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Studies in Agro-Industrial Complexes: Analysis of Literature Indexed on the Web of Science 1945-2020

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Abstract

The research analyzes scientific publications in agro-industrial complexes based on the literature indexed on the Web of Science database. This is a bibliometric, exploratory-descriptive research. Using the descriptors "agro-industrial complex" or "agro-industrial complex", 171 articles were retrieved in February 2021. There was a prevalence of the Economics category and the Business Economics research area. The study showed an upward increase in the number of publications, especially in 2018. English was the predominant language with the largest number of publications, followed by Russian. The countries from which the largest number of publications originated were Russia, Ukraine, Czechoslovakia, Belarus and Kazakhstan. Of the twenty research institutions with the highest volume of publications in agro-industrial complexes, 60% are located in Russian territory. Finally, there was an ordering with a high dispersion of publications, so that 21 researchers concentrate 44 publications (5.80%) while 94.20% of researchers (341) have one publication each.

Keywords

Agribusiness, Agro-Industrial, Bibliometrics, Web of Science, Russia

1. Introduction

The classic concept of agribusiness as "the sum total of the operations involved in the manufacture and distribution of agricultural inputs; production operations on the farm; and the storage, processing and distribution of agricultural products and items made from them" proposed by Davis and Goldberg (1957) in their classic. The Concept of Agribusiness inaugurates the transition phase of the

conception of agriculture as a relatively independent industry as that the farmer would be able to operate decoupled from other industries for a modality where one starts to consider the dependence relations of that industry both upstream and downstream. From this point of view, agricultural activities are connected to a wide network of other players involved in the production of inputs, industrial transformation to storage and distribution of agricultural products and derivatives (Batalha & Silva, 2007).

A little over a decade after this first publication, RA Goldberg publishes a study analyzing a set of commodity systems (wheat, soy and orange) and advances from the description of the total agribusiness economy to a schematic analysis of the structure and performance presented in a constant process of change. In this sense, a commodity system covers all participants involved in the production, processing and marketing of a single agricultural product. It includes agricultural suppliers, farmers, storage operators, processors, wholesalers and retailers involved in a flow of commodities from initial inputs to the final consumer. It is also considered all the institutions that affect and coordinate the successive phases of this flow, such as the government, futures markets and trade associations (Jackson, 1968).

Prokhorova et al. (2016) understand the agro-industrial complex as a set of industries that encompass agriculture and industries related to agricultural production, transportation services, storage and processing of agricultural products, delivery to its user, supply of agricultural equipment, chemicals and fertilizers, thus serving all agricultural production. The characteristic of this configuration is its dynamism, explained, above all, in the most diverse models of analysis found in the specialized literature. In general, the agro-industrial complex can be understood as a network of economic and social factors that make up the agricultural business (Kalykova et al., 2018).

Having made this brief introduction, it should be noted that this study aims to quantitatively analyze scientific publications in agro-industrial complexes from the literature indexed on the Web of Science database.

The text is organized with the following structure. In addition to the Introduction (Section 1), the article presents in Section 2 a literature review, followed by Section 3, where the materials and methods are presented. Subsequently, in Section 4 the results of the research are presented and, finally, the conclusion (Section 5).

2. Literature Review

Agro-Industrial Complexes

Prokhorova et al. (2016) understand the agro-industrial complex (CA) as a set of industries that encompasses agriculture and industries related to agricultural production, transportation services, storage and processing of agricultural products, delivery to its user, supply of agricultural equipment, chemicals and fertilizers, thus serving all agricultural production.

For Frumkin (2016), an agro-industrial complex, with agriculture as a base for raw materials, comprises the entire inter-industrial scope, with its functional structure formed by specialized units and duly related both before and during production, in addition to the transport area. Agro-industrial complex consists of an interdisciplinary sphere of the economy, a conjunction of the reproduction cycles of specific groups of final products of agricultural raw materials; includes agriculture and industries directly related to agricultural production, transportation, storage, processing of agricultural products and delivery to final consumers, supply of machinery, chemicals and fertilizers, serving agricultural production (Semin & Kondratenko, 2019). The agro-industrial complex (AC) can be seen as the basis for the consolidated development of any country, since it is directly linked to its food security and economic robustness (Shashyna et al., 2018).

