The bibliometric analysis of the studies conducted in the field of water buffalo breeding

Şenol Çelik

Department of Animal Sciences, Biometry and Genetics, Faculty of Agriculture, Bingol University, Bingol, Turkey

Summary. *Purpose:* The aim of the study is to examine nearly 500 studies published between the years 2013-2019 in the field of water buffalo breeding in bibliometric terms and to reveal the tendencies and trends in the field in recent years. *Methods:* A review has been performed on the titles "buffalo" in Web of Science Core Collection database and bibliometric data were accessed regarding the studies. The current issues regarding the concept of water buffalo breeding were revealed in order to contribute to the academicians and researchers studying on water buffalo breeding. *Results:* The studies were examined within the context of the number of publications by years, types of publication, reference analyses, country cooperation and common reference webs. In addition, social web analysis was used regarding the determination of references, authors and keywords and references, country and keywords tendencies. According to the results of the analysis, Theriogenology is the journal with the highest h index and g index values from the journal publishing in the field of buffalo breeding. The journal with the highest number of publications on water buffalo breeding is Buffalo Bulletin with 138 studies. The countries where the highest number of articles were written in this field were India, Brazil and Pakistan whereas the countries with the highest number of references were India, Italy and Pakistan. The authors with the highest number of articles were found to be Chakravarty AK, Baabr ME, Kumar S, Nadeem A and Kataria RS respectively. It was also determined that the journals mostly referred to were Theriogenology, J. Dairy Sci. and Anim. Reprod Sci. respectively. *Conclusion:* As a results, the increase in bibliometrics studies can provide an important contribution by serving as a lead to the studies conducted in the field of husbandry.

Key words: Buffalo, Bibliometrics, Social Network Analysis, citation

Introduction

Water buffalos are used for meat, dairy products and its skin by human beings for centuries. It is an appropriate breeding activity for extensive farming where the demand for organic products and organic breeding has increased in today's world (1). Buffaloes domesticated approximately 5000 years ago are grown in nearly 40 countries today (2). Water buffalos are powerful animals that are able to adapt to different environmental conditions and are resistant to diseases. They have a high ability to utilize roughages as well (3, 4).

Due to the use of the English term "Water Buffalo" in North America and Asia, the notion of buffalo is causing lack of communication in terms which animal is referred to. As the water buffalo meat and milk are rare and popular products, water buffalo raising is worth discussing in the scale of modern milk cow business. Even though water buffalos has the potential of raising suitable races for intense production conditions, there are still malnourishment, management and animal welfare issues in terms of the production (1).

Water buffalos are divided into two types as river and swamp buffalos. Swap buffalos (*Bubalus*

carabanesis) are found in China, Thailand, Philippines, Indonesia, Vietnam, Burma (Myanmar) Laos, Vietnam, Burma, Sri Lanka, Cambodia and Malaysia and they are used mainly for traction. Swamp buffalos provide 1–1.5 kg of milk per day. For this reason, they are the source of meat production as well as traction. They are known for this name since they rather prefer swamp areas (5). River buffalos are found in West India, Egypt and extend along Europe. They are raised in India for milk production (5). Anatolian buffalo milk is used for the production of cream, yoghurt, cheese and ice cream; its meat is used for Turkish style fermented sausage in Turkey (4). Water buffalo milk is also highly demanded in milk powder technologies because of its high dry substance and fat ratio (6).

Buffalo dairy and meat products are in high demand by consumers both as traditional food and as functional health food. However, buffalo productivity is limited by the species' reproductive characteristics such as a late age of puberty, a long gestation period, and difficult heat detection owing to a silent heat (7-9).

In accordance with (10), who carried out a study in the same area and reported that nearly 80.00% of farmers raised buffalo as source of power for work, in Thailand. In the conclusion for a research was confirmed that source of information used for buffalo production, patterns of buffalo production, kinds of land, the objectives for buffalo production, record keeping, types of roughage, person who suggest to select buffalo, mating systems, sire selection, information for considering replacement dams selection, age at first mating, and the problem and obstacle of buffalo production were related to the achievement in swamp buffalo production of farmers (11).

According to the (12), it is stated that the top 3 problems in buffalo breeding under intensive system in semiarid area of Bangladesh are "insufficient information on buffalo breeding", "high price of feed" and "low milk price" respectively. Then, "feeds and fodder", "high temperature", "cow boy" and "limited breeding bull, lake of AI workers and inadequate quality semen and credit facilities" are other important issues. Authors announced that ensuring training and marketing could help to improve intensive system of dairy buffalo that meet up the growing demand of milk in urban people.

According to 2018 data of FAO (Food and Agriculture Organization of the United Nations), the number of water buffalos in the world is 206 600 676. The number of water buffalos in Asia, Europe, Africa, America and Oceania is 201 258 156, 439 047, 3 506 086, 1 397 116 and 271 respectively. A great majority of water buffalos in the world are in Asia with a ratio of 97.41%. The remaining number of water buffalos are in Africa with 1.70 %, America with 0.68% and Europe with 0.21% (5). Water buffalo breeding is most commonly seen in India (55.25%), Pakistan (18.80%) and China (13.13%) in the world. These countries are followed by Nepal, Mynanmar, Egypt, Philippines, Vietnam, Bangladesh, Brazil and Thailand (13).

In one study, average energy corrected milk the minimum (14.36 kg/d) and maximum (15.75 kg/d) were observed in 2014 and 2016 in buffaloes. In the same study, between 2013 and 2017, the trend of both milk yield and energy corrected milk was slightly positive, indicating a favorable phenotypic trend for both traits across the 5 years and a slight improvement of productivity per head. Overall, fat and protein averaged 8.10% and 4.70%, respectively, ranging from 8.00% to 8.26% (fat) and from 4.69% to 4.74% (protein). The average somatic cell score was the highest in 2017 (3.11 units) and the lowest in 2013 (2.71 units) (14).

In other study, the pregnancy risk was 46.7% and was slightly lower in Italian Mediterranean buffaloes with body condition score < 6.0 and body condition score > 7.5. There were no significant differences in energy corrected milk, urea and ammonia between pregnant and non-pregnant buffaloes. The possibility of pregnancy for buffaloes with low urea blood level was 2.6 greater than for high urea level and exposure to a high urea level lowered the probability of pregnancy by about 0.25 (15).

According to the literature review, bibliometric analysis studies are found in other fields, but no studies conducted with this method in the field of buffalo breeding. Thus, the importance of the study increases accordingly.

The aim of this study is to examine the studies conducted in the field of water buffalo breeding in bibliometric terms and to reveal the tendencies and trends that have been observed in the field in recent years.

Material and Methods

The data of this research consist of 499 studies on water buffalo breeding published between the years 2013-2019 and reviewed in the Web of Science database. Web of Science (WOS) database provides the opportunity to access scientific publications' reference statistics and publications' bibliographic data (16). Regarding the 499 studies published in Web of Science Core Collection database, their publication types, titles, authors, countries of the authors, the number of sources referred to and the number of sources scanned in the Web of Science they were referred to and their reference information were accessed. Social network analysis was conducted regarding water buffalo breeding with common reference networks. This analysis was performed by loading in a format that complies with the R Studio program.

Bibliometrics is often used to assess scientific research through quantitative studies on research publications. Bibliometric analyses are based on the supposition that most scientific exploration and research results finally are published in international scientific journals where they can be read and cited by other researchers (17).

Bibliometric indicators is frequently used for the results of a bibliometric analysis. One of the definitions of the term indicator in the Oxford English Dictionary is "That which serves to indicate or give a suggestion of something; an indication of" (18). This draws attention to the fact that the results describe a reality that is too complex to be measured solely by statistics or numbers. Bibliometric studies enable to be informed about the efficiency of scientific publications in terms of various factors. Bibliometric researches provide the determination of the most productive researches and researchers in any subject and reveal the form of the interaction and networks among them. From a similar perspective, bibliometric studies enable comparisons on different topics between countries, institutions or individuals as well as titles (19). Bibliometric analysis is the quantitative analysis of different characteristics of scientific studies such as the number of authors, the year of publication, the journal where it was published and publication information (20). The quantitative and qualitative development of the scientific field

is important in terms of performing the bibliometric analysis of the studies regarding a discipline and evaluating them (21).

In the R environment, packages have been published recently on the official repository (CRAN, The Comprehensive RArchive Network, https://cran.r-project.org/) addressing bibliometrics. To illustrate, the primary aim of CITAN (22) –CITation ANal-ysis package for R statistical computing Environment is to support scholars with a tool for calculating the most popular indices of scientific impact.

ScientoText (23) is a package that is perhaps the most comparable to the bibliometrix R-package. ScientoText states that it uses data from the WoS databases. H-index Calculator uses only data from the Clarivate Analytics WoS in order to calculating the h-index (24).

Providing bibliometrix and science mapping workflow, the bibliometrix R-package (http://www.bibliometrix.org) provides a set of tools for quantitative research in bibliometrics and scientometrics. It is written in the R language. Network creation for bibliographic coupling, co-citation, collaboration, and co-occurrence analyses are made (25).

