



## BIBLIOMETRIC ANALYSIS FOR USE OF TIME SERIES IN ANIMAL SCIENCE

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**Abstract:** In this study, bibliometric analysis was applied to time series, which has been widely used in animal science studies in recent years. In the method part of the study, a bibliometric analysis was carried out for time series commonly used in animal science studies. In the study is to determine the trends in recent years in the field of animal science, by examining 3895 studies with the term "time series" in the title of the article published within the scope of SCI-Expanded between 1980 and 2023, within the scope of bibliometric analysis. Statistical evaluations were calculated using the R software belonging to the "bibliometrix" package. All data were generated bibliographically from the WoS system in plain text format. Time series has been one of the most popular research areas due to its application in many different fields such as cell biology, plant sciences, zoology, animal science, etc. There are many authors' works in the field of time series. According to the analysis, a total of 3202 studies, such as articles, journals, books, etc. by 14154 authors, were published on time series in animal science. As a result of the analysis, in the 14154 authors, only 247 studies has been single authored documents of aforementioned topic. Time series in animal science examined within the scope of author's collaboration that there were 0.275 authors per document. This study aims to conduct bibliometric analysis to determine the importance of time series in the field of agriculture, the number of publications by year, annual publication increase, and distribution by country and number of articles by keywords. The analysis results will be an important contribution to both readers and researchers.

**Keywords:** Animal sciences, Time series, Bibliometric

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### 1. Introduction

The main purpose of statistics is to examine variables from different aspects and interpret the results of data obtained from observations. The arrangement or ordering of the data obtained from the observations, taking into account some features, is referred to as a series or series. If the data obtained from these observations express the changes or movements of a variable over time, these data are called time series or time series. In other words, time series is also expressed as a sequential observation series (Çanga et al., 2021; Güneş et al., 2022; Tırınk, 2022).

Time series data are numerical data in which variables are ordered sequentially from one period to another. The most practical and easiest way to analyze the structure of the event and create future predictions by using data on variables in periods obtained over a certain period of time is to analyze it with time series. Time series data are also expressed in subgroups as economic, biological, physical and time control type data (Karaokur et al., 2019; Sözeyatarlar et al., 2021; Cui et al., 2023).

Numerical analyzes and statistical analysis of scientific studies can be defined as Bibliometrics. Bibliometric methods apply a quantitative approach to the description, evaluation, and interpretation of previously

published research. Bibliometric analysis is one of the analysis methods used by researchers to interpret and evaluate research fields, countries, citation rates of publications or the number of journals. In bibliometric methods, researchers first discover the literature and show the researcher's work by presenting the most effective studies (Freire and Nicol, 2019; Donthu et al., 2021). In bibliometric analysis, it forms the number of articles in a certain time period and also shows how much the study influenced the studies done after it. The purpose of bibliometric methods is to obtain the findings of researchers and the collective bibliographic data produced by other researchers working in this field and to express the results through citation or writing. In addition, the bibliometric method is a research field that is gaining increasing attention in the scientific community and is determined by the rapid development of computers and the internet. The bibliometric method is a basic approach used to analyze research and is based on public library and information science (Persson et al., 2009; Merigó and Yang, 2017; Derviş, 2019; Han et al., 2020).

In this study, bibliometric analysis was applied to time series, which has been widely used in animal science studies in recent years (Mansioux and Carrot, 2012; Hotamışlı et al., 2014). In the method part of the study, a



bibliometric analysis was carried out for time series commonly used in animal science studies. All statistical evaluations were made using R software with the "bibliometrix" package (R Core Team, 2020). The data was bibliographically generated from the WoS system in plain text format. Then, the bibliographic data was converted into a data frame using the "convert2pdf" function with the "bibliometrix" package. Bibliometric analysis was performed by the biblioAnalysis function (Önder and Tırınk, 2022; Yavuz and Şahin, 2020). In this context, this article aims to conduct bibliometric, collaboration and co-citation analysis to determine the importance of Time series in animal science over the years.

**2. Materials and Methods**

Bibliometric analysis method was applied from the beginning of data collection to the interpretation of the analysis results. By applying the WoS database, a search was made for studies on Time series in the field of agriculture. During the data collection process, Web of Science (WoS) was searched with the keywords "animal sciences" and "agriculture". Information from 3895 agricultural field studies out of a total of 10072 studies conducted with time series between 1980 and 2023 was used as material (Olfaz et al., 2019; Öztürk and Kurutkan, 2020).

