

BIBLIOMETRIC ANALYSIS OF THE ACADEMIC PRODUCTION ON CARBON CREDITS IN BRAZIL

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ABSTRACT

This article has as its main objective the bibliometric analysis of the Brazilian academic production with regards to carbon credits. It is an important emerging theme in the environmental control area. A documental study was thus conducted, whose source was 44 articles published from three major events in the scientific accounting field along with journals classified as A1 to B3 evaluated by the Qualis/Capes system for the period 2005-2014. The survey results revealed that: a) of the 96 authors who dedicated time to researching the carbon credit issue 33 (34,4%) had a master degree followed by 32 (34,3%) with a doctoral degree or Post-doctoral studies; b) 23 of the 44 articles were written by 6 authors where the most prolific was Maisa Ribeiro, of the School of Economics, Business and Accounting of the University of São Paulo (FEA/USP) with 6 articles and Vanderlei dos Santos of the State University of Santa Catarina (UDESC) with 5 articles; c) The University of São Paulo and the State University of Santa Catarina (UDESC) were also the institutions that had the most researchers on the topic (11 each) affiliated to them; d) The most sanctioned national journal on the topic was the *Revista de Informação Contábil* (RIC), or roughly translated as the *Journal of Accounting Information* and the international one was *Accounting, Organization and Society*; e) 79,1% of the referenced material utilized was of national origin; f) the most referenced works were written by Gabriel Sister and Antonio Carlos Porto Araújo.

Keywords: Carbon Credits. Bibliometric Analysis. Academic production.

1 INTRODUCTION

In times of noticeable changes in the global climate, environmental agencies, governments and society are organized in an attempt to solve the problems occurring in the environment. Consequently, the environmental responsibility is an increasingly important issue, both in academia, and in business. The carbon market has developed in this context by international organizations that bring together countries involved with the climate challenge. Roughly speaking, one can describe the carbon market as a mechanism that helps to increase the profits of companies operating in developing countries, applying methods to stop polluting or to diminish polluting. This market has grown and generated foreign exchange for the undeveloped countries, such as Brazil.

Since the establishment of this mechanism, the issue of carbon credits has attracted the interest of accounting researchers, trying to understand, question, evaluate its peculiarities. The issue has been debated in important scientific events in the country, such as the National Association of Graduate Programs in Accounting (ANPCONT), the USP Congress of Controllershship and Accounting and, in particular, at the meeting of the National Association of Post-graduation and Research in Administration (EnANPAD). Against this background of expansion in academic and professional circles, the issue has also featured in the publications of national periodics, evaluated by the Higher Education Personnel Training Coordination (CAPES).

Considering that the evolution of knowledge in a specific area is mainly achieved by the investigation of teachers, students and professionals through the creation and application of new theories or the increase of existing initiatives, this study has the general objective of analyzing academic production with regards to carbon credit found in the three main scientific accounting events (Congress USP, EnANPAD and ANPCONT) in addition to the publications assessed under the Qualis/CAPES system during the period 2005-2014.

Based on the preliminary finding that the subject is little explored in academia, the study was conducted in order to answer the following research question: How do you characterize the various aspects of academic research published in Brazil on the subject of Carbon Credit? As such, considering that the proposed bibliometric study on the carbon credit is something necessary and particularly useful to advance the research on the subject, this paper is also justified because the economic impact on the results of the companies interested in promoting sustainable development.

This study is divided into six sections. The first section provides an introduction to the subject. The second and third sections discuss the theoretical basis on the following topics: bibliometrics and its laws and carbon credits. In the fourth section the methodological procedures adopted in the construction of the study are listed. The following section provides a discussion on the results found from the documentary analysis of the 44 collected articles. The conclusion is treated in the sixth and final section, which outlines the contributions and limitations encountered in implementing the study.

Finally, it is expected that this study will make a contribution to future research on carbon credits in Brazil, due to the fact, in particular, that it has provided a quantitative description of the scientific production and the ordering of experiences and knowledge of those who made efforts to understand this issue during the last decade.

