

**Scientific Production on Environmental Management in Brazil**

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### ABSTRACT

This study investigates the characterization of the scientific production on Environmental Management in the areas of Administration, Accounting, and Tourism, using the electronic indexer known as Scientific Periodicals Electronic Library [SPELL], from 2006 to 2015. It is a quantitative research with descriptive objectives. The sample was composed of 215 articles. Content Analysis, Bibliometric Analysis, Multiple Correspondence Analysis, and Sociometrical Analysis were used in the data treatment. The results present a lack of regular growth in relation to the volume of publications during the years; the journal that publishes most on this subject is the “Revista de Gestão Social e Ambiental”, with 32 articles. It was observed to be the predominance of articles with theoretical-empirical nature, totaling 182; 70 articles presented descriptive objectives; 145 articles with predominance of qualitative approach; and the most recurrent procedure was the case study, with 46 articles. The Multiple Correspondence Analysis indicates association among some methodological aspects. Corporate Environmental Management was the more frequently approached theme, in 35 articles. Seventy-three articles have two authors. José Carlos Lázaro da Silva Filho is the author who published most on Environmental Management. Lastly, the existence of co-authorship networks among the authors who most publish on the subject was noted.

**Key-words:** Environmental Management. Scientific Production. Bibliometric Study. Co-authorship Networks.

## 1 INTRODUCTION

In recent years, national scientific production has evolved, and it has been consolidated through researchers and evidenced by academic journals (Ribeiro & Corrêa, 2013). In this direction, considering the relevance of the themes that involve the environmental management in the organizations, studies that aim to analyze the scientific productions have grown, generating bibliometric studies.

Environmental management has gained more and more space in the academic world, and also in the business environment (Hoffman, 2005; Gallon, Souza, Rover & Bellen, 2007; Pereira, Yen-Tsang, Manzini & Almeida, 2011; Crotty & Rodgers, 2012; Souza & Ribeiro, 2013; Lundgren & Zhou, 2017). In this context, the evolution of environmental management in the business field results in companies becoming proactive from the environmental point of view and, in some cases, increases the competitive advantage (Porter & Linde, 1995; Miles, & Covin, 2000; González-Benito & González-Benito, 2006; Paulraj, 2009; Phan & Baird, 2015). For Oliveira (2013), in addition to generating economic impacts, business decisions also produce social, environmental and political impacts that cannot go unnoticed. In this regard, understanding these impacts along with both commercial and societal responses have become a growing concern.

Thus, it is relevant to investigate and map out the scientific production on Environmental Management in order to broaden the discussion on the theme. In addition, to also present and propose new questions about the subject, contributing to the strengthening of the debate in the academic environment, as well as its implications for society.

In view of the exposed scenario, this paper aims to answer the following research question: how is the scientific production on Environmental Management characterized in the areas of Administration, Accounting and Tourism in Brazil?

This study has as general objective to investigate how the scientific production on Environmental Management is characterized in the areas of Administration, Accounting and Tourism in the last decade (2006-2015) in Brazil. Specific objectives are: (i) to quantify the published articles on the theme during the period analyzed; (ii) to identify the journals that publish the most on the subject; (iii) to classify the articles regarding the methodological aspects (nature, objectives, approach and procedures used in the research); (iv) to analyze the association between the methodological aspects present in the articles; (v) to discriminate the themes more discussed in the articles; and (vi) to outline the profile of the authors who publish the most on the subject, besides elaborating the co-authoring network among these authors.

When it comes to objectives, this study is descriptive. In regards to procedures, it is based on bibliographical and documentary research. Last but not least, the approach is a quantitative investigation. Content analysis (Mozzato & Grzybovski, 2011; Bardin, 2009), bibliometric analysis (Bjorneborn & Ingwersen, 2005; Macias-Chapula, 1998), multiple correspondence analysis (Fávero, Belfiore, Silva & Chan, 2009) and sociometric analysis (Pinto, Efrain-García, Barquín, & González, 2007; Macias-Chapula, 1998) were all used. The study has 221 articles that deal with the subject and were published during the period from 2006 to 2015. The articles were collected through the electronic indexer SPELL. For the sample composition, six articles of the 221 were excluded, among them: three reviews; two articles which did not present enough data for the analysis; and one that appears repeatedly. As a result, 215 articles were analyzed.