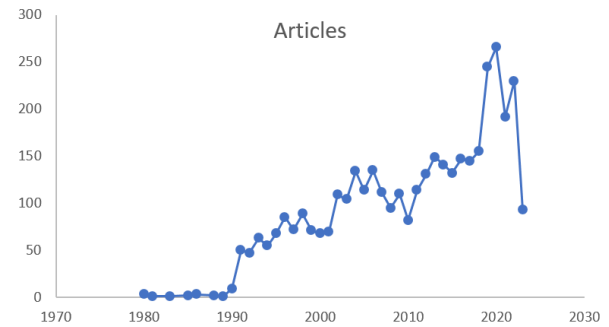
In the study, bibliometric analysis was applied to time series that have been widely used in agricultural studies in recent years. As a result of the analysis, statistical evaluations were calculated using the R software belonging to the "bibliometrix" package (R Core Team, 2020). All data were generated bibliographically from the WoS system in plain text format. The obtained data was then converted into data using the "convert2pdf" format with the "bibliometrix" package. Bibliometric analysis was implemented by the biblioAnalytics function. This study aims to conduct bibliometric analysis to determine the importance of time series in the field of agriculture, the number of publications by year, annual publication increase, distribution by country and number of articles by keywords (Aria and Cuccurulla, 2017; Yeksan and Akbaba, 2019; Sözeyatarlar et al., 2021).

**3. Results and Discussion**

There are many authors' works in the field of time series. According to the analysis, a total of 3202 studies, such as articles, journals, books, etc. by 14154 authors, were published on time series in animal science. In the 14154 authors, only 247 studies has been single authored documents of afromentioned topic. Time series in animal science examined within the scope of author's collaboration that there were 0.275 authors per document. The graphic of the number of publications in terms of yearly scientific output is given in Figure 1. According to Figure 1, while the number of time series studies in animal science was 3 in 1980 to 230 in 2022.

Thus, how much this subject has been used over the years can be seen.

General information on bibliographic data on time series in animal science is given in Table 1. According to Table 1, journals, books, etc. a total of 3895 studies have been published in some sources between 1980 and 2023.



**Figure 1.** Annual scientific production on time series in animal science.

**Table1.** The primary information of the data

Information	Number
Timespan	1980:2023
Documents	3895
Sources (Journals, Books, etc)	364
Average years from publication	8.31
Average citations per document	14.9
Average citations per year per document	1.148
Authors of single-authored documents	247
Documents per Author	0.275
Co-Authors per Documents	4.54
International co-authorships ( %)	15.94

A total of 21930 studies were utilized about the time series. However, 3895 studies were used about the time series in the animal science. Document types of 1293 studies related to time series in animal science are given in Table 2. According to Table 2, the most common form of publication related to time series is the article. Also in Table 2, is given book chapters, earlaccess studies, proceeding papers and reviews about time series in animal science.

**Table 2.** Document types for time series

Document Types	Number
Article	3202
Book chapter	26
Early access	23
Proceeding paper (Article)	133
Correction	3
Editorial material	7
Meeting abstract	11
Review	98
Proceeding paper	382

Table 3 provides information about which journals the published articles are published in about the time series

selection in animal science. In Table 3, the top 7 journals of the list were shared. According to Table 3, the researchers published 316 articles in the Javma-Journal of the American Veterinary Medical Association as the first chosen journal. The second journal was Journal of veterinary Medicine Series a-Physiology with the number of 210 articles. The third journal was Veterinary Surgery with number of 192 articles.

**Table 3.** The most published articles in journals

Sources	Number of Articles
Javma-Journal of the American Veterinary Medical Association	316
Journal of veterinary Medicine Series a-Physiology Pathology Clinical Medicine	210
Veterinary Surgery	192
Scientific Papers- Series D-Animal Science	180
Journal of Veterinary Medicine Series B-Infectious Diseases and Veterinary Public Health	148
Journal of Dairy Science Animals	123
	100

The countries that publish the most in the field of time series in animal science and the number of articles by country are given in Table 4. According to Table 4, the country with the most articles is the USA with 1028 articles. The country with the most articles after USA is United Kingdom with 227 articles.

**Table 4.** The corresponding author's countries and number of articles

Countries	Number of Articles
USA	1028
United Kingdom	227
Germany	202
Australia	173
Romania	160
China	153
Canada	129
Indonesia	127
Italy	112
Spain	90

The countries with the most citations in the field of time series in animal science and their number of citations are given in Table 5. According to Table 4, the country with the most citations is the USA with 21632 total citations.