AC is a comprehensive inter-industrial structure, focused on the production and processing of agricultural raw materials, with a view to creating products for the final consumer. Traditionally, the agro-industrial complex comprises agriculture, construction of agricultural machinery and implements, factories for agrochemical products, food processing and other non-food products industries, infrastructure industries for logistical purposes (Dudin et al., 2016).

In this work, an agro-industrial complex will be defined as an agro-interindustrial structure conceived from a framework of converging actions under a certain coordination level, in which agricultural production (basic raw material) is the core of a set formed by several other components with multiple relationships with each other, in a dynamic exchange of positions (upstream and downstream) both in the supply of inputs, including machines, implements, various equipment, various phytosanitary products, technologies and biotechnologies, information, financing, as well as in all the necessary logistical infrastructure all links, as well as the corresponding services, up to the product or series of finished products intended for the final consumer.

The literature has demonstrated an effort to investigate the development of these agro-industrial conglomerates, mostly in countries like Russia where the government itself has fostered incentives (Kurdyumov, 2019). Ukraine also stands out as the development of agricultural production continues at an accelerated pace and has become the basis for the post-crisis recovery of the country's economy (Shashyna et al., 2018). Governments, development agencies, foundations, among other economic agents have directly and indirectly mobilized investments in agribusiness/agro-industry, using territorial approaches (Fao, 2017) and, in this particular, agro-industrial complex.

3. Materials and Methods

The study, characterized as exploratory-descriptive, used the bibliometric technique to analyze scientific production on the theme of the agro-industrial complex. Gauthier (1998) defines bibliometrics as a branch of scientometrics that

focuses mainly on the quantitative study of scientific publications for statistical purposes. Some authors have proposed stricter, and therefore more significant, definitions (Broadus, 1987). According to this author, bibliometric techniques have been used mainly to study the growth and distribution of scientific publications on a given topic. Potter (1981: p. 5) declared that bibliometrics is "simply, the study and measurement of publication standards for all forms of written communication and its authors".

The use of bibliometrics was considered with a view to identifying progress that has occurred in various areas of knowledge, with AC's as the basis of investigation, which is more appropriate, above all because it allows greater authenticity in the sources of scientific publications, as well as the establishment of a more robust for the verification of academic/scientific studies (Thelwall, 2008; Martínez et al., 2015). Furthermore, taking into account that the research interests that adopt AC's as a common analytical base cross multiple disciplines and sciences boundaries, the option for adopting this method was strengthened, since it is highly recommended for the analysis of interdisciplinary studies (Van Raan & Van Leeuwen, 2002).

The research, retrieved in February 2021, was carried out directly on the Web of Science (WoS) database using the descriptors "agro-industrial complex" and "agroindustrial complex" with the insertion of the Boolean operator "OR" to enlarge the scope of the search. The Web of Science is a multidisciplinary science-based platform developed by Thomson Reuters, Institute for Science Information (ISI).

4. Search Results

171 records were retrieved that met the pre-established requirements for the search and subsequent analysis. Only Articles-type documents were chosen for this study. Table 1 presents the total sample and preliminary analytical information for the data sets that will be analyzed in this study.

Unusually, a record may appear in more than one classification category. In the study in question, the total number of records exceeds the analyzed amount by three (174), which corroborates the previous statement. However, it was decided to contemplate only the first ten categories, whose results were more superior, with representative values (128 records) in the approximate order of 3/4 of the total (74.85% of 171 records). The fifteen other categories not considered

Table 1. Total sample and basic analytical information of the analyzed data set.

Data Base	Selection	Type	Language	Analytical Information		Retrieved Date
				Frequency	Papers/Articles	
Web of Science (WoS)	Contain the explicit descriptors in the respective titles and/or subtitles	Articles	All available at Base	1945-2020	171	fev. 02. 2021

had a number of records ranging from 2 to 4. In addition, it is clarified that, in this amount of records considered in the ten most expressive categories (128), there was no occurrence of repetition of records. Table 2 shows the ten (10) most representative Web of Science Categories.

