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The study of sustainability in administration: A research of the hot topics published in the last decade

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The aim of this study was to examine publications on the topic of sustainability and to identify key areas of administration that are being studied with sustainability. The survey was conducted in the Web of Science database, searching to identify the main subject areas, authors, types of documents, titles of the sources, the year of the publications, institutions, funding agencies, countries and languages of these publications, as well as to discover the "hot topics" of administration when combined with the topic of sustainability. Data analysis was based on the calculations of h-b and m indexes of Banks (2006). According to the results of this study almost 73% of the publications are in article format (papers), among the authors with the highest number of publications there is no author that has an outstanding quantity of publications, the institution with the highest number of publications is the University Of British Columbia in Canada. Among the 20 institutions that have published the most about this subject, most institutions (11) and also the most significant in terms of total number of publications are North American totaling 1,173. As the number of institutions and the number of publications have demonstrated the bulk of publications are concentrated in the United States totaling 5,251. The English language is predominant as 96% of the publications are written in this language. Among the sources of the publications, the highlight was the Journal of Ecological Economics with 428 publications and the subject area that had the highest number of publications is environmental sciences. Among the 20 topics related to sustainability, the following were classified as "hot topics": management, production process, consumption, innovation, public management, business, stakeholders, and communication.

Key words: Sustainability, management, bibliometric research.

INTRODUCTION

Efforts to attend the needs of the growing population in an interconnected but unequal and human-dominated world are mining the essential life support system of the planet. The extraordinary complexity of challenges that lie ahead is suggested by the emerging interactions between global environmental changes and the profound ongoing changes in economical and social life (Kates et al., 2000).

The combination of satisfaction of the basic human

needs with the preservation of the life support system of the planet requires a global effort to stop the existing progress and make a transition towards sustainability. The significant response to this challenge to the scientific community began to emerge from a variety of regional and global programs of environmental research (United Nations Educational, Scientific and Cultural Organization – UNESCO, United Nations Conference on Environment and Development (UNCED), among others); through the

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academic world of science, including individual reports from African, Brazilian and American academies (e.g. the Fifth General Conference of the African Academy of Sciences and the United States Business Council for Sustainable Development); from independent scholar and scientist networks (Kates, 1994; Funtowicz and O'Connor, 1999; Grubler, 2000; Moore III, 2000; O'Riordan, 2000); and the Friibergh Workshop on the Sustainability Science in 2000.

Above all, a response began to emerge from science itself and the growing acknowledgement of several disciplines, a need for synthesis and integration – needs that are being reflected in many new efforts of multidisciplinary research and institutions (Global Change Newsletter, 1999; National Science Board, 2000). According to Kate et al. (2000) these diverse scientific efforts to further the objectives of a transition to sustainability – satisfaction of human needs while preserving life support systems – are leading to the developing of a new scientific field of sustainability.

With the objective to analyze publications on the topic of sustainability on the Web of Science database, the article by Madruga and Silva (2008) searched the spatio-temporal location of these publications, as well as identifying “hot topics”. In their findings, management/administration was detected as one of the “hot topics” in the study of sustainability.

Guided by the emergence and importance of the studies related to sustainability proposed by Kate et al. (2000) and by the findings in the study of Madruga and Silva (2008), the objective of this study was to deepen knowledge about publications in the area of sustainability in the period of 2000 to 2010, as well as to identify which topics of administration are considered “hot topics” when studied together with sustainability. For this purpose, data collection was performed on the Web of Science database.

The article is structured in six sections: Introduction; Review on the study of sustainability where the objective was to identify the evolution of its concept and some studies in administration; research methods; results; conclusion and references.

THE STUDY OF SUSTAINABILITY

The most widespread definition of sustainability is that of the Brundtland Commission (World Commission on Environment and Development, 1987) which considers that sustainable development must meet the needs of the existing generation without compromising the needs of future generations. This definition clarifies one of the basic principles of sustainability - long-term vision - as the interests of future generations must be analyzed. For better understanding of the concept of sustainability, Table 1 shows the main events in the evolution of the concept of sustainability.