Figure 2 shows the total number of citations per year for studies on time series in animal science in the years 1980-2022.

The keywords most preferred by authors in publications are given in Table 6. According to Table 6, time series expression was used as the 10 most preferred keywords. In addition, expressions such as horse, dog, canine, time series, cattle, sheep, epidemiology, animal welfare, dairy cow and pig have been used extensively.

**Table 5.** Total citations per country

Countries	Total Citations
USA	21632
United Kingdom	4107
Germany	2974
Canada	2525
Australia	2229
Italy	1844
Spain	1622
France	1490
Denmark	1467
China	1410

**Table 6.** The most chosen keywords for time series

Keywords	Total
Horse	114
Dog	84
Canine	70
Time series	59
Cattle	54
Sheep	52
Epidemiology	36
Animal welfare	35
Dairy cow	28
Pig	27

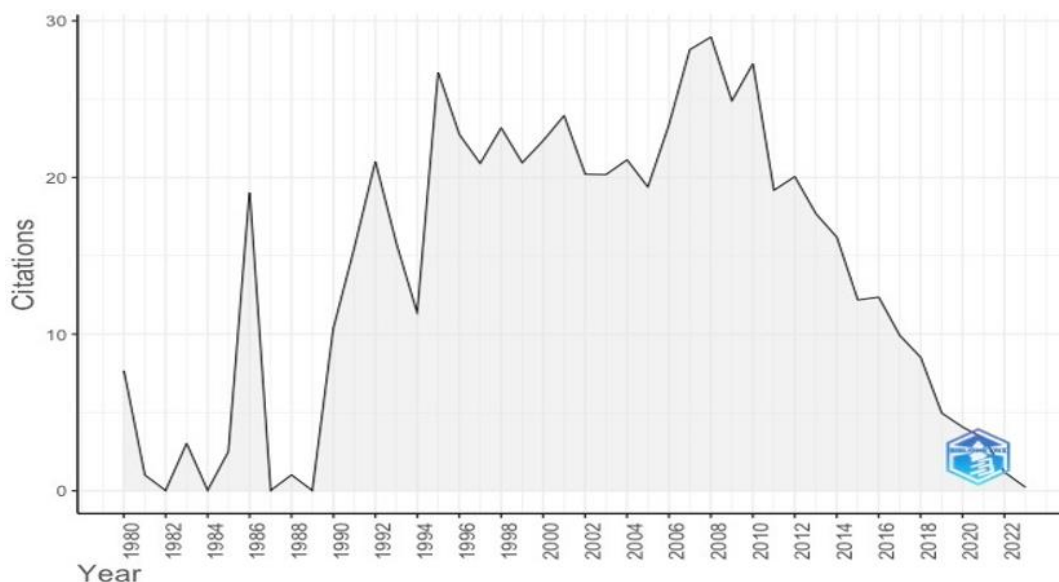


Figure 2. Average total citations per year for time series.

Table 7 shows the most leading authors for the time series researches. According to Table 7, the most leading author was Mayhew PD, Culp WTN and Kass PH, with 29, 25 and 23 articles about time series, respectively.

Figure 3 shows the authors' publications over time. According to Figure 3, studies in the field of time series were mostly carried out in the years 2012-2022.

Table 8 provides information on the most cited articles on time series. As a result of the bibliometric analysis made in this context, it was determined that the most citations were made to the article written by Marai IFM, published Small Ruminant Res in the journal in 2007 and article receives 29 citations in total. In addition total citation numbers of other journals are also given in the Table 8.

Figure 4 shows the common study network of studies on time series. Figure 5 shows the conceptual structure of the keywords used in studies in the field of time series. In the Figure, three clusters were formed according to the keywords used by the authors.

