

SCIENTIFIC PRODUCTION IN ENVIRONMENTAL LAW: A BIBLIOMETRIC STUDY IN SOUTH AMERICA

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ABSTRACT: The theme of environmental law has been widely discussed in the world, being a very polemic area of law that can influence a country's judiciary, economy, and public policies. However, what have researchers studied in this field? How has the research been conducted? These and other questions prompted us to conduct a bibliometric survey of studies on environmental law in South America. Thus, to better understand the theme and contribute to its state of the art, we searched scientific databases (SciELO and *Portal Periódicos Capes*) of articles on environmental law published in South American countries from 2010 through 2019. The results were tabulated using bibliometric indicators and analyzed using scientometry. Some of the results related to methodological indicators such as structural methodological flaws were found in the research. Another aspect identified in this study was the consequence of publication only in Portuguese, which makes the internationalization of journals and the knowledge produced in Brazil difficult. This is a quantitative method of data evaluation based on measures related to the publication of scientific papers. In this way, we hope to contribute to the development of future research on environmental law.

KEYWORDS: Scientometric; Bibliometric; Environmental Law; South America.

PRODUÇÃO CIENTÍFICA EM DIREITO AMBIENTAL: UM ESTUDO BIBLIOMÉTRICO NA AMÉRICA DO SUL

RESUMO: O tema do direito ambiental tem sido amplamente discutido no mundo, sendo uma área muito polêmica do direito que pode influenciar o judiciário, a economia e as políticas públicas de um país. Mas o que os pesquisadores estudam nesse campo? De que forma foi conduzida a investigação? Essas e outras questões nos levaram a fazer um levantamento bibliométrico de estudos sobre legislação ambiental na América do Sul. Assim, para entender melhor o tema e contribuir com seu estado de arte, buscamos nas bases de dados científicas (SciELO e *Portal Periódicos Capes*) artigos sobre direito ambiental publicados nos países da América do Sul entre 2010 e 2019. Os resultados foram tabulados com indicadores bibliométricos e analisados por cienciometria. Alguns dos resultados relacionados a indicadores metodológicos, tais como falhas metodológicas

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estruturais, foram encontrados na pesquisa. Outro aspecto identificado neste estudo foi consequência da publicação apenas em português, o que dificulta a internacionalização de revistas e do conhecimento produzido no Brasil. Trata-se de um método quantitativo de avaliação de dados baseado em medidas relacionadas à publicação de artigos científicos. Desta forma, esperamos contribuir para o desenvolvimento da futura investigação em matéria de legislação ambiental.

PALAVRAS-CHAVE: Scientométrica; Bibliométrica; Direito Ambiental; América do Sul.

PRODUCCIÓN CIENTÍFICA EN DERECHO AMBIENTAL: UN ESTUDIO BIBLIOMÉTRICO EN SUDAMÉRICA

RESUMEN: El tema del derecho ambiental ha sido ampliamente discutido en el mundo, siendo un área muy polémica del derecho que puede influir en el poder judicial, la economía y las políticas públicas de un país. Sin embargo, ¿qué han estudiado los investigadores en este campo? ¿Cómo se ha llevado a cabo la investigación? Estas y otras preguntas nos llevaron a realizar una encuesta bibliométrica de estudios sobre derecho ambiental en América del Sur. Así, para comprender mejor el tema y contribuir a su estado del arte, se realizó una búsqueda en bases de datos científicas (*SciELO* y *Portal Periódicos Capes*) de artículos sobre derecho ambiental publicados en países sudamericanos desde el año 2010 hasta el 2019. Los resultados se tabularon utilizando indicadores bibliométricos y se analizaron mediante *cienciometría*. Algunos de los resultados relacionados con indicadores metodológicos como fallas metodológicas estructurales se encontraron en la investigación. Otro aspecto identificado en este estudio fue la consecuencia de la publicación únicamente en portugués, lo que dificulta la internacionalización de las revistas y el conocimiento producido en Brasil. Se trata de un método cuantitativo de evaluación de datos basado en medidas relacionadas con la publicación de artículos científicos. De esta manera, esperamos contribuir al desarrollo de futuras investigaciones sobre derecho ambiental.