Bibliographic coupling: Two articles are described to be bibliographically coupled if at least one cited source appears in the bibliographies or referencelists of both articles (26). A bibliographic coupling network can be ensured by the formula:

$$B_{cocit} = A * A'$$

Here A is a Document x Cited reference matrix. Element b_{ij} demonstrates how many bibliographic couplings become between documents i and j. B_{coup} is a symmetrical and non-negative matrix $B_{coup} = B'_{coup}$.

Co-citation analysis of two articles occurs when both are cited in a third article. T A co-citation network can be conquered using the general formula:

$$B_{coup} = A' * A$$

Here A is a Document x Cited reference matrix.

A scientific collaboration analysis is a network where nodes are authors and links are co-authorships (27). An author collaboration network can be created using the general formula:

$$B_{coll} = A' * A$$

Here A is a Document x Author matrix.

Co-word analysis is make the conceptual structure of a framework using a word co-occurrence network to map terms extracted from keywords, titles, or abstracts in a bibliographic collection. A co-word network can be obtained using the general formula:

$$B_{coc} = A' * A$$

Here A is a Document x Word matrix, where Word is, alternatively, authors' keywords, or terms extracted from titles or abstracts (25).

Results

A total of 499 papers were published. 411 of them were articles, 3 of them were book chapters, 59 were papers and 26 of them were compilations. The studies were written by 1874 authors, iincluding 15 written by a single author and 1859 having various multi authors (Table 1).

Table 1. Main Information

Description	Results
Documents	499
Sources (Journals, Books, etc.)	78
Keywords Plus (ID)	1253
Author's Keywords (DE)	1411
Period	2013 - 2019
Average citations per documents	2.204
Authors	1874
Author Appearances	2763
Authors of single-authored documents	15
Authors of multi-authored documents	1859
Single-authored documents	19
Documents per Author	0.266
Authors per Document	3.76
Co-Authors per Documents	5.54
Collaboration Index	3.87
Document types	
Article	411
Article; Book Chapter	3
Article; Proceedings Paper	59
Review	26

Table 2. Distribution of publications by years

Years	Number of Articles
2013	96
2014	45
2015	61
2016	81
2017	77
2018	67
2019	72
Total	499

According to the records of the search made with the keyword "Buffalo" on January 22, 2020 in Web of Science database, there are 499 records found. This record comprises the 2013-2019 period (Table 2). Over that time period, there were ups and downs in the number of per year publications.

The journal in which the highest number of articles are published in the field of water buffalo breeding is the journal Buffalo Bulletin, with 138 articles. This journal is followed by Indian Journal of Animal Sciences with 57 articles and Indian Journal of Animal Research with 28 articles. The Buffalo Bulletin journal has an important status in terms of impact factor, h index, g index, m index, TC and NP. The h index, g index, m index, TC and NP numbers regarding the Buffalo Bulletin journal are respectively 5, 5, 0.625, 84 and 138. The h index, g index, m index, TC and NP numbers of the Theriogenology journal, which is the best in terms of the number of references are 8, 13, 1, 194 and 20 respectively. The journals that are in the best state in terms of h index, g index, m index, TC and NP numbers are Theriogenology, Buffalo Bulletin and Tropical Animal Health and Production respectively (Table 3, Figure 1).

The distribution of the first five journals having the highest publication by years is given in Table 4 and Figure 2. In Buffalo Bulletin journal, where the highest number of articles were published, half of the publications (69 articles) were published in 2013. A total of 138 articles were published in this journal between the years 2013 and 2019. In the Indian Journal of Animal Sciences, where 57 articles have been published,

Table 3. Number of documents and source impact values most relevans sources

Source	h index	g index	m index	TC	NP	PY start
Theriogenology	8	13	1.000	194	20	2013
Buffalo Bulletin	5	5	0.625	84	138	2013
Indian Journal of Animal Sciences	3	5	0.375	44	57	2013
Indian Journal of Animal Research	4	5	0.500	49	28	2013
Tropical Animal Health and Production	5	7	0.625	79	26	2013
Indian Journal of Dairy Science	2	2	0.400	9	21	2016
Animal Reproduction Science	4	7	0.500	51	12	2013
Genetics And Molecular Research	2	3	0.286	14	11	2014
Journal of Animal and Plant Sciences	1	1	0.143	7	10	2014
Journal of Dairy Research	2	3	0.400	16	10	2016
Journal of Dairy Science	4	6	0.500	48	10	2013
Livestock Science	2	2	0.286	11	9	2014
Reproduction in Domestic Animals	3	5	0.375	32	9	2013
Animal Biotechnology	2	3	0.333	15	6	2015
Animal Production Science	3	4	0.429	17	6	2014
Asian-Australasian Journal of Animal Sciences	4	6	0.500	65	6	2013
Italian Journal of Animal Science	2	3	0.286	13	5	2014
Brazilian Journal of Animal Science	2	3	0.250	12	5	2013
Animal	2	2	0.333	8	4	2015
Animal Reproduction	1	1	0.333	1	4	2018

PY: Per year, TC: Total Citation, NP: Number of paper
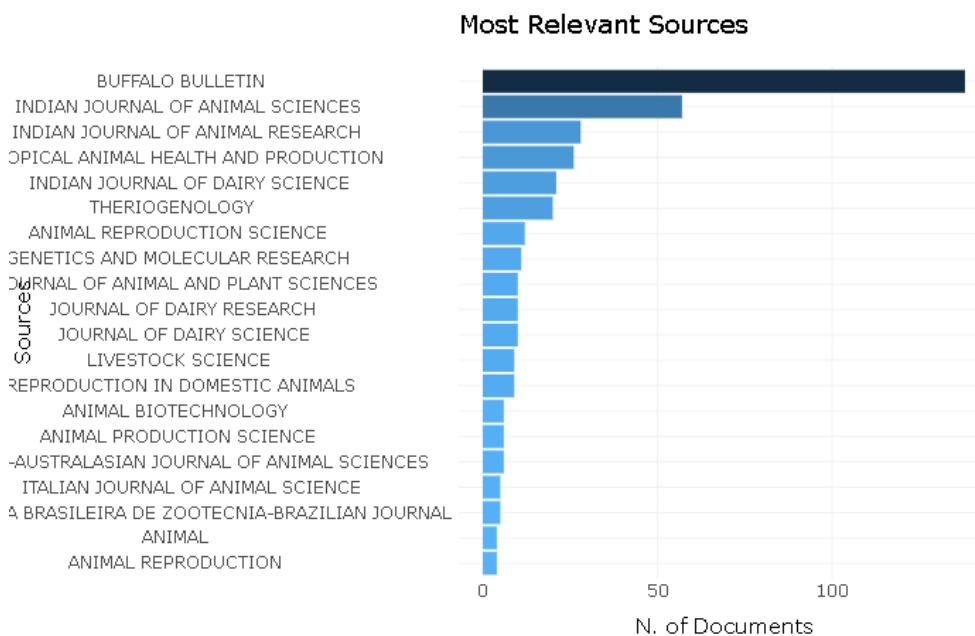
Figure 1. Number of documents most relevans sources

most of these publications were carried out between the years 2017-2019. In the Indian Journal of Animal Research, where 28 articles were published, the highest number of publications were in 2016 with 9 articles.

The average annual article references for the period 2013-2019 in the field of water buffalo breeding are presented in Table 5. While the average number of references per article was at the highest level in 2014 with 5.822, this was followed by the year 2015 with 3.705 and the year 2013 with 2.958. The annual average of references was found in 2014 with the highest number of value (0.970).

Table 4. Annual occurences source growth

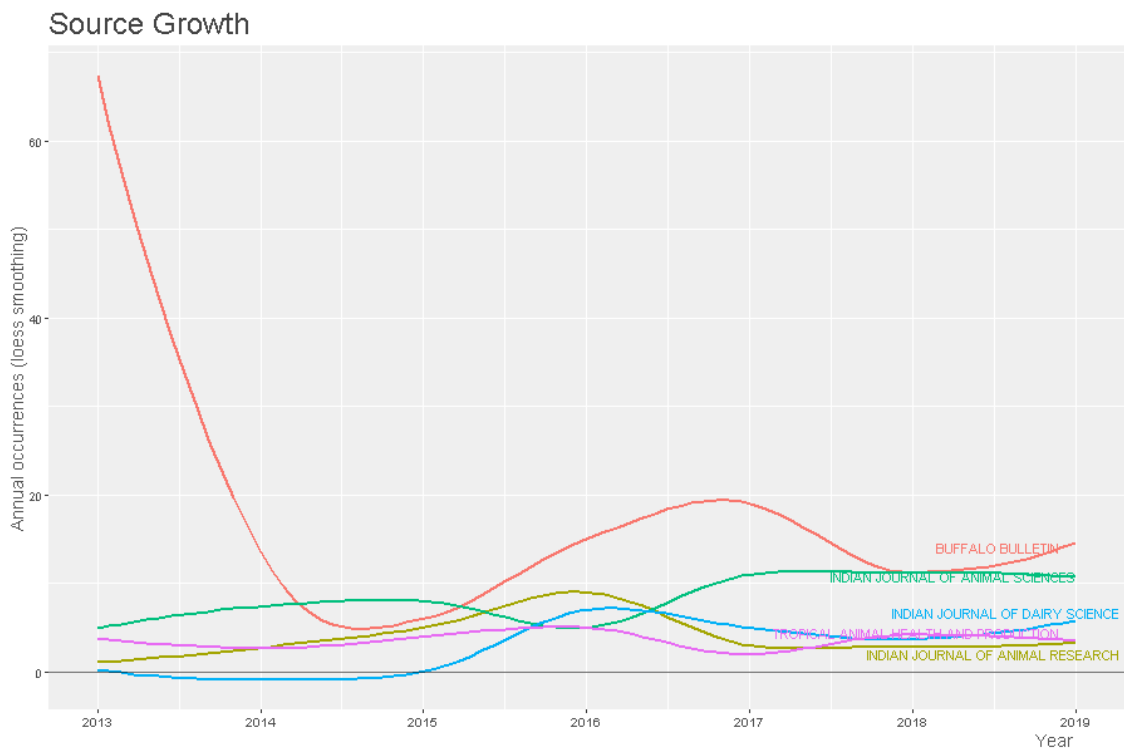| Years	Buffalo Bulletin	Indian Journal of Animal Sciences	Indian Journal of Animal Research	Tropical Animal Health and Production	Indian Journal of Dairy Science
2013	69	5	1	4	0
2014	7	7	3	2	0
2015	6	8	5	4	0
2016	15	5	9	5	7
2017	19	11	3	2	5
2018	6	10	4	6	3
2019	16	11	3	3	6
Total	**138**	**57**	**28**	**26**	**21**