2 CARBON CREDIT

2.1 ORIGIN, CONCEPT AND MARKET FOR CARBON CREDIT

The Kyoto Protocol has created market mechanisms to encourage the fulfillment of the goals it established. Among the novelties that have emerged, there is the Clean Development Mechanism (CDM), which tries to encourage the implementation of a production chain to substitute polluting activities with renewable ones. This process must always relate the developed countries to the ones still in the development process since the Protocol determines that projects should be implemented only in the second group of countries with financial commitments from the first. These projects backed by the CDM and monitored by national and international authorities, designated by the United Nations (UN), generate the Certified Emission Reductions (CERs), which are also called Carbon Credits. According to Seiffert (2013, p.60):

(...) An important issue associated with the carbon market is the semantic agreement or adopted conventions. The Certified Emission Reductions (CERs) are a consequence of certified carbon credits from a CDM project registered with the UN. Therefore, CERs can only be obtained after the CDM project registration with the CDM Executive Board (CEMDL) of the UN and validation and certification of the project's monitoring plan and the implementation of the Designated Operational Entity (DOE).

Developing countries are, in fact, the most vulnerable to climate change, in terms of having historically lower ability to respond to natural climate variability (CONEJERO, 2006). However, even with this feature, companies and developing country governments found, in combating pollution, an alternative source to increase revenue and reduce emissions of greenhouse gases (MARTINEZ, 2007). It is the commercialization of carbon credits, as these projects can be sold by specialized environmental brokers, the project implementers being allowed to sell credits even before they are generated.

In fact, in order to achieve Kyoto targets, buyers will only be allowed to use credits after they have been established and responsibility contracts associated with the agreements are under execution (COSTA, 2000). Limiro (2008, p.121) understands that, "due to its commercial nature, as well as being equivalent to one metric ton of carbon dioxide, the RCE is a kind of carbon credit, whose transaction is part of a new market: the carbon market."

The industrialized countries listed in Annex I of the Kyoto Protocol can purchase carbon credits from companies located in countries not listed, but which are acceding to the Protocol. The Companies may purchase credits or invest in CDM projects, and thereby be able to meet its reduction target in the emission of Greenhouse Gases (GHGs).

The carbon market has attracted the interest of many countries, since it has moved many sectors of the world economy and involved companies interested in promoting sustainable development. This market has been implemented from the provisions of the Kyoto Protocol, which has strived to make the implementation of reduction targets of GHG emissions feasible. In this market, according to Viola (2003, p.190) one can find, as participants:

Countries which are part of Annex I, encompassing the developed countries of the Organization for Economic Cooperation and Development (OECD) and the ex-communist industrialized countries in transition to a market economy, which have commitments to reduce greenhouse gases. The second group, called countries which are Non-Annex I participants, aggregates the developing countries that do not have

reduction commitments, but are required to develop national carbon emission inventories.

The market mechanism allows developed countries to invest in projects aimed at reducing and /or the removal of greenhouse gases in developing countries. These CERs, originating from the projects carried out in the developing countries, may be sold to industrialized countries if they have not reached the goals set by the Protocol (Limiro, 2008). Truly it is a new and very promising market for Brazil, since there is great potential for these types of projects provided for in the CDM regulations. According to Segala & Felipetto (2007, p.35-36):

In Brazil, through an agreement between the Ministry of Development, Industry and Foreign Trade and the Mercantile and Futures Exchange (BM & F), created the Brazilian Market for Emissions Reduction, which aims to develop an efficient system certificates of negotiating carbon. The agreement includes four actions: development of a project database; training of traders (traders) and multipliers; creation and implementation of the forward market of carbon certificates and proposing potential lines of funding to projects presented.

Given the above, as well as the well structured legal framework existing in the country, Brazil has a very good chance of developing a robust market in this area

2.2 MEASUREMENT OF CARBON CREDITS

A gas emission reduction project will generate a product that will be expressed in CO₂ equivalent (origin of the name Carbon Credit Market), which becomes a standard product (commodity) after issuance and registration of Emission Reduction Certificates (SEGRETI; BITO, 2006). According to Limiro (2008, p.64), "The CER is measured in tons of carbon dioxide equivalent metrics (CO₂eq. /T), i.e. each ton of CO₂ equivalent corresponds to a CER, as defined in § 1, Decision 17 / CP.7, in his art. 1, item 'b'." GHGs for quantifying the uniformity effect were rated on a carbon dioxide equivalence table (CO₂). So we can quantify the CERs in CO₂ and CO₂ equivalent. Seiffert (2013, p.54) states that:

The carbon equivalent is a measure that has been set by virtue of the recognition that Greenhouse Gases (GHGs) have different potential contribution to global warming. It is used to compare the various GHG emissions, taking as the basis amount of carbon dioxide (CO₂) which have the same global warming potential (Global Warming Potential - GWP), measured in a specified period of time, thus estimating how much environmental impact was generated by the same amount of a different kind of gas. It takes as reference in this process a period of 100 years.