Despite constant discussions about the importance of environmental issues and the need to introduce these into management actions and corporate strategies, there is still little repercussion and small advances in the academic media regarding the dissemination of the discussion about the theme, especially in Brazil (Sehnm, Oliveira, Ferreira & Rossetto, 2012).

Thus, this study becomes relevant for presenting an updated characterization of the state of the art of scientific research on Environmental Management in Brazilian journals in the areas of Administration, Accounting and Tourism, in order to enable the expansion and improvement of knowledge in relation to this theme.

## 2 LITERATURE REVIEW

Considering the relevance of the themes that involve the environmental management in the organizations, studies that aim to analyze the scientific productions have grown. This type of study becomes relevant, since it shows what is being discussed on the subject and what are the contributions of the researches.

Sehnm et al. (2012) aimed to verify the evolution of the publications that approach the themes of Environmental Management, Environmental Strategy, Environmental Performance and Environmental Strategic Assessment. The authors analyzed 113 articles that were published in 22 Brazilian journals, from 2000 to 2009. The journals were classified by the Qualis/CAPES system as A1, A2, B1 and B2, in the area of Administration, Accounting and Tourism. The results indicate that the term 'Environmental Management' was identified in the title of 38 publications; it was cited as a key word in 64; and it was found in the text body of 111 works. The most prolific years were 2006 and 2009. The authors who published the most were Charbel José Chiappetta Jabbour, Fernando César Almada Santos and Mônica Cavalcanti Sá de Abreu, with each one of them publishing 7 articles; during the years 2000 to 2009. It was found that there was growth in Brazilian journals and on the number of articles published that cited the terms of the research, including special editions on the environmental issue.

Oliveira, Silva, Alves and Vieira (2013) carried out a research about the state of the art on socio-environmental management, with the objective to analyze the scientific production on socio-environmental management in two scientific events: (i) *Simpósio de Excelência em Gestão e Tecnologia* [SEGeT]; and (ii) *Seminários em Administração* [SemeAd], which occurred in 2010. In this study, 90 articles were analyzed and the results showed that 60% of the articles were published in the SEGeT and 40% in the SemeAd. It was also verified the prevalence of the female gender, predominance of partnerships of three authors and the network with the highest concentration of authors was the SEGeT.

Almeida, Licório and Siena (2013) analyzed the published articles, from 2008 to 2012, in the Scientific Electronic Library Online database [SciELO]. The results found were: the author who produced the most was Maria Tereza Leme Fleury; most authors produced only one article; the number of productions increased from 2008 until 2011, with a small reduction in 2012; methodologically, it was observed greater use of the qualitative approach, descriptive objectives, documentary research and semi-structured questionnaires; the most frequent themes were "Performance Management by Competence" and "Environmental Performance"; and the target populations of the researches were companies and employees.

Luna, Silva and Carvalho (2013) investigated the publications carried out in national academic journals, whose theme was Environmental Management, from 2002 to 2012. The sample included scientific articles published in journals classified by Qualis/CAPES as A1, A2, B1 and B2 for all areas, which were available in the SciELO database and that had the key term "Environmental Management" inserted in the title and/or body of text. The results obtained indicate a significant evolution of the theme in the period from 2002 to 2012; the number of publications was higher in the years 2006 and 2012, the study believes that it is due to the applications and certifications of the ISO 14000 (Environmental Management System) in industries, in addition to the Rio + 20 Conference, held in 2012.

Quintana, Machado, Amaral and Quintana (2014) analyzed the articles published in the 20 scientific journals classified by the webqualis CAPES as B1, B2, B3 and B4, in the

areas of administration and accounting. The authors found that only 18 journals published articles related to environmental management. Among the results found, the following stand out: 2004, 2009 and 2010 were the years with the highest number of publications; most of the articles were written by groups of five authors; the topics most covered were “environmental and social performance”, “environmental information”, “environmental management systems” and “social and environmental investment”; a great amount of explanatory, bibliographic, qualitative and documentary researches were noticed; the authors Donaire and Porter were the most prolific.

Based on the previous studies, an increase in scientific publications that aimed to disseminate the academic and business dialogue on environmental management was noted.