Figure 2. Annual occurences source growth

Table 5. Average article citations per year

Year	N	Mean TC per Article	Mean TC per Year	Citable Years
2013	96	2.958	0.423	7
2014	45	5.822	0.970	6
2015	61	3.705	0.741	5
2016	81	1.914	0.478	4
2017	77	1.299	0.433	3
2018	67	0.925	0.463	2
2019	72	0.153	0.153	1

TC: Total citations

Table 6. Author impact values

Author	h index	g index	m index	TC	NP	PY start
Chakravarty AK	3	6	0.429	47	20	2014
Babar ME	3	4	0.375	22	15	2013
Kumar S	2	2	0.250	11	14	2013
Nadeem A	3	3	0.375	18	15	2013
Kataria RS	3	5	0.375	33	14	2013
Kumar A	3	3	0.429	16	11	2014
Kumar P	3	7	0.429	52	11	2014
Campanile G	4	6	0.500	49	10	2013
Gasparrini B	4	6	0.500	48	10	2013
Singh P	3	6	0.429	44	9	2014
Baruselli PS	4	5	0.500	33	9	2013
Carneiro PLS	1	2	0.125	10	9	2013
Gupta AK	2	3	0.333	12	9	2015
Javed M	2	2	0.250	9	9	2013
Kumar V	2	2	0.286	6	9	2014
Singh A	2	2	0.333	8	9	2015
Stafuzza NB	2	2	0.250	7	9	2013
Yang LG	3	5	0.375	27	9	2013
Hussain T	2	3	0.250	11	8	2013
Malhado CHM	1	2	0.125	9	8	2013
Mohanty TK	2	3	0.333	14	8	2015

When evaluated according to the authors, those with the highest h index values are Campanile G, Gasparrini B and Baruselli PS. The h index value of these authors is 4. Those whose h index is 3 and lower are lined up after these authors. It is seen more clearly in Table 6.

When the best authors are examined, it is seen that Chakravarty AK has numbers 24, 16 and 4 references and annual average reference values of 3.429, 2.667 and 0.8 between the years 2014-2016. Babar ME has 0-19 references and an annual average reference value between 0- 2.375 during the period 2013-2019. The information regarding other authors is shown in Figure 3.
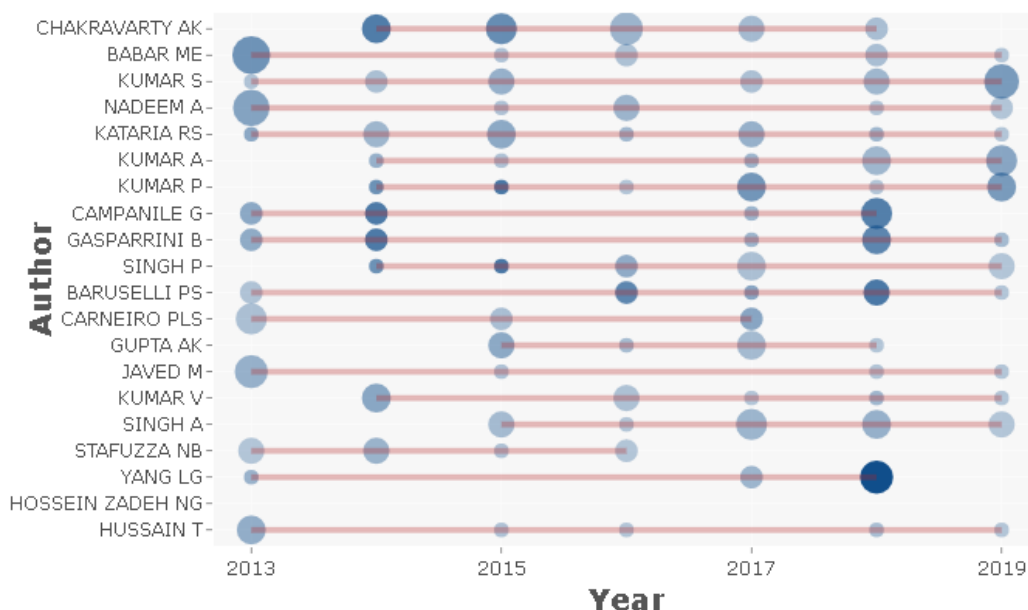
Figure 3. Top Authors Production over the

Table 7. Most cited countries number of citations

Rank	Country	Total Citations	Average Article Citations
1	India	368	1.658
2	Italy	210	6
3	Pakistan	92	1.878
4	USA	85	12.143
5	Brazil	83	1.627
6	China	82	2.485
7	Egypt	25	1.923
8	Iran	23	1.438
9	Turkey	21	2.1
10	Norway	16	8
11	New Zealand	13	13
12	Japan	12	6
13	Romania	9	3
14	Netherlands	7	7
15	Poland	7	3.5
16	Saudi Arabia	7	2.333
17	Colombia	6	1.5
18	Austria	5	5
19	Germany	4	1.333
20	Philippines	4	0.667

The highest referred countries in the publications are India (368), Italy (210) and Pakistan (62) respectively (Table 7 and Figure 4). As for the average number of references, New Zealand, USA and Norway ranked the top. The average number of references for these countries are 13, 12,143 and 8 respectively (Table 6 and Figure 4).

The mostly referenced publications are given in Table 8 and Figure 5. The highest referenced resource in the studies conducted in the field of water buffalo breeding is the article (n=75) published by Hristov AN in J. Anim. Sci. Journal in 2013. The annual average number of references of this publication is 9.375. The article published by Galli C in 2014 in Theriogenology journal (n=55) is the second most important study. Another important study is the article published by Warriach HM in 2015 in Asian Austral J Anim. (n=30).
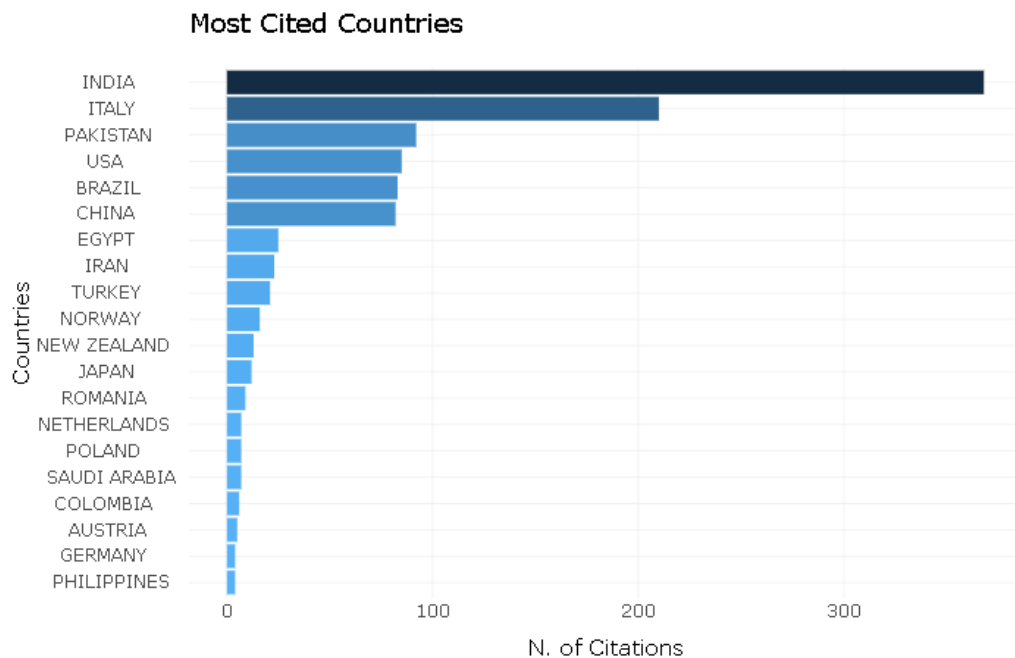
Most Cited Countries