Since its initial conception in the Brundtland Report, the definition of sustainability has been criticized because it presents ambiguity and gaps (Chaharbaghi and Willis, 1999; Hauschild et al., 1999). According to Gonçalves-Dias et al. (2007), sustainability covers a range of concepts and practices that include: ensure perpetual human survival (Farrell, 1995; Ehrenfeld, 2001); protect threatened ecosystems (Farrell, 1995; Mosovsky et al., 2000; Howarth and Hadfield, 2003); recognize human dependence on the ecosystems (Farrell, 1995; Ehrenfeld, 2001); guarantee all people access to meet their needs and enjoy freedom to develop their potential (Farrell, 1995; Ehrenfeld, 2001; Howarth and Hadfield, 2003); allocate resources equally among people, including future generations (Mosovsky et al., 2000; Ehrenfeld, 2001); and involve all individuals and institutions in order to achieve sustainability (Ehrenfeld, 2001).

The broad concept of sustainability eventually extended its borders and met other academic traditions, be it in the area of social politics, cultural studies and also in the field of administration. Administration as a science has been resizing and adjusting to the constant needs arising from contexts and era that marked its trajectory in the world, that is, these era were always marked by relevant administrative activities in their distinct periods.

The term sustainability is increasingly present in academic studies related to administration (Costanza et al., 1991; Gladwin et al., 1995; Hawken, 1993; Schmidheiny, 1992; World Commission on Environment and Development, 1987) and in the practice of the business environment. Sharma et al. (2010) verified some topics of administration that study and use sustainability in their business practices. The authors discuss the study of marketing and sustainable environment emphasizing the understanding of the environmental conscience of the consumer, making reference to authors who do research on the topic (Antil, 1984; Kinnear et al., 1974). There is also discussion on the waste and indicators in production, production process and supply chain with the support of the studies by Guide and Van Wassenhove (2001), Guide et al. (2003), and among others.

In accordance with the study of Madruga and Silva (2008) which used the h-b index created by Banks (2006) while researching the topic of sustainability, one of the areas which showed strong correlation with the topic of sustainability was administration / management, presenting a positive correlation of 0.992 and m-index of the combination of sustainability and management of 2.625. Their research also revealed the multidisciplinary nature of sustainability, as its concept encompasses other issues (environmental, social, etc.). The findings of Madruga and Silva (2008) encouraged the research of sustainability with the topics of administration.

METHOD

This article was developed from a bibliometric research perspective

Table 1. Evolution of the concept of sustainability.

Date	Events, facts and milestones that built the concept	Objectives, implications and concepts of sustainability
1972	Stockholm Conference (First World Conference about Man and the Environment).	Insertion of the environmental dimension into the international political agenda, conditioning and placing restrictions on the economic model and use of natural resources. The term sustainable development emerges in the social, economical, political, cultural and environmental aspects.
1975	Belgrade Meeting sponsored by UNESCO	The main theme of the meeting emphasized the need for a new global ethic which would lead to the eradication of poverty, hunger, illiteracy, pollution and human domination and exploitation.
1980	Publication of the document "World Strategy for Conservation. The Conservation of Living Resources for Sustainable Development." by the United Nations Environment Programme (UNEP)	Reaffirmation of a critical view of the development model of industrialized countries.
1987	Brundtland Report is released at a UN Event.	Construction of the concept which states "Sustainable development is development that meets present needs without compromising the ability of future generations to meet their own needs."
1992	The ECO 92 event drafts a document entitled Agenda 21 in Rio de Janeiro, Brazil.	Agenda 21 is a proposal for actions in favor of sustainable development involving all segments of society in the formulation of policies and practices for sustainability from a systemic perspective with global reach.
1992	Drafting of the Earth Charter also known as The Rio Declaration at the International Forum of Non-Governmental Organizations of the Global Forum	Call for the adoption of the principles of the Earth Charter consisting of 10 commitments.
1997	Kyoto Protocol (in vigor from 2005 to 2012)	International treaty with more stringent commitments to reduce gases that exacerbate the greenhouse effect considered by most scientific research as the cause of anthropogenic global warming.
2002	Event sponsored by the World Summit on Sustainable Development in South Africa (Rio 10+)	Evaluation of proposals for the implementation of the conclusions of the Rio 92 event, that is, how to put into practice the concept of sustainability on the planet.

with the objective of increasing awareness in the study area related to sustainability and determining which topics studied in administration together with sustainability are being further researched and which are most relevant.