### **3 METHOD**

The research is characterized as a quantitative study. This type of approach uses statistical techniques, ranging from the simplest to the more complex techniques such as the use of inferential statistics (Martins & Theóphilo, 2009; Collis & Hussey, 2005). In relation to the objectives, it is a descriptive research, since this type of research intends to describe a situation and provide contextual information that can serve as a basis for further explanatory research, starting from the process of observation, registration, analysis, classification and interpretation of data or facts (Vergara, 2014, Sampieri, Collado & Lucio, 2013, Gray, 2012).

Concerning the procedures, the research is bibliographical and documentary (Gray, 2012; Collis & Hussey, 2005). For the data treatment, the techniques used were content analysis (Mozzato & Grzybovski, 2011; Bardin, 2009), bibliometric analysis (Bjorneborn & Ingwersen, 2005; Macias-Chapula, 1998), multiple correspondence analysis [MCA] (Fávero et al., 2009), and sociometric analysis (Pinto et al., 2007; Macias-Chapula, 1998).

In this study, the bibliometric analysis technique predominates. This allows quantitative survey of the scientific production on a certain subject, in order to evidence the state of the art and the methodological tendencies adopted in the publications on the subject (Bjorneborn & Ingwersen, 2005; Macias-Chapula, 1998).

Given the general objective of the research, which was to investigate how scientific production on Environmental Management is characterized in the areas of Administration, Accounting Sciences and Tourism, in the last decade (2006-2015), papers were collected on the theme "Environmental Management" through SPELL that concentrates the scientific production of the areas of Administration, Accounting Sciences and Tourism. The search for the term "Environmental Management" in the "keyword" and "title of the document" fields was used as filtering mechanisms of the papers, used in other bibliometric studies, such as the study by Sehnem et al. (2012).

After the search, 221 papers on Environmental Management, published between the years 2006 and 2015 were found. They were analyzed in order to make the sample to be used in the research. In completing the analysis, it was noted that of the 221 papers found, three were reviews, two presented incomplete information regarding the publication, and one was a duplicate paper that was cited twice. Thus, six papers were excluded, leaving a sample of 215 papers to be analyzed.

In order to achieve the research objectives, some analysis techniques were used. In the first stage of the research, the content analysis method was used, as proposed by theoreticians such as Mozzato and Grzybovski (2011) and Bardin (2009). Mozzato and Grzybovski (2011) subdivided content analysis into three stages: pre-analysis; exploitation of the material; and treatment of results, inference and interpretation. The first occurred at the time of data collection; the second, in the delimitation phase of the sample; and the third when the selected documents were analyzed.

In order to quantify the published papers on the topic during the analyzed period, identify the journals that publish the most on the subject, and classify the papers regarding the methodological aspects (nature, objectives, approach and procedures used in the research), tables were elaborated with the following titles: papers per year; journals that publish more about the topic, and methodological aspects used in the papers. The procedure was done with the help of Microsoft Excel through content analysis.

To analyze the association between the methodological aspects present in the papers, the data extracted from the papers referring to the methodological aspects (nature, approach and objectives of the research) was tabulated using Microsoft Excel, where the data was then converted into categorical variables.

After the spreadsheet was organized, data was exported to the software Statistical Package for the Social Sciences [SPSS], in which the chi-square test was performed in order to verify the existence of a significant association between the variables. After verifying this association between the variables, the Multiple Correspondence Analysis [MCA] was performed, using the variables presented in Figure 1. A perceptual map was elaborated, in which the association among the variables used was verified.

In order to discriminate the themes most frequently addressed in the papers, content analysis was used. The sociometry technique was to draw the profile of the authors who publish the most on the subject and to develop the co-authoring network among these authors. Sociometry, according to Pinto et al. (2007) and Macias-Chapula, (1998), aims to identify authorship and co-authorship networks among researchers in order to relate similarities between them. These similarities may be geographical, institutional or based on subject matter. First, the authors with the largest volume of publications in the literature during the period analyzed were identified, followed by the extraction of information about these authors (titling, Academic Institution of origin and the related postgraduate program) from the Lattes Platform. Lastly, the co-authoring networks were developed, data was tabulated using Microsoft Excel, and UCINET6® and NetDraw® software were used to create the co-authoring charts.