Figure 4. Most cited countries number of citations

Table 8. Most cited documents of total citations

| Rank	Paper	Total Citations	TC per Year
1	Hristov AN, 2013, J Anim. Sci.	75	9.375
2	Galli C, 2014, Theriogenology	55	7.857
3	Warriach HM, 2015, Asian Austral J Anim.	30	5
4	Zhang LZ, 2014, Bmc Genomics	27	3.857
5	Kumar P, 2015, Anim. Reprod. Sci.	22	3.667
6	Verma A, 2014, Theriogenology	21	3
7	Lagutina I, 2013, Cell Reprogram	20	2.5
8	Rossi P, 2014, Theriogenology	19	2.714
9	Kumar D, 2014, Indian J Anim. Sci.	17	2.429
10	Ahmed H, 2016, Theriogenology	16	3.2
11	Sharma A, 2015, Trop Anim. Health Pro	15	2.5
12	Khatun M, 2013, Asian Austral J Anim.	15	1.875
13	Lin B, 2015, Anim. Feed Sci. Tech	13	2.167
14	Chand P, 2013, Trop Anim. Health Pro	13	1.625
15	Shah SM, 2015, Reprod. Domest. Anim.	12	2
16	Manuelian CL, 2017, J Dairy Sci.	11	2.75
17	Islam MA, 2014, Asian Austral J Anim.	11	1.571
18	Sodhi M, 2013, Gene	11	1.375
19	Alfano F, 2014, Bmc Genet	10	1.429
20	Singh I, 2016, Theriogenology	9	1.8

Most Cited Documents
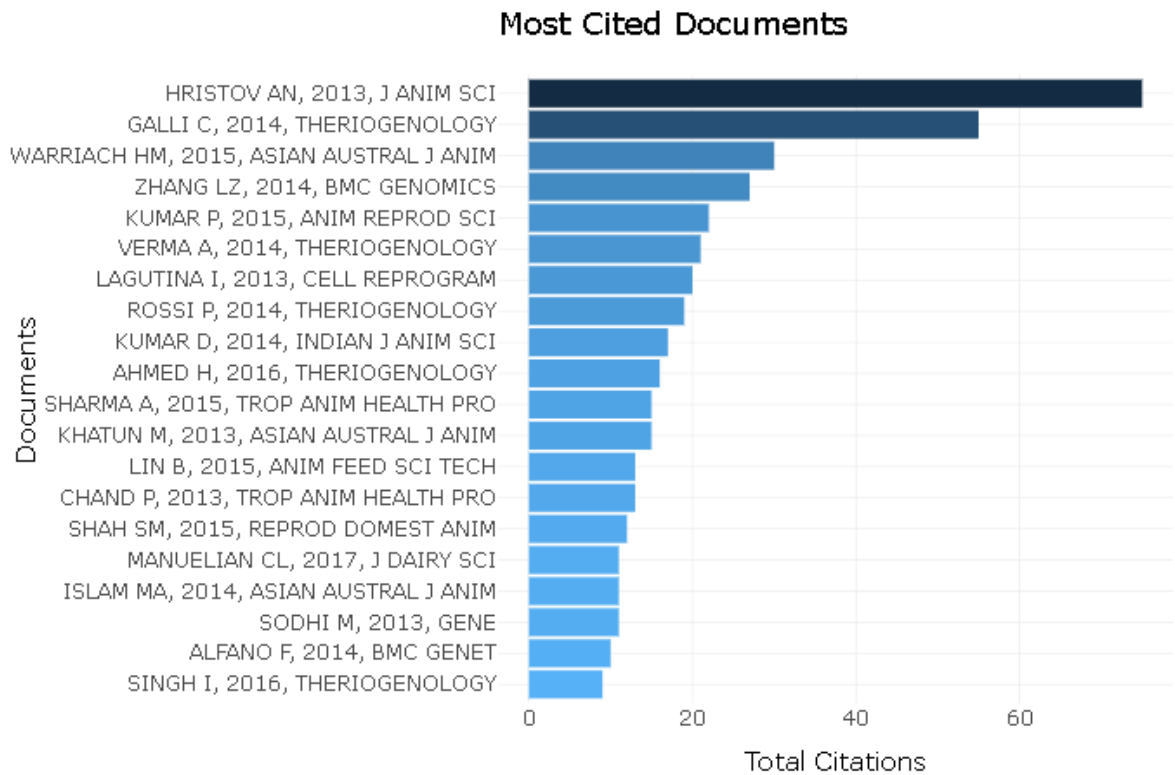
Figure 5. Most cited documents of total citations

Table 9. Distribution by country of buffalos studies

Rank	Country	Frequent
1	India	522
2	Brazil	160
3	Pakistan	149
4	Italy	101
5	China	93
6	USA	35
7	Iran	30
8	Egypt	26
9	Turkey	26
10	Philippines	16
11	Australia	13
12	Colombia	13
13	Japan	11
14	Canada	10
15	Indonesia	10
16	Mexico	10
17	Romania	10
18	Thailand	10
19	Denmark	8
20	Austria	7

The first five countries highly contributed to the number of publications themed "Buffalo" in Web of Science database are India (522), Brazil (160), Pakistan (149), Italy (101) and China (93). The first 20 countries working closely associated with water buffalo breeding are given in Table 9.

When the number of countries of responsible authors is examined, India (222) is found to be in the first place and Brazil (51) in the second and Pakistan (49) in the third place. Other countries are ranked as Italy (35), China (33), Iran (16), Egypt (13), Turkey (10), USA (7), the Philippines and Thailand (6) respectively. Details are presented clearly in Table 10 and Figure 6.

Table 10. Number of corresponding author's country documents

Country	Articles	Frequent	SCP	MCP	MCP Ratio
India	222	0.44758	206	16	0.0721
Brazil	51	0.10282	40	11	0.2157
Pakistan	49	0.09879	41	8	0.1633
Italy	35	0.07056	27	8	0.2286
China	33	0.06653	22	11	0.3333
Iran	16	0.03226	12	4	0.25
Egypt	13	0.02621	10	3	0.2308
Turkey	10	0.02016	10	0	0
USA	7	0.01411	2	5	0.7143
Philippines	6	0.0121	6	0	0
Thailand	6	0.0121	6	0	0
Colombia	4	0.00806	3	1	0.25
Argentina	3	0.00605	2	1	0.3333
Bangladesh	3	0.00605	3	0	0
Germany	3	0.00605	2	1	0.3333
Romania	3	0.00605	2	1	0.3333
Saudi Arabia	3	0.00605	1	2	0.6667
Indonesia	2	0.00403	2	0	0
Israel	2	0.00403	2	0	0
Japan	2	0.00403	2	0	0
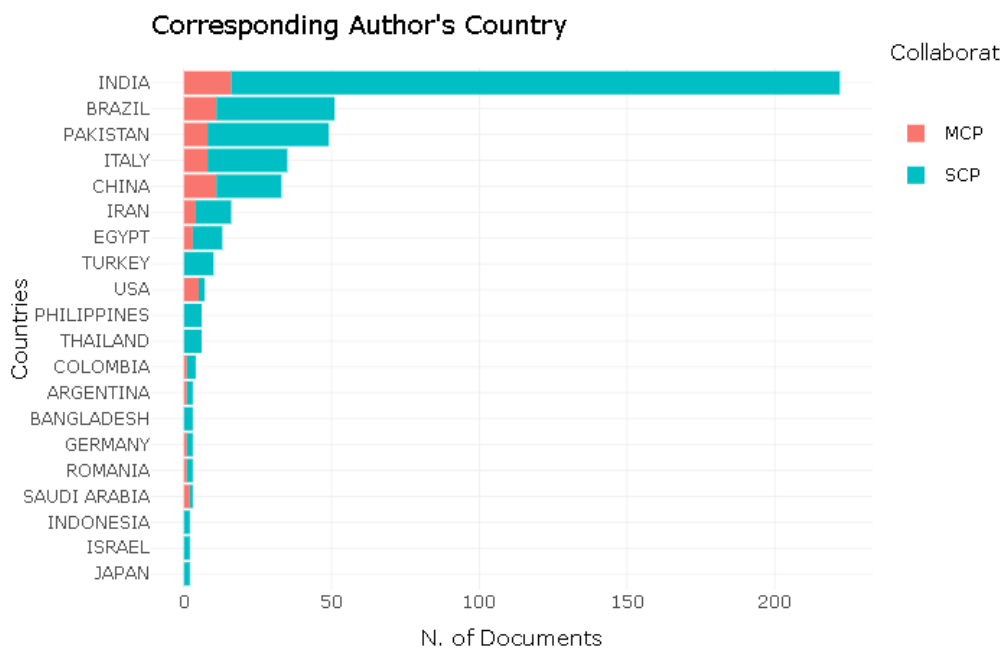
Figure 6. Number of corresponding author's country documents

When the subject "Buffalo" is addressed in terms of the area of research in the Web of Science database, 20 mostly studied research areas are as follows; cattle 69; Bubalus bubalis 51; traits 30; association 29; cows 26; dairy cattle 21; fertility 21; parameters 21; yield 21; quality 20; expression 18; Murrah buffalos 17; Polymorphism 14; age 13; Estrous cycle 13; semen 13; Polymorphisms 12; buffalo 12; Bos-Indicus 11 and Milk-Production 10. They are shown in Table 11 and Figure 7. The tendency years of the research areas are in the same table and are given in Figure 8.