PALABRAS CLAVE: Cienciométrico; Bibliométrico; Derecho Ambiental; Sudamérica.

1. INTRODUCTION

The subject of environmental law is widely discussed in Brazil and worldwide, as it affects many areas of people's lives and public services. It impacts nations from a political, economic, and social perspective. The literature on the subject clearly explains the direct relationship between the environment and socioeconomic, cultural, and human survival issues (SIRVINSKAS, 2018). However, man does not seem to comprehend the importance of environmental preservation and sustainable development.

Therefore, the study of this subject is critical to understanding the state of the art in environmental law research. To this end, a bibliometric survey of studies on this subject was adopted because, through its use of indicators, its potential contribution can guide researchers and scholars of environmental law to find more robust results in their

scientific research. Research development in social sciences encompasses the study of a wide range of theoretical and methodological problems for the advancement of environmental law, as well as other related or unrelated areas (EPSTEIN; KING, 2013). These authors emphasize that the legal field is not excluded from this context as it presents a variety of purposes and approaches with a common concern: the number of theoretical studies conducted at the expense of empirical ones. Many scholars in the legal field perceive that empirical studies are related to statistical techniques and quantitative data. However, empiricism is related to the observation and study of facts, whether they are numerical or not, and can originate from a numerical database, interviews, documents, and others (EPSTEIN; KING, 2013).

The general objective of this study was to map research on environmental law through a survey of articles in databases of scientific journals in South America from 2010 through 2019. The specific objectives were as follows: a) to construct indicators derived from scientific production (i.e., research articles) on environmental law, b) to analyze scientific production on environmental law, and c) to describe the main trends in studies on environmental law in South America over this 10-year period.

2. THEORETICAL FRAMEWORK

2.1 Environment

The environment is essential to the life of any living being on the planet, and this is why its conservation is not only a matter of ecological ideology, but also one of survival. The environment's ecological balance is extremely necessary for every living being, especially for human life and future generations (CAPRA, 2006; MANDELLI; CITOLIN, 2012; RIBEIRO; CAVASSAN, 2012). All these statements and more are part of the rhetoric created by several authors, researchers, and ecologists. However, what is the environment?

To define the environment, it is necessary to understand the complexity of the term. For D'Agostini (2002, p. 147), "the notion of environment as the physical environment of the living being is opposed to the notion of abstract environment, which only emerges from meaningful relationships to the conscious being." D'Agostini (2002) argues that the term "environment" can be a product of language based on the relationship between humans and nature, not just a specific or physical place. However, there is some conceptual confusion with the term "environment," which is why it is difficult to define

(KRZYSCZAK, 2016). Some view it as synonymous with natural resources, while others view it as either a place or nature itself.

Nonetheless, there is also a linguistic issue related to this term. According to Farias (2006), “medium” and “environment” are synonyms, and several countries, such as England and the United States (environment), France (*environnement* or *milieu*), Germany (*unwelt*), and Portugal and Italy (*ambiente*) and others, do not use the term “environmental medium,” but only “environment.” Notably, Brazilian legislative texts use “environmental medium.” Indeed, “environment” embodies a conceptual diversity that allows for a wide variety of interpretations, and it is influenced by the experience of each individual presenting the term, whether in ecology, chemistry, geology, biology, law, and art (CAPRA, 2006; RIBEIRO & CAVASSAN, 2012).

From a broad, holistic perspective, Capra (2006) explains “environment” through a systemic perspective that finds support in several fields of modern science, such as quantum physics. In this sense, living systems are autonomous, but they are not isolated from their environment. Conversely, they continuously and cognitively interact with the environment through an exchange of energy and matter. Silva (2013, p. 20) affirms that “the environment is therefore the interaction of a set of natural, artificial, and cultural elements that provide for the balanced development of life in all of its forms.” Analogous to the understanding of Capra (2006) and Silva (2013), Brazilian legislation has adopted the holistic, systematic meaning of the term “environment” through the National Environmental Policy (*Política Nacional do Meio Ambiente*, “PNMA”), Law n° 6.938/1981, which contemplates the whole set of goods, natural or otherwise, produced by man that affects him in some way in his existence.