The global warming potential of equivalence framework for Greenhouse Gases is displayed in the following table.

Table 1 - Global warming potential of greenhouse gases

Group	Name	Equivalence
CO ₂	Carbon Dioxide 1	1
CH ₄	Methane	21
N ₂ O	Nitrous Oxide	310
HFCs	Hydrofluorocarbons	140~= 11.700
PFCs	Perfluorocarbons	6.500~= 9.200
SF ₆	Sulfur hexafluoride	23.900
NF ₃	Nitrogen trifluoride	(1)
(1) Annex I of the Kyoto Protocol was amended by a decision of the COP 17, 2011. Source: Available at: < http://unfccc.int/files/meetings/durban_nov_2011/decisions/application/pdf/wgkp_outcome.pdf > . Access on: 13 March 2012.		

Source: Adapted from Seiffert (2013).

Importantly, there is no absolute harmony among experts regarding the presented parameterization, since there are many arguments both for those who defend, as to those who are against its use, due to the differences in methodology applied to quantify the effects of global warming.

2.3 ACCOUNTING ASPECTS OF CARBON CREDITS

The generation of carbon credits includes the changes in a company's equity that must be accounted for. According to Martins *et al* (2012, p.4), "carbon credits have been classified as intangible assets, stocks, derivatives and special assets." In other words, the literature on carbon credits has no consensus yet on the subject. However, there is an unanimous opinion that the carbon credits are part of a company's assets, although differences remain on their sub-classification.

Uhlmann *et al* (2012, p. 324) base their argument on the Accounting Pronouncements Committee (CPC) to explain that "according to the CPC-39, financial instrument is a contract that gives rise to a financial asset in one entity and a financial liability or equity instrument in the other entity." These authors studied and compared the CPCs 04 R1 (Intangible Assets), CPC-16 R1 (stocks), CPC-38 (Financial Instruments: Recognition and Measurement) and CPC-39 (Financial Instruments: Presentation), and concluded that the carbon credits are financial assets, since they are instruments of trade and goods not in use (MARTINS *et al*, 2010).

3 BIBLIOMETRICS

3.1 CONCEPT, ORIGIN AND IMPORTANCE OF BIBLIOMETRICS

Bibliometrics is the technique that is dedicated to the measurement of scientific production, using laws and principles applied to statistical and mathematical methods to investigate what was produced in a particular area of knowledge. The Bibliometrics can also be described as a study that tries to quantify the processes of written communication (PRITCHARD, 1969). Araújo (2006, p. 12) states that this type of analysis "appeared at the beginning of the century as a symptom of the need to study and evaluate production activities and scientific communication". Early work in the area used the term to designate

Bibliography Statistical studies that measured the production and dissemination of knowledge.

The term statistical bibliography was first used in 1922 by Edward Wyndham Hulme, at a conference at the University of Cambridge (FONSECA 1986 cited MELO *et al*, 2013). Guedes and Borschiver (2005, p. 2) states that in that event, Hulme used the term "to clarify the connotation of scientific and technological processes, through the document counting." This connotation is currently inserted in the Bibliometrics playing field. Such a designation, however, would only emerge decades after that event, when it was broadcast by Allan Pritchard, in his article on Statistical Bibliography Bibliometrics, published in 1969 (PAO 1989, cited by GUEDES; BORSCHIVER, 2005). Also according to this author, Pritchard noted that literature is the key ingredient in the knowledge communication process. So he developed the idea that journal articles and books can be studied statistically.

Bibliometric studies are quantitative analyzes; they are metric studies of information. They aim to map the data analyzed, providing indicators that reveal patterns used in established ways. As Macias-Chapula says (1998, cited by SOUZA *et al*, 2012), Bibliometrics is the study of quantitative traits of scientific publications, concerned with the measurement, dissemination and use of scientific production information.

In the beginning, Bibliometry was busy studying the extent of the books, as the edited quantity, size of copies, number of words, etc. It was later directed to scientific production in order to quantify various aspects of this area. The bibliometrical technique can be used to evaluate the performance of researchers, research trends identified by analyzing quotes, analyze the obsolescence of scientific literature, among other purposes.