#### 4 RESULTS AND DISCUSSION

Initially, the quantitative of articles published throughout the analyzed period was verified, as can be seen in Table 1.

Table 1  
Papers per year.

Year	Number of papers	Relative Frequency (%)	Cumulative Frequency (%)
2006	17	7,91	7,91
2007	10	4,65	12,56
2008	19	8,84	21,40
2009	27	12,56	33,96
2010	33	15,35	49,31
2011	17	7,91	57,22
2012	21	9,77	66,99
2013	26	12,09	79,08
2014	25	11,63	90,71
2015	20	9,30	100,00
<b>Total</b>	<b>215</b>	<b>100,00</b>	<b>100,00</b>

Note. Source: Research Data.

Table 1 shows a constant increase in the publications on the subject Environmental Management. With 33 publications in 2010 representing 15% of total publications in the last 10 years, and 10 publications in 2007, the resulting difference is 23 papers. During the periods

from 2008 to 2010 and from 2011 to 2013 there was growth of production, however, not drastic. These findings corroborate partially those found by Almeida et al. (2013), who verified the evolution of productions on the theme from 2008 to 2011.

In regards to the most published journals on Environmental Management, it shows in Table 2 that the Revista de Gestão Social e Ambiental stood out with 32 publications. In spite of the great amount of publications, it is verified that in some years (2006 and 2008) there was no publication. On the other hand, in 2010 there was a peak of 11 published papers, contributing a third to the total amount of the period.

Table 2

**Journals that publish more about the topic.**

Journal	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Revista de Gestão Social e Ambiental	-	2	-	4	11	5	2	4	2	2	32
Revista Eletrônica de Administração	2	1	1	1	-	-	1	2	1	1	10
Revista Rosa dos Ventos	-	-	-	-	-	-	-	1	6	2	9
Revista de Gestão Ambiental e Sustentabilidade	-	-	-	-	-	-	1	-	3	4	8
Revista de Administração da UFSM	-	-	-	1	2	-	-	3	1	1	8
Revista de Administração Mackenzie	-	-	-	1	1	-	-	1	-	3	6
Revista de Administração e Inovação	1	1	-	1	-	1	1	-	1	-	6
Revista de Administração, Contabilidade e Sustentabilidade	-	-	-	-	-	1	2	-	1	1	5
Revista Ciências Administrativas	2	-	-	2	-	1	-	-	-	-	5
Revista de Administração FACES	-	-	1	1	1	1	-	-	1	-	5
Revista Gerenciais	1	2	2	-	-	-	-	-	-	-	5
Revista Pensamento Contemporâneo em Administração	-	-	-	-	1	-	-	2	2	-	5
Revista de Administração Pública	4	1	-	-	-	-	-	-	-	-	5
Others with less than 5 publications	7	3	15	16	17	8	14	13	7	6	106
<b>Total</b>	<b>17</b>	<b>10</b>	<b>19</b>	<b>27</b>	<b>33</b>	<b>17</b>	<b>21</b>	<b>26</b>	<b>25</b>	<b>20</b>	<b>215</b>

Note. Source: Research Data.

Regarding methodological aspects, according to Table 3, it can be noted most of the papers were theoretical-empirical in nature, totalling 182 papers. Only 33 out of 215 were theoretical.

Table 3

**Nature of research.**

Nature	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Theoretical-empirical	9	6	17	23	28	15	17	24	24	19	182
Theoretical	8	4	2	4	5	2	4	2	1	1	33
<b>Total</b>	<b>17</b>	<b>10</b>	<b>19</b>	<b>27</b>	<b>33</b>	<b>17</b>	<b>21</b>	<b>26</b>	<b>25</b>	<b>20</b>	<b>215</b>

Note. Source: Research Data.

Regarding the research objectives, we can see in Table 4, predominance of descriptive papers (70), corroborating the studies by Almeida et al. (2013). In relation to the exploratory studies, a total of 41 publications were found, and the explanatory only four. It is observed that many papers did not mention the methodology of the research regarding the proposed objectives (51), according to Table 4.