CAI can be seen as the basis for a country's consolidated development, especially in its relationship with food security and economic strength (Shashyna et al., 2018); this corroborates the fact that the Economics category occupies the first position in the ranking with approximately 1/3 of the records. Nevertheless, since in general terms the conceptual spectrum includes an economic interdisciplinary, a conjunction of several other fields of study intrinsically connected, such as agriculture, logistics, the supply of raw materials, inputs, management as a whole and, above all, the focus on the final consumer (Semin & Kondratenko, 2019), the following more expressive categories seem to indicate an alignment with the literature, notably lacking the History category of a separate study, which may allow significant findings.

As for the number of articles published per year, there is a gradual increase in publications. In general, in the early years of the period, publications were limited to one article per year, especially in the 1960s to 1990s (the first publication occurred in 1967), with the years 2008, 2012 and 2014 being exceptionally included.

With small variations, this pattern is maintained for the quantity of two articles per year (1973, 1974, 1975, 1977, 1980, 1981, 1992, 2013); three articles per year (1972, 1976, 1978, 1984, 1987, 1999, 2011); four articles per year (1970, 1979, 1982, 1986, 2015) and five articles per year (1983, 2009). Not unlike the years that presented only one publication, the others have in common their outliers (2013, 2011, 2015, 2009), highlighting those that differ from the other decades because they are more recent (less than 13 years, considering 2008).

Figure 1 illustrates the data obtained from the number of publications/records

Table 2. The ten most representative categories of WoS.

	Category	Registry	% of total
1	Economics	51	29.82
2	Political Science	14	8.19
3	History	13	7.60
4	Multidisciplinary Science	12	7.01
5	Agriculture Multidisciplinary	9	5.26
6	Agricultural Economics Policy	7	4.09
7	Business	7	4.09
8	Biotechnology Applied Microbiology	5	2.93
9	Food Science Technology	5	2.93
10	Management	5	2.93
	Total	128	74.85

Table 3. Number of publications per year and quantity.

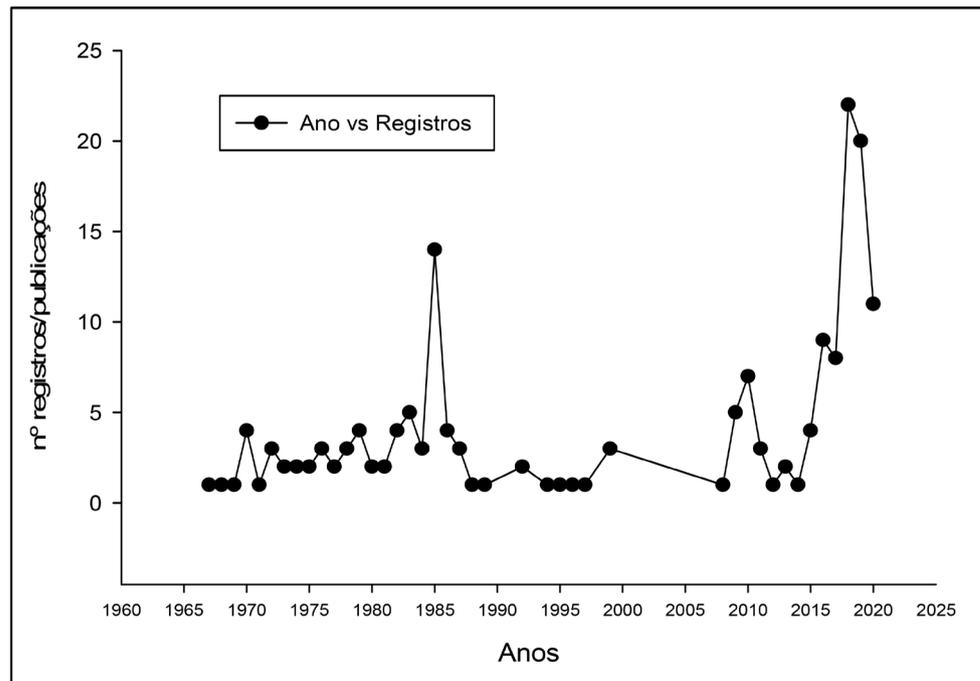| Registry	Years	Registry/Year	% of total (171)
1	1967,1968, 1969, 1971, 1988, 1989, 1994, 1995, 1996, 1997, 2008, 2012, 2014	13	7.60
2	1973-1975, 1977, 1980, 1981, 1992, 2013	16	9.37
3	1972, 1976, 1978, 1984, 1987, 1999, 2011	21	12.28
4	1970, 1979, 1982, 1986, 2015	20	11.69
5	1983, 2009	10	5.86
7	2010	7	4.09
8	2017	8	4.68
9	2016	9	5.26
11	2020	11	6.43
14	1985	14	8.19
20	2019	20	11.69
22	2018	22	12.86
Total		171	100.00