3.2 LAWS OF BIBLIOMETRICS

Information science scholars have developed methodologies that have become landmarks of bibliometric development and became known as 'laws of Bibliometrics'. The methods are: the method of measuring scientific productivity of Lotka, the dispersion law of scientific knowledge of Bradford and the distribution model and frequency of words in a text of Zipf (ARAÚJO, 2006). These methodologies were conceptualized according to Guedes and Borschiver (2005) as follows:

- a) Lotka's Law deals with the productivity of scientists. According to Vanti (2002, cited in ROSE, 2012) a size-frequency distribution model of several authors is applied and considers that some researchers, supposedly the most prestigious in a particular area of knowledge, produce very much while the less prestigious researchers supposedly produce little;
- b) Bradford's Law analyzes the spread of scientific knowledge, while this allows for the estimate of the degree of relevance of the journals in a given field of knowledge. Guedes and Borschiver (2005) state that this law is a useful tool for the development of the acquisition and disposal of periodic policies therefore possible to estimate the magnitude of a particular bibliographic field;
- c) Zipf's Law focuses on the assessment of the distribution of words in a text, allowing us to estimate the relationship between words and the frequency of the occurrence of words and the region of concentration of keywords. This law allows the word count on wide sampling, indicating the number of order (importance) of these words. Zipf realized that the most used words indicate the subject of the document (ARAÚJO, 2006).

Chan *et al* (2007, p. 3, cited by ROSA, 2012) reported that, traditionally, "the bibliometric analysis makes use of concepts present in the laws of Bradford, Lotka and Zipf, which present specific approaches to productivity periodicals, scientific productivity of authors and frequency of words, respectively. " The three laws cited work distributions of scientific papers which have similar properties, that is, physical pattern or the like content, consistent forming sample showing relevant data (CUP; BRASCHER, 2008).

3.3 FIRST BIBLIOMETRIC STUDIES IN THE WORLD AND IN BRAZIL

The first genuinely bibliometric work was published in 1917 by Cole and Eales, who investigated books dated from 1550 to 1860, making a statistical analysis of the Comparative Anatomy bibliography. (SCHMIDMAIER, 1984, cited by FARO and Silva 2008); (FONSECA, 1986, cited by MELO *et al*, 2013). In Brazil, according to Araújo (2006, p.21), "bibliometric studies proliferated in the 1970s, mainly to the studies conducted in the Brazilian Institute of Bibliography and Documentation (IBBD)". According to the author, such work focused on various areas of science, such as chemistry, geology, and health, among others.

In the field of Accounting there is an increment in international publications of bibliometric studies since the 1980s, involving different themes, such as the evaluation of periodicals, institutional checks and Academy of criticism, among others (MELO *et al*, 2013). The first national bibliometric studies in the accounting area came later, with the work of Riccio *et al* (1999) who analyzed the Brazilian scientific production in the Accounting area from 1962 to 1999; Frezatti (2000) investigated the patterns of international scientific journals in the area of Accounting; and Oliveira (2002) studied the content and form of accounting journals in the country.

4. METHODOLOGY

This section of the report presents the methodological procedures adopted in this study, which are the means used to guide the research and present the results obtained. In this research the inductive method was used, for assuming that a survey was conducted of the largest possible number of articles with the carbon credit issue within the established parameters to qualify them, seeking to discover the profile of definitive research on carbon credit in Brazil.

The universe observed in this study consists of articles concerning carbon credits, presented in Brazilian scientific conferences, as well as those articles published in journals evaluated by Qualis/CAPES system in the period 2005-2014, classified as A1 to B3. Data collection was performed by consulting the websites of journals and conferences. Also the Lattes platform of the National Scientific and Technological Development Council (CNPq) was consulted, for academic information on authors and co-authors.

Scientific research can be classified in many ways, due to the diversity of epistemological perspectives that can adopt and differentiated approaches taken (SEVERINO, 2007). For the study in question, it was decided to use the approach presented by Beuren *et al* (2010), as these authors identify a methodological grouping applicable to research in the area of Social Sciences. With regards to the objectives, the research is exploratory-descriptive. It is a documentary research, where the sources of primary data are scientific articles presented at

conferences and published in journals. It is designed to measure the academic literature on the subject of carbon credits in the current accounting context. The research is both qualitative and quantitative in nature, aimed at measuring the content of scientific papers presented during the period of 2005 and 2014.

The data collection instrument was divided into three sections: the first presents general data about the items (year, amount of authors and the publishing periodic); the second presents general information about the authors (affiliated institution, number of authors for the article, academic formation and titles); Finally, the last section presents the overall data on the references of the articles (types of references, temporality of the documents, type of authorship, languages used for the documents, national and international journals that were referenced). The data collected was processed through the Statistical Package for Social Sciences (SPSS), which helped in the construction of tables used in the presentation and discussion of the results.