Table 7. The most productive authors for time series

Authors	Total
Mayhew PD	29
Culp WTN	25
Kass PH	23
Brown DC	19
Monnet E	19
Withrow SJ	19
Singh A	18
Selmic LE	17
Ward MP	17
Berent AC	16

Table 8. Top manuscripts per citations for time series

Paper	Total Citation
Marai IFM, Small Ruminant Res	29
Jacobson RH, Rev SCI Tech OIE	25
Sorensen DA, Genet Sel Evol	23
Lopez-Gatius F, Theriogenology	19
Lind TC, J Dairy SCI	19

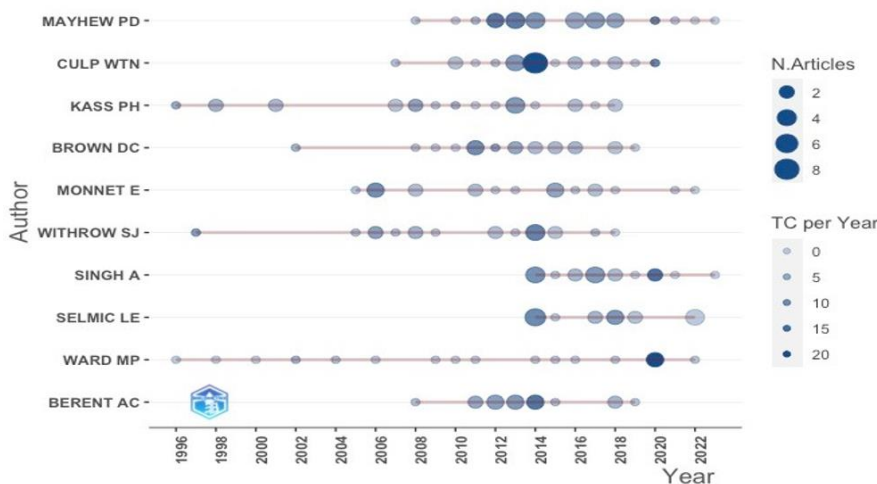


Figure 3. Authours publications over year.

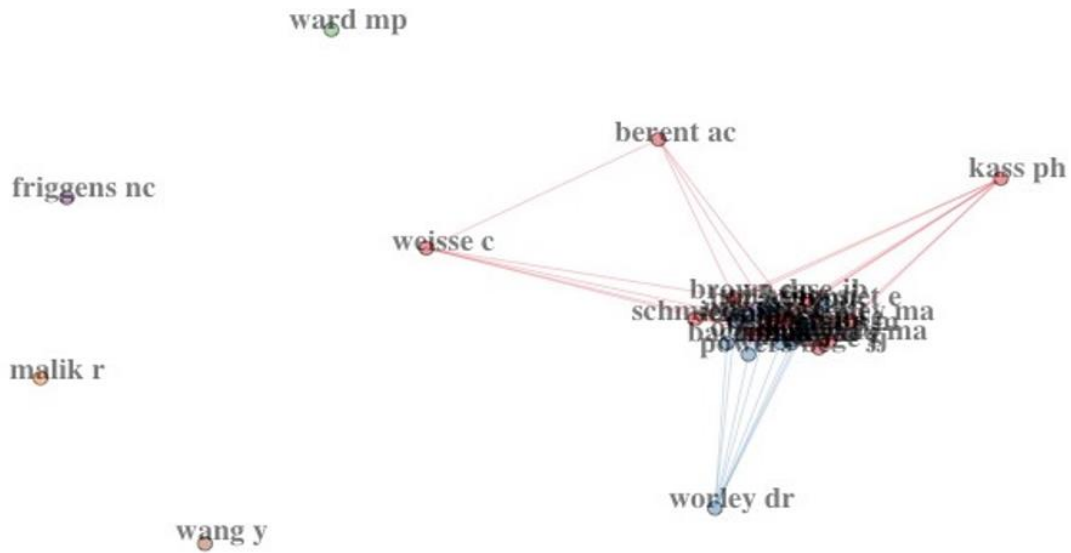


Figure 4. Collaboration for time series.