Table 4  
**Objectives of research.**

Objectives	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Descriptive	2	3	4	7	6	4	6	15	11	12	70
Exploratory	4	1	5	2	5	4	3	5	6	6	41
Explanatory	-	-	-	-	-	-	1	2	1	-	4
Descriptive-Exploratory	-	1	5	2	14	7	7	4	7	2	49
Not mentioned	11	5	5	16	8	2	4	-	-	-	51
<b>Total</b>	<b>17</b>	<b>10</b>	<b>19</b>	<b>27</b>	<b>33</b>	<b>17</b>	<b>21</b>	<b>26</b>	<b>25</b>	<b>20</b>	<b>215</b>

Note. Source: Research Data.

The analysis of the research approach shows that most of the papers on Environmental Management were of a qualitative approach. These results are in line with the results of Almeida et al. (2013) and Quintana et al. (2014). Yet, only 43 out of 215 have a quantitative approach, as shown in Table 5.

Table 5  
**Approach of research.**

Approach	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Quantitative	2	1	2	2	3	2	3	8	13	7	43
Qualitative	15	9	12	16	26	12	17	15	11	12	145
Both approaches	-	-	5	4	3	3	1	3	1	1	21
Not mentioned	-	-	-	5	1	-	-	-	-	-	6
<b>Total</b>	<b>17</b>	<b>10</b>	<b>19</b>	<b>27</b>	<b>33</b>	<b>17</b>	<b>21</b>	<b>26</b>	<b>25</b>	<b>20</b>	<b>215</b>

Note. Source: Research Data.

Table 6 presents the procedures used in the research and shows that most papers used more than one procedure (99). Case studies totalized 46 in the analyzed period. Only four papers used field research.

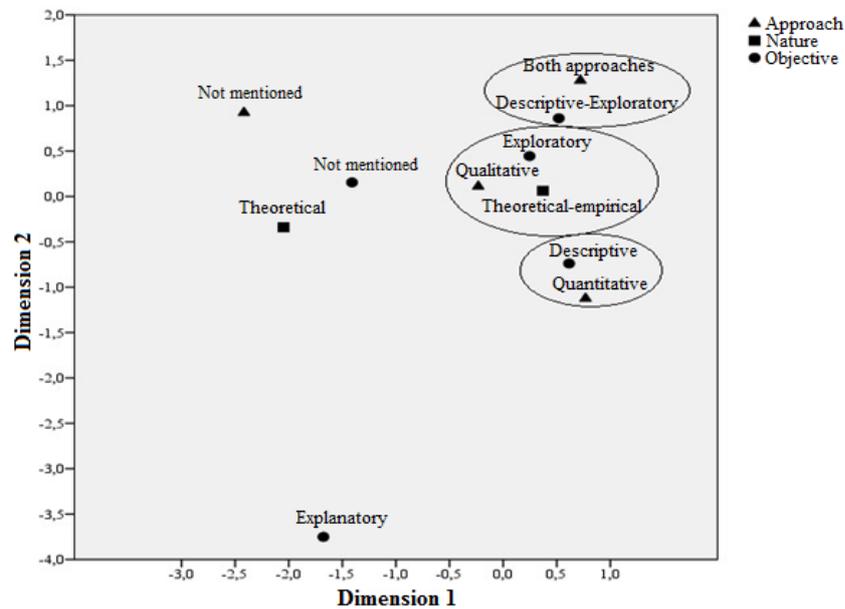
Table 6  
**Procedures of research.**

Procedures	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Bibliographic research	4	3	2	-	4	1	4	2	2	1	23
Field research	1	-	-	-	1	-	-	1	1	-	4
Documental analysis	-	1	2	2	-	2	2	7	5	1	22
Case study	1	-	1	3	9	4	8	6	9	5	46
Survey	-	-	5	-	-	1	-	1	-	-	7
Research-action	-	-	-	1	-	-	-	-	-	-	1
More than one procedure	11	6	9	16	19	9	7	7	6	9	99
Not mentioned	-	-	-	5	-	-	-	2	2	4	13
<b>Total</b>	<b>17</b>	<b>10</b>	<b>19</b>	<b>27</b>	<b>33</b>	<b>17</b>	<b>21</b>	<b>26</b>	<b>25</b>	<b>20</b>	<b>215</b>

Note. Source: Research Data.

The chi-square test was applied to verify the variables with significant associations. Cross-tabulation showed evidence of association between the variables nature of the research, approach and objectives, since the level of significance was lower than 0.05 in all cases. In

this way, it was possible to develop the MCA, generating the perceptual map represented by Figure 2.