According to Fonseca (1986), bibliometry is a quantitative and statistical technique for measuring the rates of production and the dissemination of scientific knowledge. For Araújo (2006) the most important area of bibliometry is citation analysis which contributes to the development of science, provides the necessary recognition of a scientist by his colleagues, establishes property rights and priority of the scientific contribution of an author, are important information sources and helps judge the habits of information and show literature which is essential to the work of scientists (Foresti, 1989).

Data analysis was supported by qualitative and quantitative research approaches. In qualitative terms, the issues addressed in the researched publications were analyzed. As regards content, key words and topic relevance were analyzed. As for the quantitative data the following variables were investigated: total number of publications, authors, subject areas, types of documents, title of sources, year of publications, institutions, funding agencies, languages, countries and analysis of the number of times each publication was cited through the h-b index and the m index.

In accordance to Hirsch (2005) quantification of the impact and relevance of individual scientific research is often required for evaluating researchers and comparing purposes. From this principle Hirsch presented the h-index in his research called "An index to quantify an individual's scientific research output".

Figure 1. Steps of the research.

Afterwards, Banks (2006) contributed with the h-b index, an extension of the h-index. This index, in turn, is obtained through the number of citations of a topic or combination in a given period listed in descending order of citations. This is found in publications that have obtained a number of citations equal to or greater than their ranking position. Banks (2006) also explains the calculation of the m-index, which is obtained by dividing h-b index by the period of years that one wishes to obtain information (n).

The following considerations made by Banks (2006) were used to analyze the h-b and m-indexes:

- When $0 < m \leq 0.5$, the topic/combination may be of interest for researchers in a specific research field, where the field encompasses a small community;
- When $0.5 < m \leq 2$, the topic/combination is likely to be a “hot topic” as a research area, where the field is too large or the topic/combination presents very interesting characteristics; and
- When $m \geq 2$, it is a unique topic/combination where the consequences have a greater scope than its own research area. It is probably a topic/combination with application effects or unique characteristics.

Steps for the collection of data

The collection of data used in this research was done through the

Web of Science database of the ISI Citation Index which was first published in print in 1963 with citation data beginning from 1961 (Garfield, 1963). According to Bar-Ilan (2010), in September 2008 Thomson Reuters added indexed citations of conference proceedings in the area of Science, Social Sciences and Human Sciences to the ISI Web of Science. Web of Science provides direct access to retrospective multidisciplinary flow of information of approximately 8,700 of most prestigious, high impact research journals in the world (Thomson Scientific, 2010). The references of all indexed items are extracted and the cited reference interface lists all citation to works of an author, regardless of whether the cited items are indexed by Web of Science or not (Bar-Ilan, 2008).

As shown in Figure 1, the research was divided into 4 steps. Firstly the term sustainability was typed as a topic in the search field for the period of 2000 to 2010 (10.5 years). Thus the following information arose: total number of publications, subject areas, types of documents, authors, title of sources, institutions, funding agencies, the year of publication, languages and countries. With the result of this first search, it was also possible to investigate the main articles related to the area of administration and thus list along with the literature studied, 20 subjects to be combined with the term sustainability.

In the second step, there was a second search in the system, combining each of the topics related to the area of administration with the term sustainability in the same period of time of the first search (2000-2010). Afterwards, there was a classification of the

Table 2. Subject areas in the study of sustainability.