Table 1 shows that, from 2005 to 2014, 44 articles on the issue of carbon credits were identified, 24 published in the three largest scientific events in the accounting field and 20 in journals evaluated by Qualis / CAPES in the areas of administration, accounting and tourism. Among the three scientific events presented, 15 articles were presented at the ENANPAD Congress, followed by 6 articles at the USP Congress, and only 3 papers were presents at the ANPCONT Congress.

Table 1 - Number of articles collected by congress or journal on the carbon credit issue

Sources of articles	Number of articles	%
ENANPAD Congress	15	34,1
ANPCONT Congress	3	6,8
USP Congress	6	13,6
SUBTOTAL 1 - ARTICLES PUBLISHED IN SCIENTIFIC EVENTS	24	54,50
Revista de Informação Contábil (RIC)	3	6,8
Revista de Administração da PUC-RS	1	2,3
Revista Brasileira de Gestão de Negócios	1	2,3
Revista Conjuntura Internacional	1	2,3
Revista Contabilidade Vista & Revista	1	2,3
Revista de Contabilidade do Mestrado de Ciências Contábeis da UERJ	1	2,3
Revista de Contabilidade e Organizações (RCO)	2	4,5
Revista de Educação e Pesquisa em Contabilidade (REPEC)	3	6,8
Revista de Contabilidade da UFBA	1	2,3
Revista de Administração, Contabilidade e Sustentabilidade (REUNIR)	1	2,3
Revista eletrônica Saber Contábil (RESC)	1	2,3
Revista de Administração e Contabilidade (REAC)	1	2,3
Revista de Administração, Contabilidade e Economia (RACE)	1	2,3
Revista Contabilidade Gestão e Governança	1	2,3
Revista Pensar Contábil	1	2,3

SUBTOTAL 2 – ARTICLES PUBLISHED IN SCIENTIFIC JORNALS	20	45,50
TOTAL NUMBER OF ARTICLES	44	100,0

Source: Research data.

On the other hand, with respect to publications in journals, of the 476 journals listed by Qualis / CAPES, only 20 articles were found for the period studied. It can be observed in Table 1 that the Journal of Accounting Information (RIC) and the Journal of Education and Research in Accounting (REPEC) were the most used by researchers on this theme, with three publications each. Second place is given to the Journal of Accounting and Organizations (RCO), with 2 articles published, while all the other journals only published one article each in the period surveyed (TABLE 1).

5 DISCUSSION OF THE RESEARCH FINDINGS

This section presents and discusses the results obtained from the bibliographic analysis. First, it provides information on the authors of the Carbon Credit theme in Brazil. Next, it deals with the academic characteristics of the authors and the frequency of their publications and their University affiliation. This is followed by the type of references cited by the authors and the name of the most cited authors. Finally, more technical information is presented such as the language utilized in the publications, timeliness of the articles, number of authors per publication and the basic themes presented.

5.1 INFORMATION ABOUT THE AUTHORS

Table 2 reports the amount of authors per article studied. When analyzing these data, it is clear that the most active researchers on the Carbon Credit theme were among the groups of 2 or 3 authors. The frequency of these groups is similar to each other with the two authors groups representing 31,8% of the total while the three authors group represents 34,1% of the articles. Other authors were dispersed between single authorship to 6 authors and all these other groups together accounted for 34,1% of all published articles.

Table 2 - Number of authors who participated in the articles analyzed on carbon credit

Authors	1 Author	2 Authors	3 Authors	4 Authors	5 Authors	6 Authors	Total
Frequency	2	14	15	8	2	3	44
%	4,5	31,8	34,1	18,2	4,5	6,8	100,0

Source: Research data.

Table 3 investigates the academic degree of the 96 authors who dedicated themselves to researching the carbon credit issue. The most frequent academic degree registered was that of the master degree present in 34,4% of the authors, followed by the doctoral degree, 27,1%. This result confirms the predominance of the Post Graduate group in the Brazilian academic production especially if you add the Postdoctoral and Free-teaching authors to this group for a

total of 69,9% of the total number of authors. It is interesting to also note that 18,8% of the authors were still university students.