Figure 1. Number of records/publications per year (increasing scale).

and their respective years.

As of 2014, there has been an increase in publications in the year, with the year 1985 as a "point outside the curve". In the graphic illustration, the peak of publications growth in the year is noticeable, corroborating the fact that the number of publications in that single year exceeds the sum of the number of

publications of more than a decade, considering the initial years and some more recent ones (1967, 1968, 1969, 1971, 1988, 1989, 1994, 1995, 1996, 1997, 2008, 2012, 2014).

Given the strategic character of CAI (Shashyna et al., 2018), the verified increase in the number of publications points to what Kalykova et al. (2018) understood it as an "upward movement", especially when advocating the adoption of policies to encourage the development of agro-industrial complexes.

38 research areas involved in the subject in question were listed, so that only the 10 most expressive ones will be presented here. Table 4 lists these areas, presenting the number of records (publications) for each one.

The more general concept of CAI, understood in an interdisciplinary sphere of economics (Semin & Kondratenko, 2019) involving the most diverse players, both upstream and downstream, especially in the agro-industrial economy, as well as the direct implication of complexes in economic development and competitiveness of a country, can sufficiently justify the ascendancy of the Business Economics research area, whose number of records is equivalent to the sum of the records of the next four best positioned areas (Agriculture, Government Law, Science Technology Other Topics, History).

English is the predominant language of publications with approximately 58% of the total records, followed by Russian (28.07%) and Czech (8.19%). Despite the fact that the English language is considered a universal language, publications on AC's in the Russian language represent close to 49% of the records in the English language. Figure 2 systematizes the data in table format and graphically for better understanding.

The information presented in Figure 2 directly reflects the information systematized in Figure 3. The three countries that lead the origin of the publications, Russia (69 records), Ukraine (19) and Czechoslovakia (11), totaling 99 records, represent well over half of the volume of records retrieved and analyzed in this study (57.9% of 171).

Table 4. Research areas and respective record numbers.

	Research area	Registry	% of total
1	Business Economics	64	37.43
2	Agriculture	21	12.28
3	Government Law	16	9.36
4	Science Technology Other Topics	14	8.19
5	History	13	7.60
6	Biotechnology Applied Microbiology	5	2.92
7	Engineering	5	2.92
8	Environmental Sciences Ecology	5	2.92
9	Food Science Technology	5	2.92
10	Social Sciences Other Topics	5	2.92