Subject areas	Number of publications
1. Environmental Sciences	3,572
2. Environmental Studies	2,248
3. Ecology	1,920
4. Economics	1,270
5. Engineering, Environmental	1,160
6. Agriculture, Multidisciplinary	998
7. Water Resources	988
8. Energy and Fuels	738
9. Planning and Development	720
10. Agronomy	703
11. Geography	670
12. Forestry	643
13. Public, Environmental and Occupational Health	631
14. Soil Science	580
15. Engineering, Civil	565
16. Management	459
17. Geosciences, Multidisciplinary	449
18. Marine and Freshwater Biology	449
19. Engineering, Chemical	447
20. Fisheries	413

publications and identification of the "hot topics".

Lastly, an analysis was made on the ratio of the number of publications per author and the number of times the author was cited in order to ascertain whether the quantity published by the author is directly related to the relevance of its scientific output. For this reason, for each combination considered a "hot topic", the 10 most published authors and the 10 most cited publications were selected. According to Hirsch (2005) the total number of articles published measures the productivity of the author, but it does not measure the importance and/or impact of their publications. The impact of the publications is measured by the number of citations that each publication obtains being measured using the h-index.

ANALYSIS AND DISCUSSION

The study of sustainability in the last decade

At first, the term sustainability was searched in Web of Science. As a result, 18,535 publications were found, which were divided in this study in: subject areas, authors, types of documents, title of the sources, the year of publications, institutions, funding agencies, languages and countries.

In relation to the subject areas which cover the study of sustainability, the top twenty were found to have obtained the highest number of publications as shown in Table 2. Analyzing the results and theoretical reference discussed earlier, multidisciplinary is evident in the study concerning sustainability. Fields of study related to ecology, engineering, agronomy, economics, management, geography, etc. also arise. The phenomenon of

multidisciplinary can be supported by the comprehension of the concept of sustainability, which according to Sachs (1993) involves the social, environmental, economic, spatial and cultural dimensions.

The following are the top 20 authors who have the highest published articles on sustainability, excluding unsigned publications: Chen G.Q. (22), Haberl H. (22), Scholz R.W. (21), Chen B. (20), Dincer I. (20), Krausmann F. (20), Bastianoni S. (19), Folke C. (19), Zhang Y. (18), Yang Z.F. (17), Berkes F. (16), Botsford L.W. (15), Cairns J. (15), O'Riordan T. (15), Scott D. (15), Bakshi B.R. (14), Brent A.C. (14), Giampietro M. (14), Hammond G.P. (14), and Hilborn R. (14). It is observed that there is parity among the authors concerning the number of publications.

Among the 18,535 publications found, 13,495 (almost 73% of the total) are articles, 2,152 are annals, 1,114 are reviews, 868 are editorial material and 480 are book reviews. As for the title of the sources there was a great diversification of the study fields, such as: ecology, management, agriculture, technology, among others. The 20 sources that most published in the period investigated released 73 to 422 publications: Ecological Economics (428), Journal of Cleaner Production (306), Forest Ecology and Management (186), Agriculture Ecosystems and Environment (169), International Journal of Sustainable Development and World Ecology (169), Energy Policy (165), Journal of Environmental Management (149), Water Science and Technology (134), Sustainable Development (129), Journal of Sustainable

Figure 2. Publications per year.

Agriculture (125), Environmental Management (114), Ecological Modelling (102), Journal of Business Ethics (95), Australian Journal of Experimental Agriculture (91), Proceedings of the National Academy of Sciences of the United States of America (87), Renewable and Sustainable Energy Reviews (87), Environmental Science and Technology (81), Agricultural Systems (75), Forestry Chronicle (75) Landscape and Urban Planning (74).

Observing the historical timeline of publications involving the term sustainability (Figure 2), there was a gradual increase in the last decade, intensifying in the last 5 years. The evolution of research in this area may be justified by greater awareness of society in face of social-environmental issues which are gaining increasing prominence in various media (Dias, 2008).