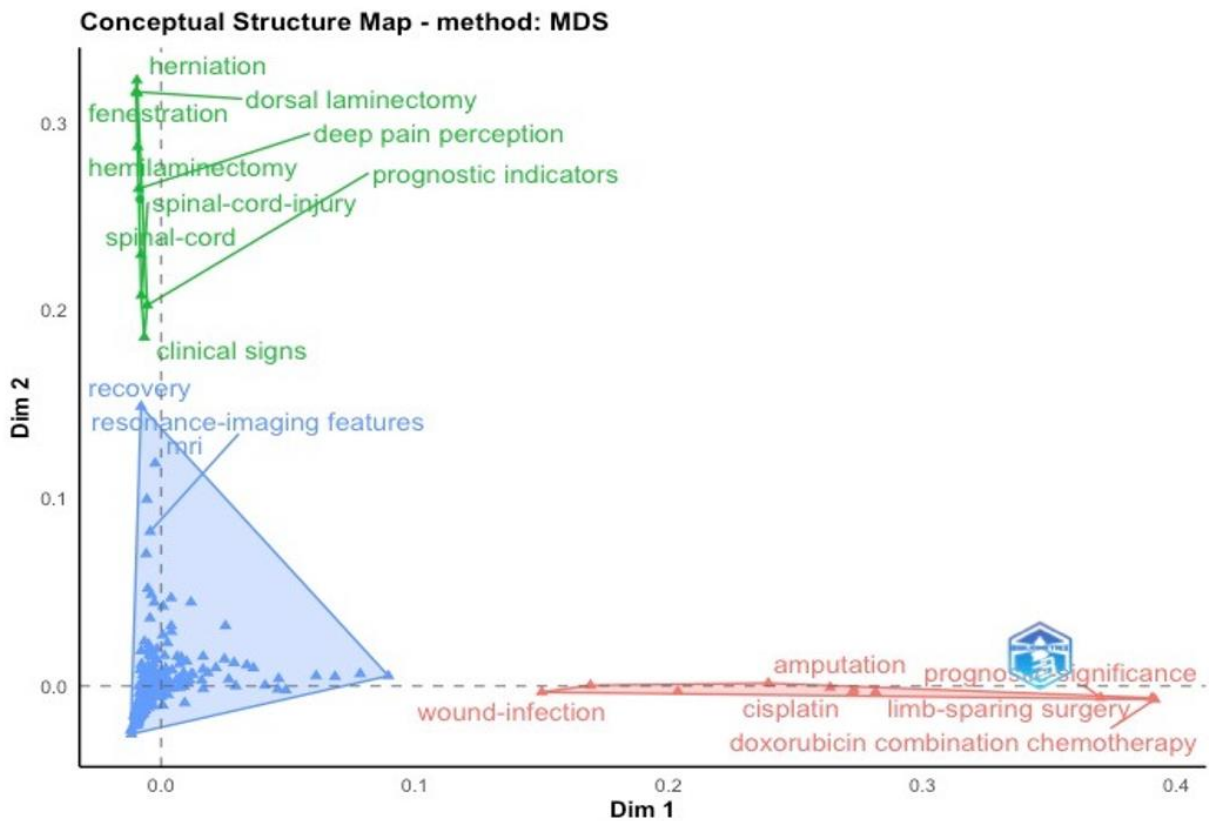


Figure 5. The conceptual structure for time series.

#### 4. Conclusion

In this research, publications in the field of time series in animal science were examined on the basis of document, source, author and country with bibliometric analysis management and prepared for readers and researchers to reach them in the shortest way. Only Web of Science (WOS) database was used in the study. Data from other databases were not taken into account. What has not been achieved? All statistical evaluations were made using R software with the “bibliometrix” package. The

depth of knowledge of the concept of time series, which always maintains its currency and importance, increases every year. With this study, the rich literature of time series management is presented to the reader by classifying, visualizing and interpreting in a way that will guide research.

Time series has been one of the most popular research areas due to its application in many different fields such as cell biology, plant sciences, zoology, animal science, etc. Especially in animal science, it is seen that there are

many studies on subjects such as meat quality, milk yield, gene expressions and reproduction, etc. Considering the distribution of 364 studies published between 1983 and 2023 on time series applications in animal science, it is seen that the most studies were done in 2020. In this context, the issue has not lost its importance and is a current issue.

In this context, as a result of the bibliometric analysis of time series in animal science, Journal of The American Veterinary Medical Association has the status of the journal with the most publications on this subject. Also, when the number of citations was examined, it was determined that the most effective author was Marai IFM. USA and United Kingdom stand out as the countries with the highest broadcasting rate.

In line with this information, it will be an important contribution that time series studies with bibliometric analysis are still up-to-date and that the studies to be done will increase their contribution to animal science. Additionally, this study facilitates the analysis of the literature by providing a holistic perspective on time series management. Researchers who will study or study on time series management will benefit from the results and have general information about the time series method.

#### Author Contributions

The percentage of the author contributions is presented below. The author reviewed and approved the final version of the manuscript.

	E.Y.
C	100
D	100
S	100
DCP	100
DAI	100
L	100
W	100
CR	100
SR	100
PM	100
FA	100

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

#### Conflict of Interest

The author declared that there is no conflict of interest.

#### Ethical Consideration

Ethics committee approval was not required for this study because of there was no study on animals or humans.

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