Table 3 - the academic level of the authors of articles on the carbon credit issue

Academic Degree	Free-teaching	Postdoctoral	PhD	Master	Specialization	Under Graduate	Total
Frequency	2	6	26	33	11	18	96
%	2,1	6,3	27,1	34,4	11,5	18,8	100,0

Source: Research data.

Table 4 specifies the researchers who have published more about the carbon credit issue from 2005 to 2014. Prof. Maisa Souza Ribeiro, affiliated with the School of Economics, Business and Accounting of the University of São Paulo (FEA / USP) was the most prolific, with six articles. This researcher defended a thesis on this subject and besides having published articles on the subject, has acted as major professor for several students in the academic world, with theses and other scientific works on the thematic. Second place is attributed to Vanderlei dos Santos of the University of the State of Santa Catarina (UDESC) with five published articles. Other authors presented a production of only three articles each.

Table 4 - The most prolific Authors on the carbon credit issue

Author	Institutional Affiliation (1)	Articles
Maisa de Souza Ribeiro	University of São Paulo (USP)	6
Vanderlei dos Santos	State University of Santa Catarina (UDESC)	5
Elizio Marcos dos Reis	Nova Faculdade (NF)	3
Guineverre Alvarez Machado de Melo Gomes	Federal University of Bahia (UFBA)	3
Layla Beatriz Boos Martins	State University of Santa Catarina (UDESC)	3
Terezinha Vicenti	Universidade do Estado de Santa Catarina (UDESC)	3
(1) According to data from the last article.		

Source: Research data.

Listing the 96 authors of carbon credits according to the institutions to which they were affiliated, Table 5 shows that the University of São Paulo (USP) and the State University of Santa Catarina (UDESC) occupied the first position of the ranking, with 11 researchers each. The second position is occupied by the Regional University of Blumenau (FURB), with 9 researchers, followed by the Federal University of Bahia (UFBA) 8, which ranked third.

Table 5 - List of the amount of authors per article by affiliated institution

Institution of higher education	Frequency	%
Federal University of São Paulo (USP)	11	11,5
State University of Santa Catarina (UDESC)	11	11,5
Regional University of Blumenau (FURB)	9	9,4
Federal University of Bahia (UFBA)	8	8,3
Federal University of Pernambuco (UFPE)	7	7,3
Foundation Institute Capixaba of Accounting, Economic and Financial Research (FUCEPE)	4	4,2
Federal University of Minas Gerais (UFMG)	4	4,2
Nova Faculdade (NF)	3	3,1
Federal University of Rondônia (UNIR)	3	3,1
9 Educational Institutions with only 2 author found	18	18,8
18 Educational Institutions with just one author found	18	18,8
Total	96	100,0

Source: Research data.

5.2 INFORMATION REFERENCES

To analyze the 349 references found in 44 articles about carbon credits, initially the data were separated into national and international groups. They were then divided into seven categories of documents: 1) book; 2) Periodic; 3) Proceedings; 4) Academic documents; 5) Reports and communications; 6) Email and 7) Other. In this context, by dividing the total amount of references used (349) with the number of published articles (44), it is clear that researchers have used an average of eight references for each article produced.

According to Table 6, Brazilian authors used predominantly national materials (79,1%) to support their research, although the issue is often discussed by researchers of various nationalities. With this data, you can see that Brazilian researchers sought little information outside the country, and the reason for this is not probably related to the dominion of another language among the researchers, since most of the authors are masters and doctors where the dominion of a foreign language is part of the course requirements. Apart from this fact, however, it was also found that national books were scarcely referenced in the research sample (6,3%). This finding can probably be explained by the low number of works published in the country and to the fact that it is a recent theme.

By analyzing the data presented in Table 6, you can see the equivalent application between domestic and foreign documents in such categories as periodicals (9,2 e 9,5% respectfully) and Reports and communications (8,0 and 6,0% respectfully). The other categories of documents were predominantly those produced in Brazil.

Table 6 - Types of documents contained in the references of articles on Carbon Credit

Type of countersigned document	National		Foreign		Total	
	Frequency	%	Frequency	%	Frequency	%
Book	22	6,3	2	0,6	24	6,9
Periodicals	32	9,2	33	9,5	65	18,6
Annals	68	19,5	2	0,6	70	20,1
Academic documents	54	15,5	0	0,0	54	15,5
Reports and Communications	28	8,0	21	6,0	49	14,0
Electronic Mail	56	16,0	12	3,4	68	19,5
Others	16	4,6	3	0,9	19	5,4
Total	276	79,1	73	20,9	349	100,0

Source: Research data.