The following 20 institutions with the most publications related to the topic of sustainability were found: 11 North American institutions totaling 1,173 publications - University of Washington (130), United States Department of Agriculture – Agricultural Research Service (126), University of Florida (117), University of California, Davis (112), University of California, Berkeley (111), University of Wisconsin (102), Cornell University (98), Arizona State University (96), Harvard University (96), University of Michigan (96) Ohio State University (89); 4 Australian institutions totaling 420 publications - University of Queensland (117), Australian National University (107), University of Melbourne (100), Monash University (96); 2 Canadian institutions totaling 340 publications - University of British Columbia (203) University of Toronto (137); 1 Chinese institution totaling 191 publications - Chinese Academy of Sciences, 1 Dutch institution totaling 157 publications - Wageningen University and Research Center; and 1 French institution totaling 121 publications - French National Institute for Agricultural Research.

In relation to the funding agencies that cover sustainability, the top 10 with the highest number of publications were: National Natural Science Foundation of China (57), National Science Foundation (54), European Commission (34), The United States of America (31), Chinese Academy of Science (20), European Union (19), NSF - National Science Foundation (19), National Basic Research Program of China (17), CNPQ - *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (The National Council for Scientific and Technological Development) (14) and EPSRC - Engineering and Physical Sciences Research Council (13).

Regarding the number of publications by country (Figure 3) the United States leads the ranking of most published with 5,251, followed by England (2,091), Australia (1,533), Canada (1,369), Germany (975), The Netherlands (837), China (692), France (620), Italy (520), Brazil (519), India (488), Sweden (454), Switzerland (426), Japan (373), Scotland (366), South Africa (345), New Zealand (297), Austria (237) and Belgium (235). From the findings it may be inferred that these are the countries in which the institutions publish more and invest more in research in the field of sustainability.

According to the list of the countries that have the most published work on the topic of sustainability (United States, England, Australia and Canada), the English language stands out among other languages with 17,666 publications, nearly 96% of the total. Following is the German language with 270 publications, Spanish with 177, Portuguese with 163 and French with 81 publications.

The study of sustainability in administration

At this stage of the research, publications on sustainability related to distinct areas in the study of

Figure 3. Top 10 countries with the highest number of publications on sustainability.

Table 3. Selected topics for the study related to administration.

Topics		Total number of publications
1st.	Communication	> 100,000
2nd.	Consumption	> 100,000
3rd.	Management	> 100,000
4th.	Production Process	99,986
5th.	Business	57,510
6th.	Innovation	39,336
7th.	Public Management	20,368
8th.	Marketing	18,640
9th.	Brand	14,488
10th.	Financial Market	12,909
11th.	Stakeholders	11,110
12th.	Supply Chain	10,231
13th.	Business Performance	8,818
14th.	Performance Indicators	8,402
15th.	Certification	7,954
16th.	Competitiveness	6,771
17th.	Consumer Behavior	5,476
18th.	Strategic Planning	3,620
19th.	Business Ethics	2,053
20th.	Corporate Social Responsibility	1,614

administration were investigated. With a brief bibliographic review of the material found in the Web of Science database, 20 topics were selected associated to the area of administration, which showed good incidence of studies with the sustainability topic. The selected topics were: Management, Business, Public Management, Strategic Planning, Competitiveness, Marketing, Communication, Consumer Behavior, Consumption,

Brand, Corporate Social Responsibility, Business Ethics, Stakeholders, Financial Market, Innovation, Supply Chain, Production Process, Performance Indicators, Business Performance and Certification. Table 3 shows the ranks of the 20 topics according to the number of publications:

Subsequently, a combination of each topic listed earlier with sustainability was done. The total number of

Table 4. Sustainability in administration.

