and the dissemination of research

The Bradford's Law analysis indicates that publications on AMR in broiler chickens and poultry products are distributed unevenly across the 234 sources. The analysis identified 19 core sources, 65 secondary sources, and 150 peripheral sources, with a Bradford multiplier of 2.86 and an R^2 value of 0.9579. This pattern suggests that a relatively small group of journals accounts for a substantial concentration of publications, while the remaining literature is dispersed across a larger number of sources.

The presence of journals such as *Antibiotics*, *Frontiers in Microbiology*, *Foods*, and *Microorganisms* among the prominent sources reflects the interdisciplinary character of the subject. These publication outlets provide platforms for research related to antimicrobial agents, microbial resistance, food safety, and microbiological investigation. Their increasing activity around 2017–2018, as indicated by the source trends, is consistent with the broader expansion of scholarly attention observed in the publication dataset.

The identification of core journals has practical implications for researchers seeking relevant literature and selecting appropriate publication outlets. It can also assist librarians and research institutions in identifying journals that contribute substantially to this specialized field. However, the classification of a journal as a core source reflects its publication contribution within the defined dataset, not necessarily its overall scientific quality or influence across all research disciplines.

4.6. Intellectual and thematic structure of the research field

The science-mapping results provide a complementary view of the knowledge structure underlying research on AMR in broiler chickens and poultry products. The three-field plot connects cited references, authors, and merged keywords, thereby illustrating bibliographic relationships among influential references, contributing researchers, and recurring research themes. Such relationships help identify how the literature is organized and which concepts appear together within the retrieved publications.

The connections among cited references, authors, and keywords indicate the presence of an interconnected knowledge base in which established research contributions are associated with recurring themes in poultry-associated AMR. The prominence of surveillance, microbiological characterization, genomics, and One Health-related concepts in the manuscript's thematic interpretation suggests that the research area draws on both pathogen-focused investigation and broader approaches to understanding antimicrobial resistance across connected health sectors.

These relationships should nevertheless be interpreted as bibliographic associations. A co-occurrence of keywords or a connection between authors and cited references does not establish

that the corresponding studies investigated the same biological transmission pathway. Similarly, the presence of terms associated with One Health does not necessarily mean that a publication examined all relevant human, animal, and environmental components. The science maps therefore describe the conceptual and intellectual organization of the indexed literature rather than providing direct evidence of AMR transmission between poultry, food products, humans, or the environment.

The country and institutional overlay visualizations further provide a framework for examining the geographical and organizational distribution of research activity. They can help identify the countries and institutions represented in the bibliographic network and their relative positions within the mapped research landscape. However, the interpretation of specific clusters, collaboration strengths, or temporal shifts requires examination of the actual network images and underlying bibliographic data. Accordingly, these visualizations should be discussed in terms of the relationships they demonstrably represent, rather than being used to infer unverified research partnerships or biological connections.

Taken together, the performance and science-mapping results show that research on poultry-associated AMR has developed into a growing, internationally connected, and interdisciplinary area of scholarship. Its publication structure is characterized by contributions from multiple countries and institutions, a concentration of output in a relatively small group of journals, and a broad bibliographic knowledge base. These characteristics provide a foundation for future research that integrates microbiological investigation, surveillance, food safety, and One Health perspectives.

4.7. Implications, limitations, and directions for future research

The findings have several implications for the future development of research on AMR in broiler chickens and poultry products. First, the observed growth in publications highlights the continuing relevance of this subject and the need for research that addresses both the microbiological characteristics of resistant organisms and their implications for poultry production and food safety. Second, the international distribution of research contributions and the substantial proportion of internationally co-authored publications suggest opportunities to strengthen cross-country research initiatives, particularly those that improve the comparability of surveillance methods and reporting practices.

Third, the institutional and journal findings provide a useful overview of the organizations and publication outlets represented in the field. These results may help researchers identify established sources of literature and potential areas for scholarly engagement. Finally, the thematic relationships identified through science mapping suggest that future investigations may benefit from stronger integration of veterinary, microbiological, epidemiological, and public health approaches.