Table 7 presents the national journals most referenced in the articles investigated. Of the total, 21 of the 32 published articles utilized journal that basically covered topics for the fields of Accounting and Management. The other journals treat such areas such as: Environment, Agribusiness and Law. In this universe, the Revista da Informação Contábil (Journal of Accounting Information) received 10 referrals, of a total of 32, followed by the Revista de Educação e Pesquisa em Contabilidade (Journal of Education and Research in Accounting) with 6 references and, in sequence, the Revista Contabilidade - Vista & Revista (Journal of Accounting - Seen & Reviewed), with 5 articles on Carbon Credit published. These three journals accounted for 65,7% of the references found.

Table 7 - National journals cited that address the Carbon Credit theme

National journal	Frequency	%
Revista da Informação Contábil (RIC)	10	31,3
Revista de Educação e Pesquisa em Contabilidade (REPEC)	6	18,8
Revista Contabilidade - Vista & Revista	5	15,6
Revista de Gestão Social e Ambiental (RGSA)	4	12,5
Revista Organizações Rurais & Agroindustriais	2	6,3
5 Journals that published an article on the topic	5	15,5
Total	32	100,0

Source: Research data.

With regard to the foreign journals, the references utilized referred to areas such as Accounting, Economics, Business Administration, Energy and Environment, among others. Table 8 shows the total amount of the equivalent international references. Here, 12 articles cited the Accounting, Organization and Society journal, which represented 36,4% of the total findings. This type of document is highlighted in quantity because it was similar to the volume seen in national journals of the same type.

Table 8 - cited foreign journals that address the Carbon Credit theme

Foreign Journals	Frequency	%
Accounting, Organization and Society	12	36,4
Energy Economics	4	12,1
Energy Policy	3	9,1
Environmental Science & Policy	3	9,1
The Energy Journal	2	6,1
9 journals that published an article on the topic	9	27,20
Total	33	100,0

Source: Research data.

Table 9 shows the low amount of citations for books, a fact previously mentioned. Only 11 works were utilized as references in the articles analyzed, two of which are foreign. It is noteworthy that some of these works are more recent than several published articles. Of the total findings, the book *Carbon Market and the Kyoto Protocol* of Gabriel Sister was quoted in the references of five of the studied articles. The book *How to commercialize the carbon credits*, of Antonio Carlos Porto Araújo, was quoted 4 times. The remaining works had 3 or fewer citations.

Table 9 - Most quoted works on Carbon Credit.

Author (s)	Work	Frequency	%	Ranking
SISTER, Gabriel	<i>Carbon Market and the Kyoto Protocol: negotiating aspects and taxation</i>	5	20,8	1°
ARAÚJO, Antonio Carlos Porto.	<i>How to commercialize the carbon credits</i>	4	16,7	2°
FERREIRA, Aracéli Cristina de S..	<i>Environmental Accounting: An information for sustainable development - Includes Carbon Certificates</i>	3	12,5	3°
SEIFFERT, Mari Elizabete Bernardini	<i>Carbon Market and the Kyoto Protocol: Business opportunities in the pursuit of sustainability</i>	3	12,5	4°
SOUZA, Rafael Pereira de (Org.)	<i>Global Warming and Carbon Credits</i>	2	8,3	5°
LIMIRO, Danielle	<i>Global Warming and Carbon Credits</i>	2	8,3	6°
5 books cited 1 time		5	20,8	
Total		24	100,0	

Source: Research data.

From the data presented in Table 10, the wide predominance of national works in thereferenced documents can be observed. This fact draws more attention to the possible lack of international works on the subject of Carbon Credit. The causes for the low access to foreign works should be better analyzed. This may be due to cost, language barrier, or even the inapplicability of certain studies to the Brazilian market.

Table 10 - Language of the referenced documents on Carbon Credit

Languages	Portuguese	English	Spanish	Total
Frequency	273	75	1	349
%	78,2	21,5	0,3	100,0

Source: Research data.

For the period in which the documents cited by the researchers were published, table 11 shows that the prevalence occurred between 2001 and 2009 (81,9%). It is noteworthy that only 17,8% of the works surveyed were published in the last five years.

Table 11 - timeliness of the aforementioned documents on Carbon Credit

Time periods	2010-2014	2001-2009	1991-2000	Total
Frequency	62	286	1	349
%	17,8	81,9	0,3	100,0

Source: Research data.