Topics	Total number of publications	h-b index	m-index
1st. Management	6,332	66	6.29
2nd. Consumption	1,156	31	2.95
3rd. Production Process	895	33	3.14
4th. Business	836	24	2.29
5th. Stakeholders	781	23	2.19
6th. Innovation	721	25	2.38
7th. Public Management	665	25	2.38
8th. Communication	441	21	2.00
9th. Performance Indicators	328	20	1.90
10th. Supply Chain	225	15	1.43
11th. Certification	221	17	1.62
12th. Marketing	204	16	1.52
13th. Business Performance	190	17	1.62
14th. Corporate Social Responsibility	169	11	1.05
15th. Strategic Planning	167	14	1.33
16th. Competitiveness	166	11	1.05
17th. Financial Market	149	11	1.05
18th. Business Ethics	46	5	0.48
19th. Brand	45	9	0.85
20th. Consumer Behavior	42	8	0.76

publications for each combination was also calculated (topic related to administration $\times$ sustainability), the h-index and the m-index (Table 4). The results were listed according to the total number of publications of each combination, although it is important to observe that some topics that individually have a significant number of publications (Communication, Financial Market and Brand), when researched with the topic of sustainability, the number of publications becomes less significant compared to other combinations. It may also be noticed that some topics have a lower number of individual publications (Stakeholders, Performance Indicators and Certifications), and when researched with the topic of sustainability, it becomes more significant compared to other combinations.

With the calculation of the h-index and the m-index it is possible to measure the performance of the topics/combinations investigated based on their number of citations (Kelly and Jennions, 2006). Based on considerations of Banks (2006) on the h-b and m-indexes, it is possible to classify as “hot topics” combinations of sustainability with: management (6.29); production process (3.14); consumption (2.95); innovation (2.38); public management (2.38); business (2.29); stakeholders (2.19) and communication (2.00). The other combinations by presenting $m > 0.5$ may be considered as emerging “hot topics” as research areas.

Based on research conducted in the Web of Science database, the top 10 authors with the most publications were selected for the combinations considered “hot

topics” (management, production process, consumption, innovation, public management, business, stakeholders and communication). It was also investigated among these researchers, those who appear as authors of the 10 most cited publications for each combination (Table 5).

Table 5 clearly elaborates the ratio of the number of publications per authors with the number of times each author (publication) was cited. Based on Table 5, it is possible to observe that the number of publications is not related to the efficiency of the author (number of times it was cited). Only authors such as Folke C. (management), Burger J.A. and Garcia S.M. (public management), and Butler B.S. (communication) of the top 10 authors with the most publications are on the list of the 10 most cited publications as researchers.

FINAL CONSIDERATIONS

According to Madruga and Silva (2008), the findings of this study demonstrated the multidisciplinary nature of sustainability. The research also showed that in the last decade (2000-2010) the study of sustainability is increasing year after year. This increased interest in studying the sustainability theme is parallel to the growth of environmental concern of organizations and society.

The information obtained in the Web of Science database indicated that almost 73% of the publications are in article format (papers), among the authors with the

Table 5. Ratio of authors with the most publications and the most cited publications.