The distribution of the research areas in which the subject of water buffalo breeding is studied the most by years is given in Table 12 and Figure 9.

The word tree map of the studied research areas is given in Figure 10. In the first column, the cattle, bubalus bubalis, traits and association areas in the big boxes are in the forefront. In Figure 11, the word cattle is written in the biggest form and it is found to be the area studied the most.

The intensity of the subjects are shown in Figure 12. Cattle, dairy-cattle, identification, bubalus-bubalis, fertility and infection are the subjects studied the most.

The social network analysis of the relationship between references, authors and keywords in the field of water buffalo breeding is shown in Figure 13. The keyword, Buffalo is strongly associated with Sambrookj

Table 11. Most relevant words occurences and trend topics

| Rank	Words	Frequent	Year
1	Cattle	69	2016
2	Bubalus-Bubalis	51	2017
3	Traits	30	2016
4	Association	29	2015
5	Cows	26	2016
6	Dairy-Cattle	21	2016
7	Fertility	21	2017
8	Parameters	21	2017
9	Yield	21	2016
10	Quality	20	2017
11	Expression	18	2015
12	Murrah Buffalos	17	2017
13	Polymorphism	14	2014
14	Age	13	2017
15	Estrous-Cycle	13	2017
16	Semen	13	2017
17	Polymorphisms	12	2018
18	Buffalo	12	2015
19	Bos-Indicus	11	2018
20	Milk-Production	10	2018
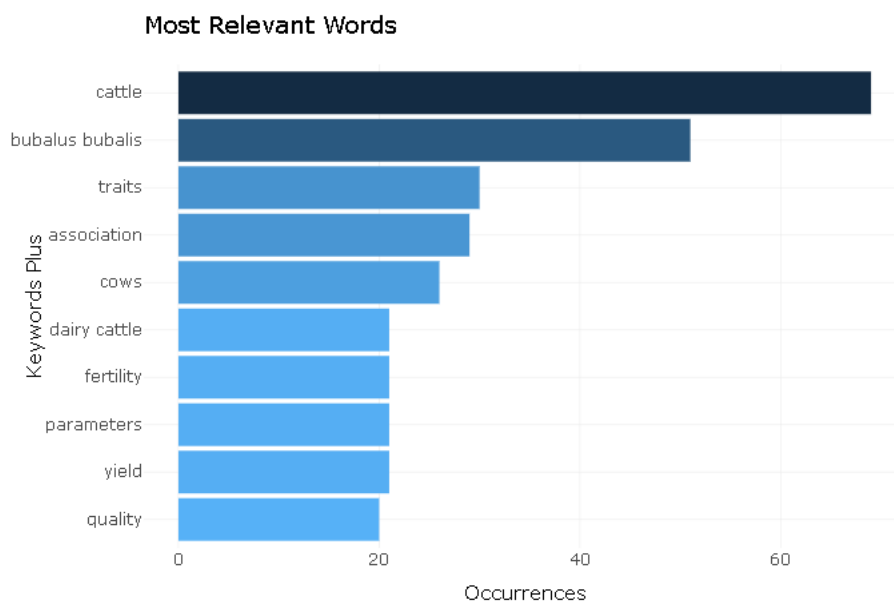
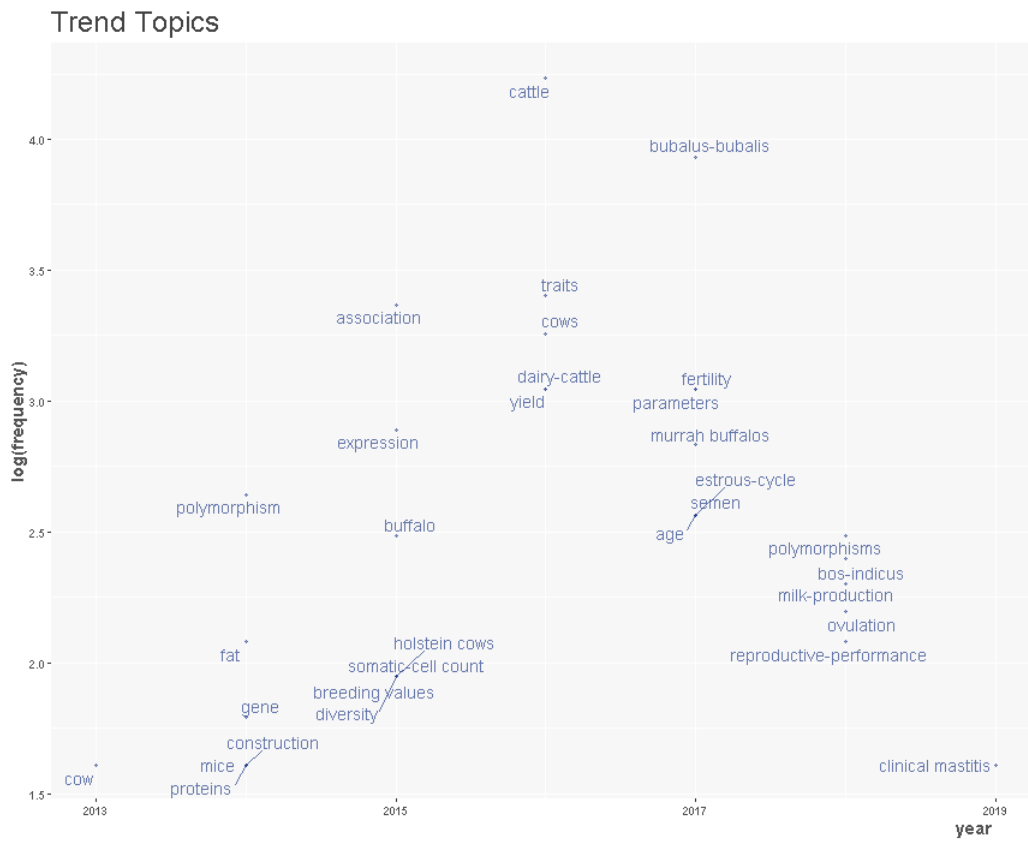**Figure 7.** Most relevant words occurences

Figure 8. Trend topics

Table 12. Word Dynamics (2013-2019)

Year	Cattle	Bubalus-bubalis	Traits	Association	Cows	Dairy-cattle	Fertility	Parameters	Yield	Quality
2013	14	9	4	9	4	2	0	1	3	5
2014	5	3	5	3	3	1	0	0	2	2
2015	9	5	4	3	3	2	3	5	2	3
2016	10	7	3	4	8	6	6	4	6	2
2017	11	13	5	4	3	2	4	6	2	2
2018	10	12	2	3	2	4	7	2	3	4
2019	10	2	7	3	3	4	1	3	3	2
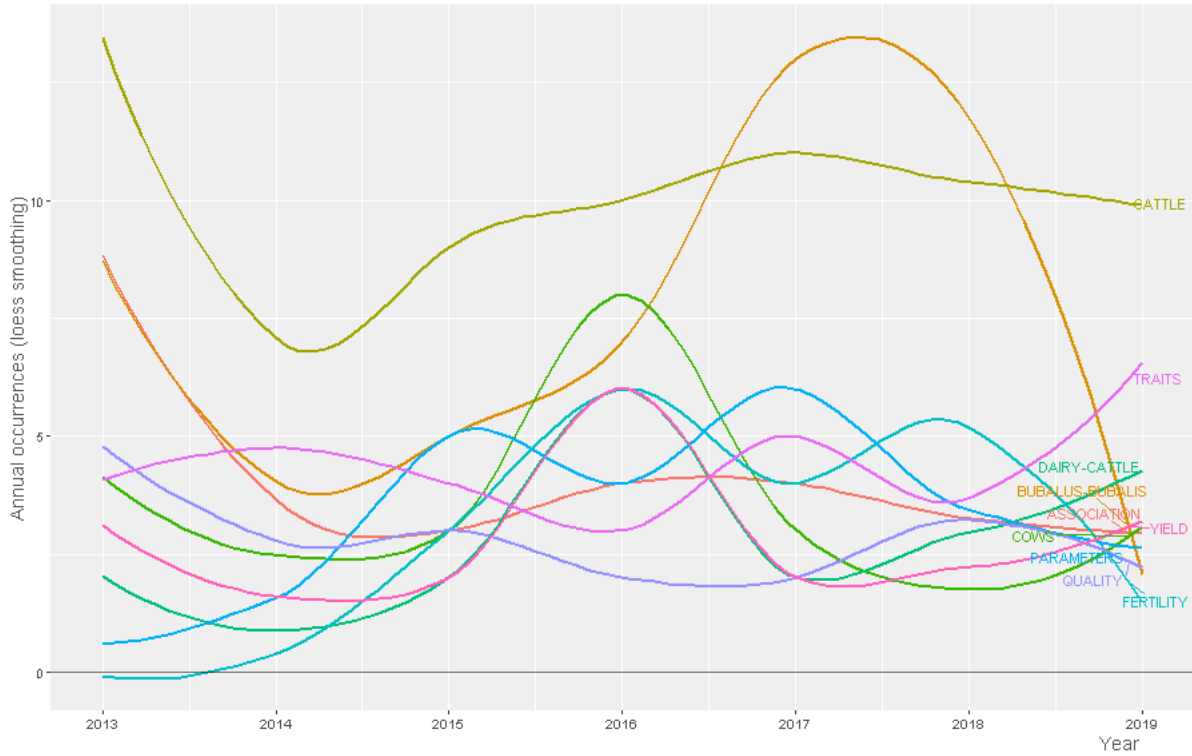
Figure 9. Word growth