**Figure 2.** Perceptual map of methodological aspects.

Source: Research Data.

According to the perceptual map, there is a strong association between descriptive objectives and quantitative approach, which suggests that the quantitative research analyzed tend to have descriptive objectives. A strong association between exploratory objectives, a qualitative approach and a theoretical-empirical nature can be observed, so the studies analyzed with exploratory objectives tend to be theoretical-empirical and with a qualitative approach. Yet, according to the perceptual map, it can be verified that studies with both approaches are associated with descriptive-exploratory objectives.

With regard to the predominant theme, it can be seen in Table 7 that Corporate Environmental Management stands out with 35 publications followed by Environmental Strategy (19), Environmental Legislation (17), Sustainability (16) and Environmental Accounting (14). Table 7 presents the most recurrent themes among the articles analyzed, with only the themes repeated in at least five different articles listed.

Table 7

**Predominant themes in publications.**

Themes	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Corporate Environmental Management	2	1	1	1	14	2	4	5	2	3	35
Environmental Strategy	3	-	2	1	4	2	1	4	1	1	19
Environmental Legislation	4	1	5	2	1	-	-	1	1	2	17
Sustainability	1	2	-	3	2	-	4	-	3	1	16
Environmental Accounting	3	-	-	2	2	5	2	-	-	-	14
Environmental Management in Public Sector	2	-	-	1	-	1	1	1	3	-	9
Solid Waste Management	1	-	-	-	-	3	-	1	2	2	9
Environmental Education	1	-	1	1	1	-	-	3	-	1	8
Environmental Impacts	-	1	-	1	-	-	2	1	-	2	7
Reverse Logistic	-	1	-	2	1	-	1	-	2	-	7
Environmental Management Practices	-	-	-	1	1	-	-	-	4	1	7
Scientific Production in Environmental	-	-	1	-	-	-	1	3	2	-	7

Management											
Environmental Disclosure	-	-	2	3	-	-	-	-	-	-	5
Environmental Tourism and Ecotourism	-	-	1	-	1	1	-	1	1	-	5
Others with less than 5 publications	-	4	6	9	6	3	5	6	4	7	50
<b>Total</b>	<b>17</b>	<b>10</b>	<b>19</b>	<b>27</b>	<b>33</b>	<b>17</b>	<b>21</b>	<b>26</b>	<b>25</b>	<b>20</b>	<b>215</b>

**Note.** Source: Research Data.

Regarding the number of authors per paper, Table 8 shows that there are between one and eight authors per paper, with the majority occurring between two and four. With a total of 73 publications, double authorship is most common, followed by papers with three and four authors, totalling 60 and 47 publications, respectively. Studies with one and five authors are less common and papers ranging from six to eight authors are rare.

Table 8  
**Number of authors per paper.**

Number of authors	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
1 author	1	-	-	2	3	-	4	4	2	2	18
2 authors	7	6	7	8	12	7	3	8	9	6	73
3 authors	7	3	4	10	9	6	5	6	5	5	60
4 authors	2	-	6	6	5	3	6	8	5	6	47
5 authors	-	1	2	1	3	1	3	-	3	-	14
6 authors	-	-	-	-	-	-	-	-	-	1	1
7 authors	-	-	-	-	-	-	-	-	1	-	1
8 authors	-	-	-	-	1	-	-	-	-	-	1
<b>Total</b>	<b>17</b>	<b>10</b>	<b>19</b>	<b>27</b>	<b>33</b>	<b>17</b>	<b>21</b>	<b>26</b>	<b>25</b>	<b>20</b>	<b>215</b>

**Note.** Source: Research Data.

The analysis of the profile of the authors who publish more about Environmental Management indicates that José Carlos Lázaro da Silva Filho is at the top of the ranking. With twelve published papers during the ten years of analysis, he holds a PhD and belongs to the Post-Graduation Program in Administration and Controllershship of the Federal University of Ceará. At a close second with 11 publications is Mônica Cavalcanti Sá de Abreu, also belonging to the same program as Silva Filho as well as having a PhD. This finding confirms Sehnem et al. (2012), which presents Abreu as one of the most prolific authors in this area. The other authors and profiles are presented in Table 9. It is noteworthy that the authors were tabulated with at least four publications.