Topics	Authors with the most publications	Most cited publications
Management	Berkes, F. (16) ¹ ; Folke, C. (15); Christie, P. (12); Hilborn, R. (12); Botsford, L.W. (11); Lodge, G.M. (11); Scholz, R.W. (11); Deckers, J. (10); Govaerts, B. (10); and Ridley, A.M. (10).	50. ² Lambin E.F., Turner B.L., Geist H.J., Folke C., et al. (2001). The causes of land-use and land-cover change: moving beyond the myths, <i>Global Environmental Change-Human and Policy Dimensions</i> , v. 11, p. 261-269. (284) ³ 10 ⁰ . Hughes T.P., Bellwood D.R., Folke C., et al. (2005). New paradigms for supporting the resilience of marine ecosystems, <i>Trends in Ecology and Evolution</i> , v. 20, p. 380-386. (172)
Consumption	Chen, G.Q. (12); Chen, B. (10); Krausmann, F. (10); Haberl, H. (8); Bakshi, B.R. (7); Erb, K.H. (7); Yang, Z.F. (7); Fischer-Kowalski, M. (6); Verbeke, W. (6); and Browne, D. (5).	-
Production Process	Bastianoni, S. (7); Dewulf, J. (7); Haberl, H. (7); Van Langenhove, H. (7); Krausmann, F. (6); Van Ittersum, M.K. (5); Feijoo, G. (4); Gonzalez-Garcia, S. (4); Hungerbuhler, K. (4); and Marchettini, N. (4)	-
Business	Robert, K.H. (5); Lenzen, M. (4); Van Marrewijk, M. (4); Broman, G. (3); Brown, H.S. (3); Danes, S.M. (3); Genaidy, A.M. (3); Khan, S. (3); Kolk, A. (3); and Konrad, A. (3).	-
Stakeholders	Burger, J. (15); Decker, D.J. (14); Loisel, P. (14); Carter, R. (13); Van Ittersum, M.K. (12); Van Keulen, H. (12); Abma, T.A. (11); Scholz, R.W. (11); Ouma, J. (10); and Gochfeld, M. (10).	-
Innovation	Geels, F.W. (7); Smith, A. (5); Vezzoli, C. (5); Tukker, A. (4); Anastas, P.T. (3); Lovell, H. (3); Partidario, P.J. (3); Raven, R.P.J.M. (3); Van Keulen, H. (3); and Vergragt, P.J. (3).	-
Public Management	Sinclair, A.J. (5); Kneeshaw, D.D. (4); Messier, C. (4); Burger, J.A. (3); Duda, A.M. (3); Garcia, S.M. (3); Hull, R.B. (3); Preuss, L. (3); Sansom, K. (3); and Abebe, Y. (2).	4 ⁰ . Schoenholtz S.H., Van Miegroet H., Burger J.A. (2000). A review of chemical and physical properties as indicators of forest soil quality: challenges and opportunities, <i>Forest Ecology and Management</i> , v. 138, p. 335-356. (68) 7 ⁰ . Garcia S.M., Staples D.J. (2000). Sustainability reference systems and indicators for responsible marine capture fisheries: a review of concepts and elements for a set of guidelines, <i>Marine and Freshwater Research</i> , v. 51, p. 385-426. (57)
Communication	Castillo, A. (3); Hilty, L.M. (3); Verbeke, W. (3); Arlinghaus, R. (2); Barr, S. (2); Branch, G.M. (2); Butler, B.S. (2); Carusone, S.C. (2); Davies, G.P. (2); and Dye, A.H. (2)	6 ⁰ . Butler B.S. (2001). Membership size, communication activity, and sustainability: a resource-based model of online social structures, <i>Information Systems Research</i> , v. 12, p. 346-362. (68)

¹number of publications by author; ²position of the publication according to the number of citations; ³number of citations.

highest number of publications there is no author that has an outstanding quantity of publications, the institution with the highest number of publications is the University Of British Columbia in Canada. However, among the 20 institutions that have published the most about this subject, most institutions (11) and also the most significant in terms of total number of publications are North American totaling 1,173. As the number of institutions and the number of publications have demonstrated the bulk of publications are concentrated in the United States totaling 5,251. Also corroborating with the previous information, the English language is predominant as 96%

of the publications are written in this language. Among the sources of the publications, the highlight was the Journal of Ecological Economics with 428 publications and the subject area that had the highest number of publications is environmental sciences. It is not surprising that the concentration of the work about this theme is in the United States because is in this country that are the principal investigators of this subject.

As "hot topics", it was noticed that Management, Consumption, Production Process, Business, Stakeholders, Public Management and Communication were more relevant with the study of sustainability. It was also

ascertained that the authors who have the highest number of publications are not necessarily the most relevant to academic knowledge in terms of number of times they were cited in other papers. These subjects with sustainability theme are increasingly evident in empirical studies, both investigating the buying behavior of consumers, as exploring environmental practices in the company's business.

It is suggested for future research the use of other topics of administration which may be considered "hot topics" with the study of sustainability as this article was limited to the choice of subjects as perceived by researchers and a brief bibliographic review on the subject. Another suggestion is regarding the period of years investigated, which may cover a longer time period than the one in this study. Lastly, according to Madruga and Silva (2008), this research can be done using other database in order to complement, compare or substitute the results found in this study.

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