Figure 10. Word Tree Map
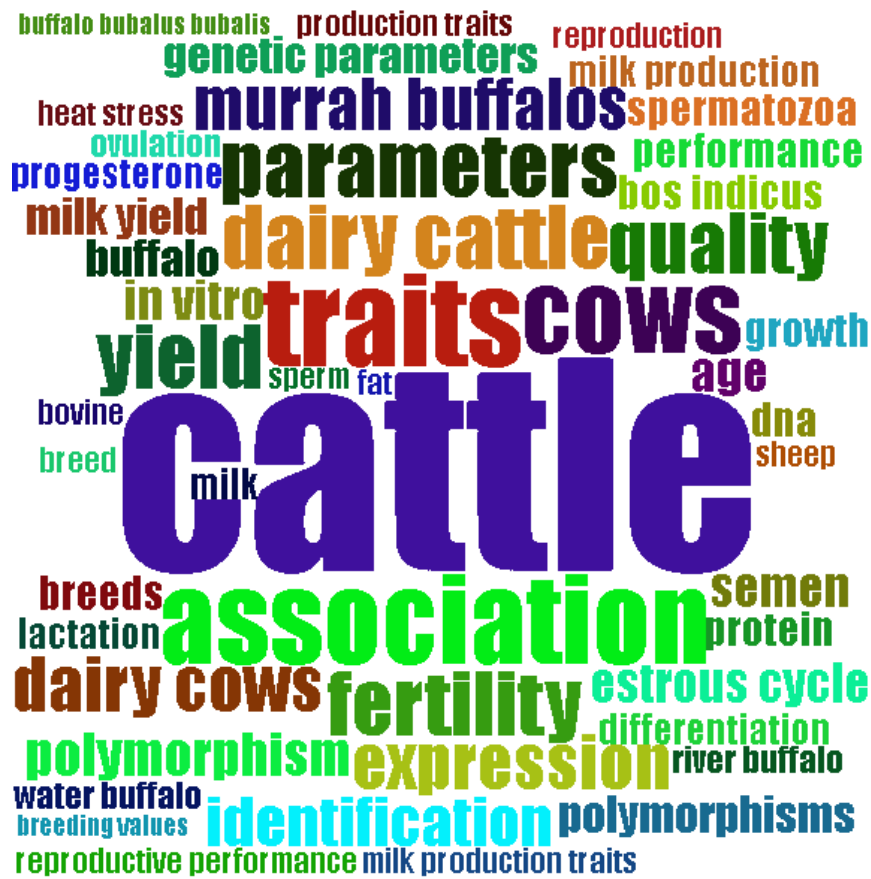
Figure 11. Word Cloud
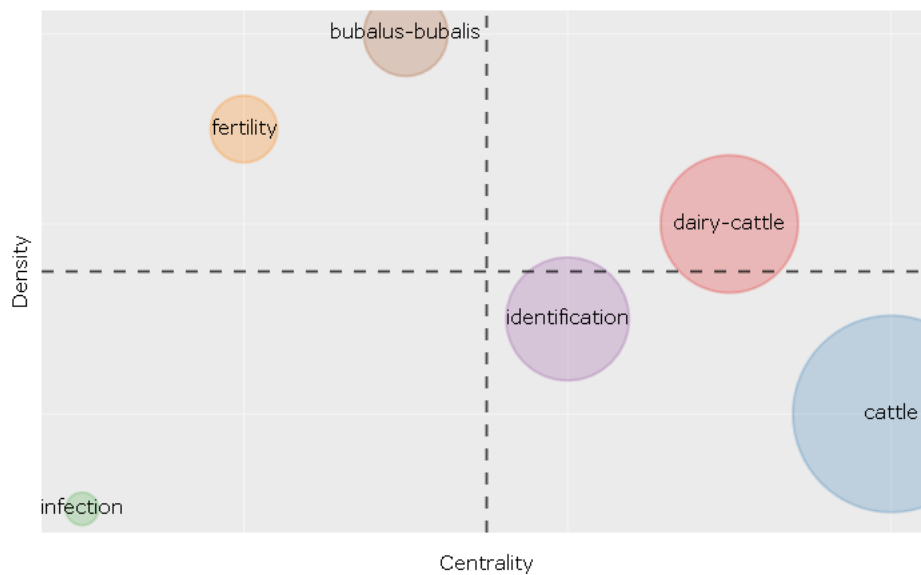
Figure 12. Density of topic

2001 molcloning lab manual reference and its author Javed M. Buffalo is related to Sambrookj 2001 molcloning lab manual reference and its author Babar MM. Buffalo is related to Sambrookj 2001 molcloning lab manual reference and its author Nadeem A. The subject of Buffalo Sambrookj 2001 molcloning lab manual reference and its author Katarina RS. Buffalo is related to Michelizzivn 2010 Int J Biol Sci. reference and its author Campanileg. They have strong relations with Buffalo, Campanileg 2010 Anim. Reprod Sci. and its author Baruselli PS. The polymorphism key word and Kataria RS.'s Sambrookj 2001 molcloning lab manual reference are strongly related as well. The subject of Bubalus bubalis and Amaral Mej 2008 Bmc Genomics referenced Stafuzza NB. Author are strongly associated with each other. The Murrah

buffalo subject and Chakravarty AK. author CY are closely related to 1957 Biometrics reference.

As is seen in the social network analysis in Figure 14, the Indian authors are highly active. The Indian author Snedecorg studied the murrah buffalo subject with the references 1994 Stat. Methods and Kramer CY 1957 Biometrics and another Indian author Sambrook J. studied the subject murrah with the 2001 Molcloning Lab. Manual reference. Indian authors directly studied the subjects of buffalo, buffaloes, polymorphism, cattle, production, prevalence, mastitis, milk yield and bubalus bubalis. The authors' relationships with each other are presented in Figure 15. Authors such as Williams JL, Ramunno I, Ajmone-Marsan P, Valentini A, Cosenza G, Bomba I, Coletta A shown with green color in Figure 15 are strongly
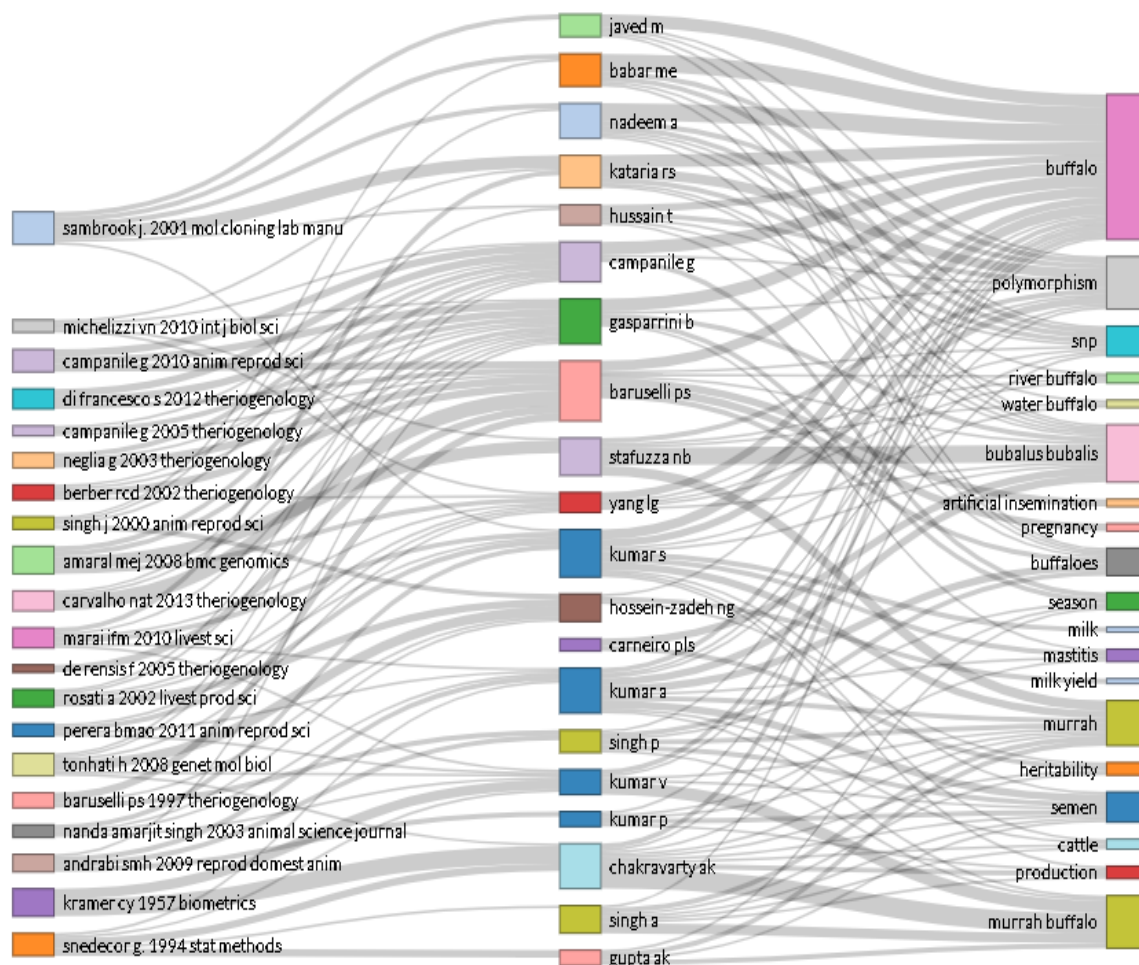