Table 9  
**Profile of the authors who publish more.**

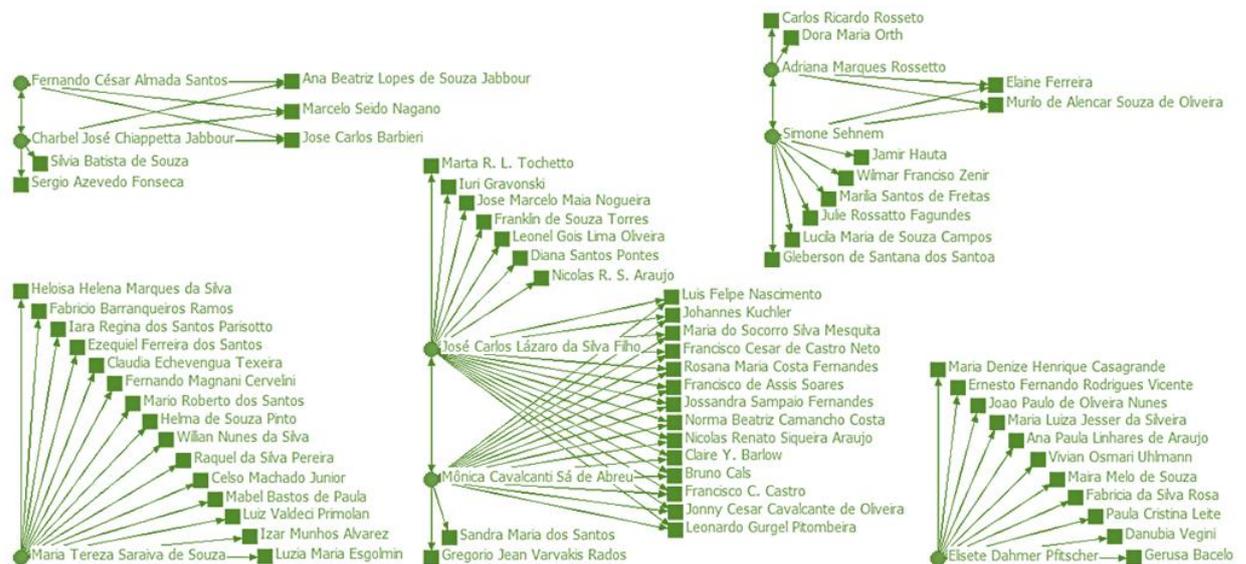
Author	Number of participations in publications	Academic Degree	Institution	Member of Post-Graduation Program
José Carlos Lázaro da Silva Filho	12	Ph.D.	UFC	Yes
Mônica Cavalcanti Sá de Abreu	11	Ph.D.	UFC	Yes
Charbel José Chiappetta Jabbour	8	Ph.D.	UNESP	Yes
Maria Tereza Saraiva de Souza	8	Ph.D.	FEI	Yes
Elisete Dahmer Pfitscher	6	Ph.D.	UFSC	Yes
Fernando César Almada Santos	6	Ph.D.	USP	Yes
Simone Sehnem	5	Ph.D.	UNOESC	Yes
Adriana Marques Rossetto	4	Ph.D.	UFSC	Yes
Authors with 3 participations or less.	564	-	-	-
<b>Total</b>	<b>624</b>	<b>-</b>	<b>-</b>	<b>-</b>

**Note.** Source: Research Data.

With regards to the co-authorship networks among the most published authors on the subject, Table 10, as well as Figure 5, reveal the existence of three networks involving two authors of the ranking in each of them, unlike the study by Oliveira et al. (2013), which detected the prevalence of co-authoring networks of three authors. The first and largest co-authoring network among the two authors that lead the ranking of the most published on the subject are Silva Filho and Abreu. These authors have a total of 10 publications together. It is noteworthy that Silva Filho has a total of 12 publications, with Abreu being absent in two of them. Subsequently, Abreu has 11 publications with Silva Filho not being a co-author in only one of them. Both are linked to the Federal University of Ceará and belong to the same postgraduate program, the Graduate Program in Administration and Controllershship.