Idiomas	Registros	% of 171
English	99	57.895
Russian	48	28.070
Czech	14	8.187
Spanish	6	3.509
French	2	1.170
Ukrainian	2	1.170
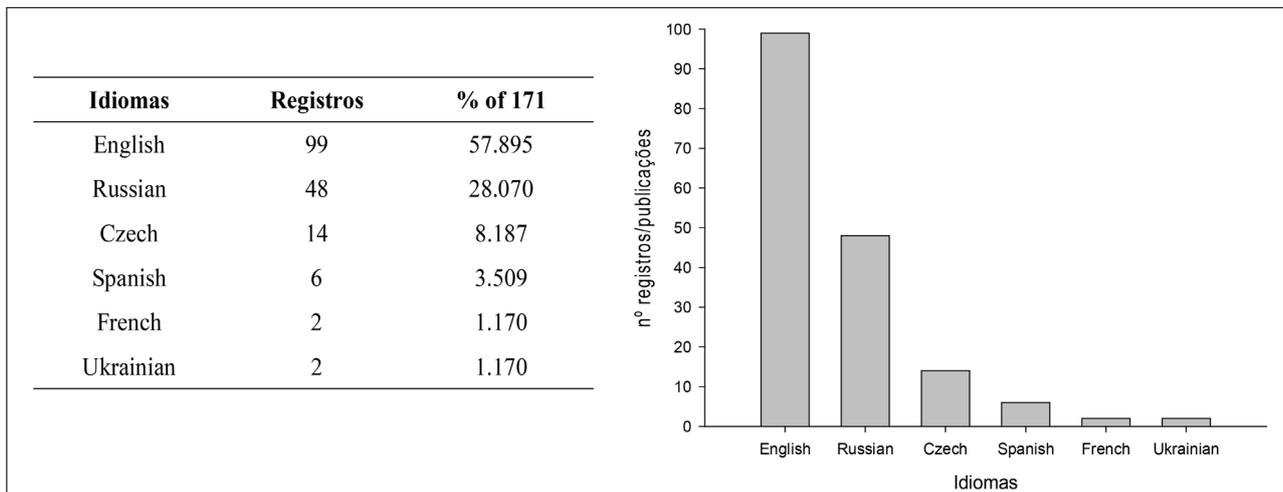
Figure 2. Languages and quantities of records/publications.

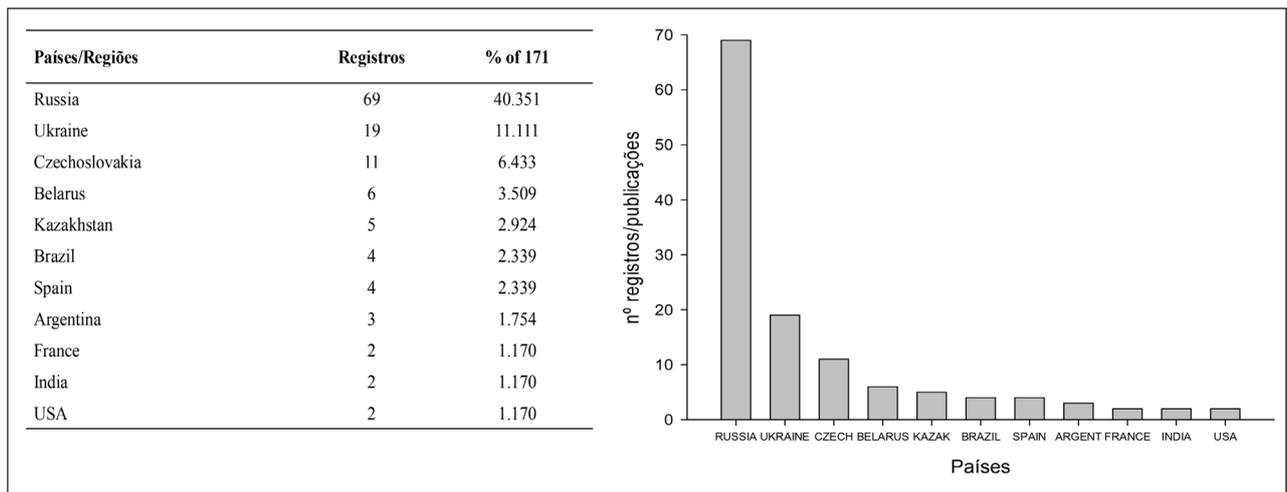| Países/Regiões	Registros	% of 171
Russia	69	40.351
Ukraine	19	11.111
Czechoslovakia	11	6.433
Belarus	6	3.509
Kazakhstan	5	2.924
Brazil	4	2.339
Spain	4	2.339
Argentina	3	1.754
France	2	1.170
India	2	1.170
USA	2	1.170

Figure 3. Countries/regions of origin of publications.