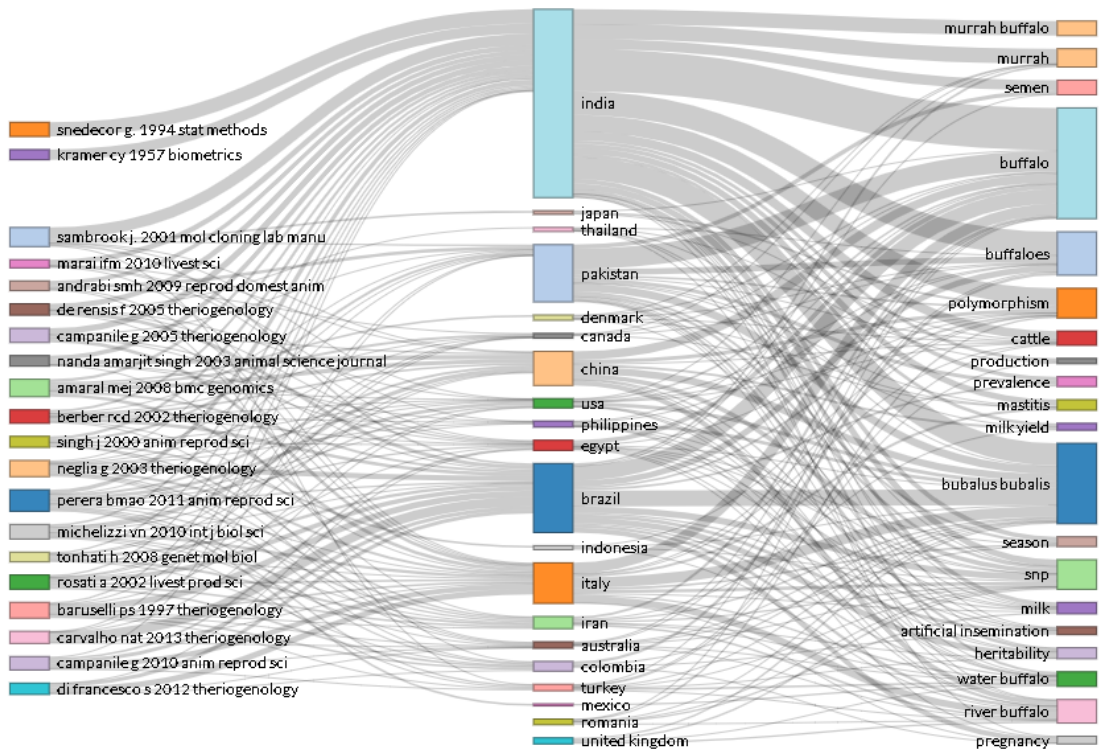**Figure 13.** Three field plot buffalo (references, authors, keywords)

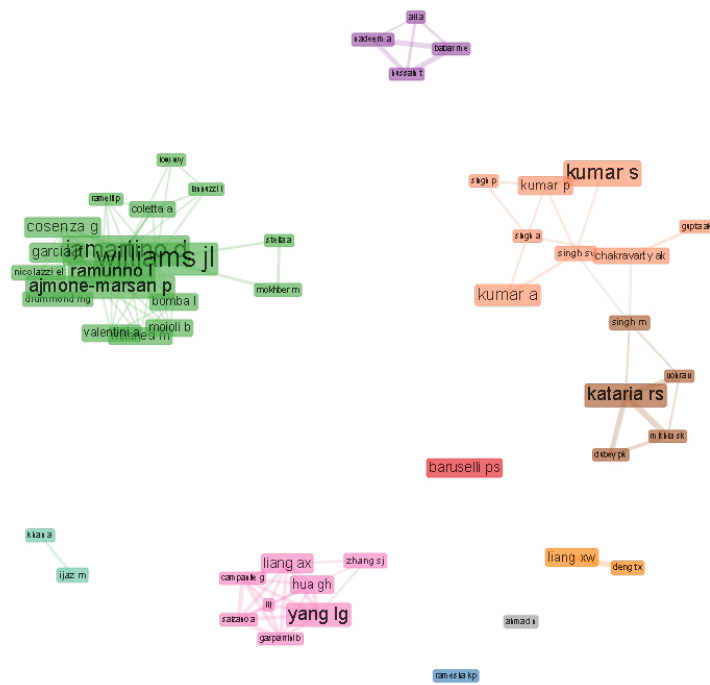**Figure 14.** Three field plot buffalo (references, country, keywords)

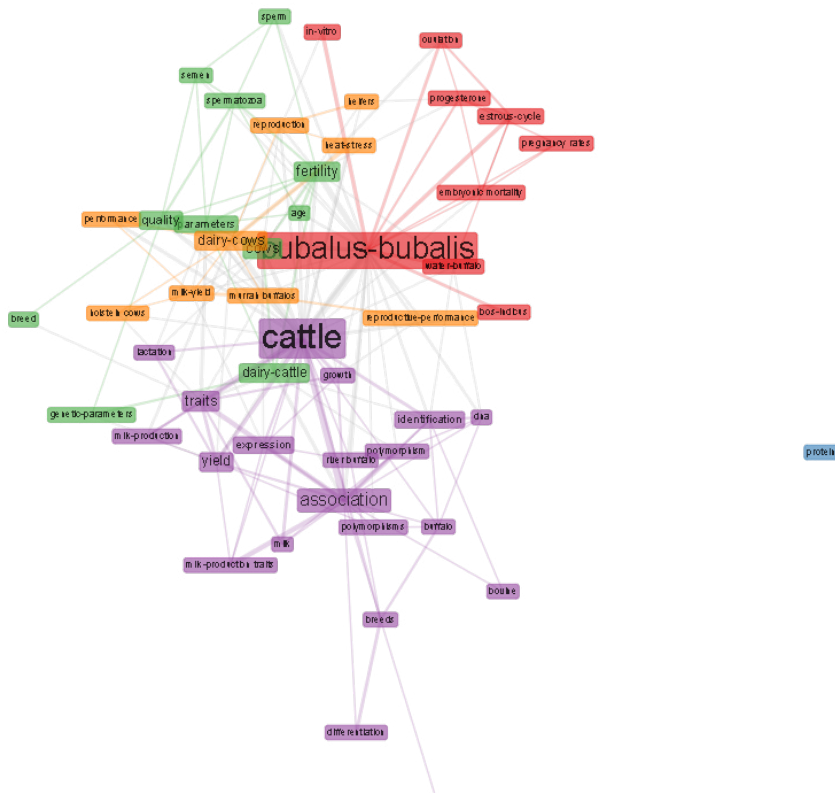**Figure 15.** Collebration network (authors)

Figure 16. Collebration occuurence network (keywords)

related with each other. All A, Ladeem A, Babar ME and Lassah T, who are shown with dark pink are separated from the others by being very closely and strongly related with each other. Kataria RS, Dibey PK, Singh formed strong relationships with each other, IJaz M and Klav A among themselves, the authors Yang LG, Liang AX, Hua GH, Zhang SJ, Campale G with each other and Kumar S, Kumar P, Kumar A, Singh SV and Chakravarty AK were formed strong relationship together. The social network analysis of the subjects related to each other are presented in Figure 16. The subjects with the same color were found to reveal strong relationships with each other.

Discussion

Concerning the distribution of 499 studies published between 2013-2019 in the field of buffalo breeding, it is seen that the highest number of studies was conducted in 2013 (n = 96). The review of the researches according to the publication types displayed different types of publications, such as article, proceedings paper, review and book chapter. As regards mostly performed publication types in the field of buffalo breeding, articles compose the majority, with a percentage of 82.36% in total. Considering the data of the study, India has been determined as the most publication make country (n=522). India appears to be the country where the studies that guided the field in 2013-2019 period have been completed.