Several limitations should be considered when interpreting the results. The study relied on Scopus-indexed records and therefore represents the literature retrieved from that database rather than the complete global body of research on poultry-associated AMR. Publications indexed in other databases, non-indexed journals, reports, and other forms of grey literature may not be represented.

The findings are also dependent on the search strategy, the selected publication period, and the document types retained in the final dataset.

Furthermore, citation indicators are influenced by publication age, document type, citation practices, and the visibility of individual publications. Country and institutional rankings may be affected by affiliation assignment and variations in institutional naming. The apparent inconsistency in the author count and the identical metrics reported for several authors in Table 4 also require correction before the authorship and productivity results can be regarded as definitive. These issues should be addressed through verification of the original Scopus export and the calculations used to generate the tables.

Finally, bibliometric and scientometric techniques characterize scholarly production, citation relationships, and thematic associations. They do not directly measure the prevalence of antimicrobial resistance, establish the direction of transmission, or demonstrate the movement of resistant bacteria or resistance genes through poultry production and food chains. The findings should therefore be interpreted as a map of the scientific literature rather than as epidemiological evidence. Future studies could complement this bibliometric overview with systematic reviews, meta-analyses, and primary surveillance investigations to examine the occurrence, determinants, and potential transmission pathways of AMR in broiler chickens and poultry products.

v. CONCLUSION

This study provides a bibliometric and scientometric overview of global research on antimicrobial resistance in broiler chickens and poultry products based on 451 Scopus-indexed publications from 1984 to 2025. The findings demonstrate sustained growth in scholarly output, with an annual publication growth rate of 12.07%, an average of 67.98 citations per document, and contributions distributed across 234 publication sources. The retrieved literature comprised both research articles and review papers, reflecting the combined role of empirical investigation and scholarly synthesis in the development of this research area.

The geographical analysis identified the United States and the United Kingdom as leading contributors in total publication output and citations, while several countries, including Sweden, Switzerland, South Africa, Pakistan, and Tanzania, demonstrated comparatively high average citations per document. Institutional contributions were concentrated among a limited number of highly cited organizations, while the international co-authorship rate of 45.68% highlighted the collaborative dimension of the field. The Bradford analysis further identified 19 core sources, demonstrating that a relatively small group of journals accounts for a concentrated share of the retrieved literature.

The science-mapping results provide an overview of the intellectual and thematic relationships connecting cited references, authors, and keywords. Together, these findings characterize poultry-associated AMR research as a growing and interdisciplinary area involving contributions from veterinary medicine, microbiology, food safety, and public health. They also provide a bibliographic basis for identifying established research themes, influential publication sources, and opportunities for further international and institutional collaboration.

Overall, this study establishes a structured overview of the development and organization of research on AMR in broiler chickens and poultry products. Its findings may assist researchers, institutions, and other stakeholders in understanding the scholarly landscape and identifying areas for future investigation. Further research should integrate bibliometric evidence with systematic assessments and empirical surveillance to better understand AMR occurrence and potential transmission pathways across poultry production and food systems. Importantly, the present findings describe patterns within the Scopus-indexed literature and do not independently establish the prevalence, direction, or mechanisms of antimicrobial resistance transmission.

Use of Generative-AI tools declaration

The author declares the use of Artificial Intelligence (AI) tools in the preparation of this article. AI tools used: SciSpace, Perplexity, and Grammarly. How the AI tools were used: SciSpace was used to support literature exploration and organization of the substantive mathematics-anxiety and bibliometric literature; Perplexity was used to help structure and refine the presentation of arguments; Grammarly was used for grammar and language editing. Where in the article this support is reflected: Primarily in the Literature Review, and in the organization and phrasing of the Methods and Discussion sections. After using these tools, the author carefully reviewed and edited all content and takes full responsibility for the final manuscript.

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Ethics Approval and Consent to Participate

This study is based on bibliometric analysis of published literature and publicly available bibliographic records. It did not involve human participants, human or animal subjects, or the collection of personal or sensitive data. Therefore, ethical approval and informed consent were not required.

Consent for Publication

Not applicable. This manuscript does not contain any individual person's identifiable data.

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