The quantitative pattern of publications from the countries of Eastern Europe, Eastern Europe, North Asia and the surrounding areas (Figure 3) is maintained when checking the academic institutions and research institutes to which the authors are linked. Among the twenty most prominent institutions, 12 (60%) are located in Russian territory, representing 54.8% of the sum of the records of the best positioned. Ukraine comes in second place with 3 organizations in its territory (15%), representing 26.18% of the publications. Belarus ranks third, with 9.51% of the publications, the same percentage value of the publications together from Czechoslovakia, Argentina and France (9.51%).

Table 5 presents the twenty most prominent academic institutions in the AC research area, based on the institutional link informed by the authors directly in the publications (papers).

It appears that the findings of this analytical bibliographic study, on the WoS platform, corroborate the prevalence of research and, consequently, publications

Table 5. The 20 most prominent academic institutions in research in the field of CA.

Organization	Registry	Country
Ministry of Education Science of Ukraine	16	Ukraine
Russian Academy of Sciences	11	Russia
Acad SCI USSR	5	Russia
Kuban State Agrarian University	5	Russia
Czech Academy of Sciences	4	Czechoslovakia
Inst Syst Research Agro Complex of the Nat Acad of Sc of Belarus	4	Belarus
Kabardino Balkarian State Agricultural University	4	Russia
Kuban State Technological University	4	Russia
Lviv National Agrarian University	4	Ukraine
National Academy of Sciences of Belarus, NASB	4	Belarus
Kabardino Balkarian State Univ	3	Russia
Krasnodar Univ	3	Russia
Russian Univ Cooperat	3	Russia
Chechen State University	2	Russia
Consejo Nacional de Investigaciones Cientificas y Tecnicas	2	Argentina
Financial University Under the Government of Russian Federation	2	Russia
Inst Rech Agron Trop	2	France
Institute of Economics Russian Academy of Sciences	2	Russia
Kazan Federal University	2	Russia
Mykolayiv National Agrarian University MNAU	2	Ukraine

with the object of study the agro-industrial complexes with predominant origin in the countries of Eastern Europe, Eastern Europe, North Asia and regions next, which is in line with what was proposed by Kurdyumov (2019). The same pattern can be seen with regard to funding agencies. At the top of the list are foundations, state organizations, government agencies (Fao, 2017), among others, mainly located in Russian territory (50%) and nearby countries.

As for the authors, the systematization (Table 6) presents at the limit of those who have two or more publications. Therefore, as of the twenty-second author, all the others have a single publication.

In addition, it is worth observing the order itself, characterized by the high dispersion of publications. The total of 385 publications is distributed among 362 authors, with those presented in Table 6. In other words, 21 authors concentrate 44 publications (5.80%), while the remaining 341 specialists (94.20%) have one publication each.

5. Conclusion

The present study sought to analyze publications indexed on the Web of Science in the period from 1945 to 2020 on the theme "agro-industrial complexes". It was found that the majority of publications come from Eastern European countries, with emphasis on the Russian Federation.

Table 6. Authors with two or more publications on CAI in the researched period.

Nº	Authors	Registry	% of 385
1	Divila E	3	0.7792
2	Tekueva MT		
3	Ange A		
4	Anonymous		
5	Bertrand R		
6	Bourgeon G		
7	Bronshtein M		
8	Dokholyan SV		
9	Dudin MN		
10	Gusakov EV	2	0.5195
11	Kotenev A		
12	Kraus J		
13	Melnikov A		
14	Mikitaeva IR		
15	Morozov V		
16	Savenko VG		
17	Simush PI		
18	Staroverov VI		
19	Trysyachny V		
20	Veselovsky MY		
21	Yarema LV		
	Total	44	

This investigation has some limitations that need to be considered. The first of them concerns the fact that the search was carried out only on the basis of indexing journals, although it is considered to be an international reference. The second limitation refers to the fact that the study did not advance to a more qualitative analysis of published articles, such as co-authors, citations, co-citations, high index, among others, although this was not the scope defined a priori for the research, since, due to the space, it was decided to expose data that would validate the initial assumption of this investigation.

In this sense, it is proposed as an agenda for future studies, an investigation that broadens the search bases, in addition to contemplating qualitative aspects in its analysis.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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