Some bibliometric studies have been reached on various subjects in animal husbandry. (28) reported that 320 studies were published until 2018 in a study on organic livestock farming. Germany is the country with the largest number of published papers (56 study). Researchers top keywords included: animal welfare (29 times), animal health (22 times), cattle (15 times),

grazing (10 times), and sheep (10 times). 854 articles, published between 2008 and 2018 were identified as relevant to the welfare of pigs (n = 505) or chickens (n = 349) in the Chinese scientific literature. The most common topic categories were rearing systems, disease treatment and prevention, and normal behavior. Articles on pig breeding largely focused on adult females in different stages of the breeding cycle, particularly pregnant (32.5%) and lactating sows (28.9%). For chickens, only 12.3% of the articles focused on breeding animals within the meat industry. In egg production, with 33.0% of the chicken literature focused on laying hens (29). In another bibliometry study on animal welfare, publication data were collected from the Web of Science for the year range 1968–2017 and pre-processing of the data was undertaken to identify reviews and articles on animal welfare. There has been a 13.3% annual growth in animal welfare publications in the last 50 years with Animal Welfare and Applied Animal Behaviour Science the most frequent publishers of animal welfare publications. Highly cited review articles were grouped into five clusters with affective state and fish welfare the most (30). Arya and Sharma (2011), collected data from 2006-2010 from "CABI abstract" in Veterinary science. The most papers (23263) was published in the year 2009 year while the least number of papers (15152) was published in the year 2010. When categorization of subject, it is observed that the literature on veterinary covers 13 broad subject areas. Among the total 97740 records in different subject areas, it can be seen that the veterinarians have shown a greater interest in Veterinary Physiology, followed by Animal Nutrition (31).

Conclusion

Buffalo Bulletin journal has been supporting water buffalo breeding studies for many years. That the journal published the highest number of studies in this area (n=138) between the years 2013-2019 serves as to prove it.

According to the Web of Science data platform analysis results, the ones with the highest h index value among the authors having articles on the subject of

water buffalo breeding are Campanile G, Gasparrini B and Baruselli PS. Chakravarty AK, Babar ME, Baruselli PS, Campanile G and Carneiro PLS are the best authors who contribute to the field. The authors whose publications are mostly referenced are from India, Italy and Pakistan. India, Brazil and Pakistan are the countries with the highest number of publications in the field. Their research subjects are mostly cattle, bubalus-bubalis, traits, association and cows. The most active authors in the field of buffaloes, polymorphism, cattle, production, prevalence, mastitis, milk yield and bubalus-bubalis are the Indian authors. According to these results, the increase in bibliometrics studies may provide an important contribution by serving as a guide to the studies conducted in the field of husbandry.

References

1. Soysal MI. Manda ve Ürünleri Üretimi, Tekirdağ, 2009; ISBN:9944-5405-1-X.245s.
2. Nanda AS, Nakao T. Role of buffalo in the socioeconomic development of rural Asia: Current status and future prospectus. Anim. Sci. J. 2003; 74(6): 443–455.
3. Soysal, MI. Manda ve Ürünleri Üretimi. Ders Notları, Tekirdağ Üniversitesi Ziraat Fakültesi Zootekni Bölümü, Tekirdağ, 2006.
4. Atasever S, Erdem H. Water Buffalo Raising and Its Future in Turkey. J. of Fac. of Agric. OMU 2008; 23(1): 59–64.
5. Subasinghe, DHA, Horagoda NU, Abeygunawardena H, Siriwardene JA de S. (Eds.) 1998. Water Buffalo-Improved Utilization through New Technologies. National Science Foundation.
6. Anonymous 2012. USDA, United States Department of Agriculture. http://www.usda.gov/wps/portal/usda/usdahome.
7. De Rensis F, Ronci G, Guarneri Pi, Nguyen BX, Presicce GA, Huszenicza G, Scaramuzzi, RJ. Conception rate after fixed time insemination following ovsynch protocol with and without progesterone supplementation in cyclic and non-cyclic. Mediterranean Italian buffaloes (Bubalus bubalis). Theriogenology 2005; 63:1824–1831.
8. Chaikhun T, Tharasanit T, Rattanatep J, De Rensis F, Techakumphu M. Fertility of swamp buffalo after synchronization of ovulation by sequential GnRH and PGF administration (ovsynch) and fixed-timed artificial insemination. Theriogenology 2010; 74: 1371–1376.
9. Suebkhampet A, Marcou TC. Vaginal Cytology in Buffaloes: A Review. Buffalo Bulletin 2019; 38(3): 399-412.
10. Sarakul M, Yaemkong S, Rodchoom P, Sirisom P, Suranarakul T, Jaipong P. Situation and factor affecting on swamp

buffalo production for conservation and genetic develop swamp buffalo of farmers in Songkhram wet land, Nakhon Phanom province. Khon Kaen Agriculture Journal, 2016; 44 (Special Issue 2): 841–849.

11. Yaemkong S, Sarakul M, Ngoc TN. Factors Affecting Swamp Buffalo Production in Songkhram Wet Land, Nakhon Phanom Province. Thailand. Buffalo Bulletin, 2019; 38(1): 99–106.

12. Rahman SMR, Islam Md N, Rashid Md H, Siddiki Md SR, Islam MA. Dairy Buffalo Production under Intensive System in Semi Arid Area of Bangladesh. Buffalo Bulletin, 2019; 38(1): 83–98.

13. FAO, Food and Agriculture Organization of the United Nations. Live animals. FAOSTAT 2018; http://www.fao.org/faostat/en/#data/QA (Access: 20.03.2020).

14. Costa A, Negrini R, Marchi M, Campanile G, Neglia G. Phenotypic Characterization of Milk Yield and Quality Traits in a Large Population of Water Buffaloes. Animals, 2020; 10: 327.

15. Campanile G, Neglia G, Di Palo R, Gasparrini B, Pacelli C, D'Occhio MJ, Zicarelli L. Relationship of body condition score and blood urea and ammonia to pregnancy in Italian Mediterranean buffaloes. Reprod. Nutr. Dev., 2006; 46: 57–62

16. Meho LI, Yang K. Impact of Data Sources on Citation Counts and Rankings of LIS Faculty: Web of Science versus Scopus and Google Scholar. Journal of the American Society for information Science and Technology, 2007; 58(13): 2105–2125.

17. Rehn C, Gornitzki C, Larsson A, Wadskog D. Bibliometric Handbook for Karolinska Institutet. University Library Bibliometric Team, 2014; p39.

18. Oxford English dictionary. Retrieved Mars 19, 2014; From. http://dictionary.oed.com/.

19. Koehler W. Information Science as Little Science: The Implications of A Bibliometric Analysis of the Journal of the American Society for Information Science. Scientometrics, 2001; 51(1): 117–132.

20. Al U, Tonta Y. Citation Analysis: Sources cited in dissertations completed at Hacettepe University Department of Librarianship. Bilgi Dünyası, 2004; 5(1): 19–47.

21. Law R, Cheung P. An Analysis of Publications in Leading Tourism Journals and Its Implications. Journal of China Tourism Research, 2008; 4 (1): 78–97.

22. Gagolewski M. Bibliometric impact assessment with R and the CITAN package. Journal of Informetrics, 2011; 5(4): 678–692

23. Uddin A. scientoText: Text & Scientometric Analytics. R package version 0.1. [https://CRAN.R-project.org/package=sciento Textversion 0.1.4,http://github.com/jkeirstead/scholar], 2016.

24. Alavifard S. hindexcalculator: H-index calculator using data from a web of science (WoS) citation report. R package version 1.0.0.https://CRAN.R-project.org/package=hindexcalculator; 2015.

25. Aria M, Cuccurullo C. bibliometrix: An R-tool for comprehensive science mapping analysis. Journal of Informetrics, 2017; 11: 959–975.

26. Kessler MM. Bibliographic coupling between scientific papers. Journal of the Association for Information Science and Technology, 1963; 14(1): 10–25.

27. Glänzel W, Schubert A. Analysing scientific networks through co-authorship, Handbook of quantitative science and technology research (11), 2004; pp. 257–279.

28. Manuelian CL, Penasa M, Costa L, Burbi S, Righi F, Marchi M. Organic Livestock Production: A Bibliometric Review. Animals, 2020; 10: 540.

29. Sinclair M, Zhang Y, Descovich K, Phillips CJC. Farm Animal Welfare Science in China-A Bibliometric Review of Chinese Literature. Animals, 2020; 10: 540.

30. Freire R, Nicol C. A bibliometric analysis of past and emerging trends in animal welfare science. Animal Welfare, 2019; 28(4): 465–485. https://doi.org/10.7120/09627286.28.4.465

31. Arya C, Sharma S. Authorship trends and collaborative research in veterinary sciences: A bibliometric study. Chinese Librarianship: an International Electronic Journal, 2011; 34: 38–47, URL: http://www.iclc.us/cliej/cl34AS.pdf

———

Correspondence:
Senol Celik
Department of Animal Sciences, Biometry and Genetics, Faculty of Agriculture, Bingol University, Bingol, Turkey
Email: senolcelik@bingol.edu.tr