In addition to this network of co-authorship, there was another that totals six publications involving the authors Charbel José Chiappetta Jabbour and Fernando César Almada Santos. Jabbour ranks third in the most published on the subject, with a total of eight publications. Of these, only two do not include the participation of Santos. Subsequently, Santos totals six publications on the subject. Jabbour is linked to the "Júlio de Mesquita Filho" State University, and was guided by Santos during his doctorate at the University of São Paulo, an institution to which Santos is linked.

The third and last network of co-authorship observed was between Simone Sehnem and Adriana Marques Rossetto, totaling two articles in partnership. Sehnem has five publications on the subject, while Rossetto has four. Sehnem is linked to the University of the West of Santa Catarina and was guided by Rossetto during her PhD at the University of Vale do Itajaí. Rossetto, in turn, is linked to the Federal University of Santa Catarina. In this network of co-authorship, there is a smaller volume between the co-participations than others, who presented a higher collaboration rate.



**Figure 3.** Co-authorship networks among the most published authors.

Source: Research Data.

In addition to the co-authorship networks previously presented, it was also noticed that two authors who appeared in the ranking of those who publish the most do not participate in co-authoring networks with other authors in the ranking: Maria Tereza Saraiva de Souza and Elisabete Dahmer Piftscher. Furthermore, based on the analysis, it is possible to observe trends in co-authorship networks. In one of them, the authors belonged to the same institution as well as the same program, and in the others there exists a mentorship in the relationship

between a professor and a student. This reveals institutional links between the authors who publish the most on the subject.

## **5 FINAL CONSIDERATIONS**

The objective of this study was to investigate how the scientific production on Environmental Management is characterized in the areas of Administration, Accounting Sciences, and Tourism in the last decade (2006-2015). In order to do so, we analyzed 215 papers on Environmental Management in SPELL and used techniques of content analysis, bibliometric analysis, sociometric analysis, and multiple correspondence analysis.

In relation to the first specific objective to quantify the published articles on the topic during the analyzed period, it was observed a lack of regular growth in relation to the volume of publications throughout the years. The lowest number of publications occurred in 2007 while 2010 presented the highest. The second specific objective sought to identify the most published journals on the subject, identifying the *Revista de Gestão Social e Ambiental* as the most published journal on the subject.

Regarding the third specific objective to classify articles in terms of their methodological aspects, a predominance of articles of a theoretical-empirical nature was observed with descriptive objectives, a qualitative approach, and with a case study procedure. Through the fourth specific objective, which aimed to analyze the association between the methodological aspects present in the articles, a strong association was seen between the theoretical-empirical articles with qualitative nature and exploratory objectives. There is also a strong association between articles with descriptive objectives and quantitative nature, as well as mixed approach and descriptive-exploratory objectives. The fifth specific objective sought to discriminate the topics addressed in a more recurrent way in the articles. It was verified that the issue of Corporate Environmental Management was more frequent.

The sixth and last specific objective, which was to trace the profile of the authors who publish the most on the subject and to elaborate the network of co-authorship between these authors, showed that the most common arrangement is that of two authors. It was also identified that the authors who publish the most on the subject are José Carlos Lázaro da Silva Filho, Mônica Cavalcanti Sá de Abreu, Charbel José Chiappetta Jabbour, Maria Tereza Saraiva de Souza, Elisete Dahmer Pfitscher, Fernando César Almada Santos, Simone Sehnem and Adriana Marques Rossetto. They all have a doctorate degrees and ties to postgraduate programs, with Maria Tereza Saraiva de Souza being the only one linked to a private Institution. In addition, three co-authorship networks were identified between the main authors: Filho and Abreu, with ten publications in partnership; Jabbour and Santos, with six publications in partnership; and Sehnem and Rossetto, with two papers in partnership.

It should be emphasized that the present study presents limitations, especially those related to the methodology used, which restricts the conclusions obtained. The limiting aspect of the research was the search criteria. Additional criteria may be used in future searches. Therefore, the results found in this study should not be generalized since they do not represent the conjuncture of the area in the period, but the position found for the articles analyzed under the predetermined conditions. It is hoped that this study contributes to raising the level of knowledge about the state of the art of Environmental Management.

As a suggestion for future research, the use of other sources of scientific articles search, as well as analysis of the international publication on the subject should be used. Comparative studies are also suggested as a way of describing similarities and differences between national and international production.

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