Regarding the types of authorship of the works endorsed in the articles studied, Table 12 indicated that most of them are of single authorship (45,8%). Here, the reference most prevalent published by institutions (reports and institutional communications) was the electronic address, which in many cases was signed by a single author (TABLE 12).

Table 12 - Types of authorship of the ratified documents on Carbon Credit

Authorship	Single	Multiple	Institutional	No authorship	Total
Frequency	160	130	56	3	349
%	45,8	37,2	16,0	0,9	100,0

Source: Research data.

Because of the plurality of methods, procedures and research techniques, it becomes difficult to establish a classification or typology for the different kinds of existing social research. But despite the difficulties, the 44 articles selected for this study were analyzed as demonstrated in table 13, and it was found that 81,8% did not report the method used. On the other hand, regarding the procedures, most of the research is classified as documentary (38,6%), based often on business documents in theme investigation. As to the objectives, 38,6% of the articles are classified as exploratory research and 45,5% used a qualitative approach.

Table 13 - Types of research, procedures, techniques and approaches utilized in the Articles on the Carbon Credit Issue

Method Used	Freq.	% S / Total articles	Typology of procedures	Freq.	% S / Total articles
Inductive	5	11,4	Case study	14	31,8
Deductive	2	4,5	Documentary	17	38,6
No Information	36	81,8	Survey	4	9,1
Another	1	2,3	No Information	9	20,5
Total	44	100,0	Total	44	100,0
Typology of the aims	Freq.	% S / Total articles	Typology of the approach	Freq.	% S / Total articles
Exploratory	17	38,6	Qualitative	20	45,5
Descriptive	9	20,5	Quantitative	6	13,6
Exploratory and descriptive	9	20,5	Quantitative and qualitative (mixed)	2	4,5
No Information	9	20,5	No Information	16	36,4
Total	44	100,0	Total	44	100,0

Source: Research data.

Listing the 44 articles selected with 76 keywords given by the authors Table 14 shows that the theme "Carbon Credit Market" occupies the first position of the ranking, with 16 citations. The second position is occupied by "Environment" with 8, followed by the Clean Development Mechanism (CDM), with 7 and Accounting Treatment with 6.

Table 14 - Issue addressed in the articles on Carbon Credit

Issue	Frequency	%
Carbon Credit Market	16	21,1
Environment	8	10,5
Clean Development Mechanism (CDM)	7	9,2
Accounting Treatment	6	7,9
Kyoto Protocol	4	5,3
Carbon Efficient Index	4	5,3
3 issues cited 2 times	6	7,9
25 issues cited 1 time	25	32,9
Total	76	100,0

Source: Research data.

6 CONCLUSION

This research showed aspects of the Brazilian academic production on carbon credit found under the three main scientific accounting events and journals evaluated by Qualis/CAPES system, from 2005 to 2014. The scientific literature on the subject began in the mid 2000s, a time when the Clean Development Mechanism (CDM) was implemented via the Kyoto Protocol.

Based on the findings of the bibliometric study, it is clear that the carbon credit issue has not yet reached an academic level of production that characterizes it as an independent theme and consolidated research agenda. Unlike other issues of social and environmental area, it is little explored in Brazilian academia, despite the economic impact on the results of companies interested in promoting sustainable development.

Besides the meager results found along a decade (only 44 articles), only 84.1% (37) of the articles were prepared as a team composed of 2-4 researchers. Among the 96 authors who have dedicated themselves to researching the carbon credit issue, there was a predominance of teachers and doctors, a fact that highlights the importance of this group in the scientific production of the country.

The two most prolific authors were Maisa de Souza Ribeiro and Vanderlei dos Santos, belonging to the University of São Paulo and the University of the State of Santa Catarina, respectively. These institutions were also important to focus 23% (22) of the researchers who have dedicated themselves to studying the carbon credit issue.

Regarding the references used in the articles produced, only 20% of the material quoted was of international origin and the sources of information provided related more to national conference proceedings and email addresses. Another aspect observed was that the authors used in the references of the articles produced an average of 8 documents.

In this context, the most referenced Brazilian journal was the Journal of Accounting Information and abroad, it was the Journal of Accounting, Organization and Society. Regarding books, the highlight was the work *Carbon Market and the Kyoto Protocol*, of Gabriel Sister.

Finally, this study is expected to make a contribution to future research on carbon credits in Brazil, due to the fact that it has provided, in particular, a quantitative description of the scientific production and has given order to the experiences and knowledge of those who made efforts to understand this issue in the last decade.

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