For the purposes of this study, the term “environment” will be based on the understanding of Capra (2006), Silva (2013), Krzysczak (2016), and other authors, and is consistent with the idea that the environment is something systemic, holistic, and interconnected among all beings of the universe. In addition to the difficulty of conceptualizing the term “environment,” it is difficult to define its classifications or easily accept divisions for studying it. Capra (2006) divided the environment into natural (nature), social (interactions between organisms), cultural (philosophical, religious, ideological perceptions, etc.), universal (interplanetary, stellar relations, and other spatial organisms), internal (to each organism), and external (surrounding the organism). Ribeiro and Cavassan (2012) characterize the environment as a physical or geographical space,

an internal and external environment for living beings, social interactions, and with the nature.

There are many classifications by various authors. Silva (2013) uses a classification or approach related to their definition of the environment, which is connected to Brazilian environmental legislation, particularly the Federal Constitution of 1988 (CF/88): *Natural or physical*: soil, water, air, flora, fauna, and the interaction of living beings and their environment (Article 225 of CF/88, Law nº 6.938/81 [PNMA], and specific environmental protection legislation at the federal, state, and municipal levels); *Cultural*: historical, cultural, archeological, landscape heritage, and heritage tourism (Articles 215 and 216 of CF/88 and specific legislation at the federal, state, and municipal levels); *Artificial*: constructed urban space and public areas (Articles 182 and 183 of CF/88, Law no. 10.257/01—City Statute, and specific legislation at the federal, state, and municipal levels); *Work*: place where human beings work (Article 7, XXII and Article 200, VIII of CF/88, and the Consolidation of Labor Laws, “CLT”).

There are economic and business challenges regarding the use of environmental resources. The corporate world is overly focused on profit and not concerned with other aspects of life, as a company is not a living being, although its managers and owners are. As a legal entity, it is an abstraction that develops economic activities (RAMOS, 2017; LIEBL; SANTOS, 2020). Nevertheless, business entities utilize free goods such as air, water, and soil, as well as social relations, which are affected by their economic expansion. Accordingly, profits are obtained from public environmental resources and life in general, with no concern for future generations. This notion of the environment as something isolated and disconnected has led to the commercial exploitation of these public resources by different business groups for their own benefit (CAPRA, 2006).

To protect public environmental resources, the branch of environmental law has emerged in the Brazilian legal system, as well as in other countries. Due to its importance, regulations are not restricted to environmental law, as the Brazilian Constitution of 1988 clearly defines a balanced environment as a fundamental human right. Therefore, it is necessary to address the specific topic of environmental standards, which is discussed below.

2.2 Foundations of Environmental Law

The fundamental rights of the CF/1988 are divided into five dimensions. The first dimension is related to individual and public freedoms (civil rights) and limits the power of the state. The second dimension covers social, economic, and cultural rights, which are related to the collective whole and the reduction of social inequality. The third dimension constitutes the rights of society in general (environment, peace, sustainable development, communication, etc.); the Brazilian Environmental Law is constitutionally grounded in this dimension. The fourth dimension of rights addresses biotechnology and bioengineering (LENZA, 2019; WOLKMER, 2002). The fifth dimension relates to the digital, virtual, and cyber worlds (WOLKMER, 2002).

The environmental law, as part of the Brazilian legal system, is defined by Antunes (2010, p. 5) as “the rule that establishes the normative mechanisms capable of disciplining human activities related to the environment, based on environmental fact and environmental ethical value”. Prior to the Brazilian Federal Constitution of 1988, Law 6.938/81, which was the first Brazilian law that legally outlined Brazil’s environment, was enacted. Article 3, item I of the aforementioned law defines the environment as “the set of conditions, laws, influences, and interactions of a physical, chemical, and biological order which allows, sustains, and governs life in all of its forms” (BRASIL, 2018, p. 1408). In Article 2, item I, it establishes that the environment is a public asset that needs to be ensured and protected, given its collective use. To confirm the characterization of the environment as public heritage, Brazil (2018) clearly set forth in Article 3, item V, that environmental resources are the atmosphere; internal, surface, and underground waters; estuaries; territorial waters; soil; subsoil; and elements of the biosphere.

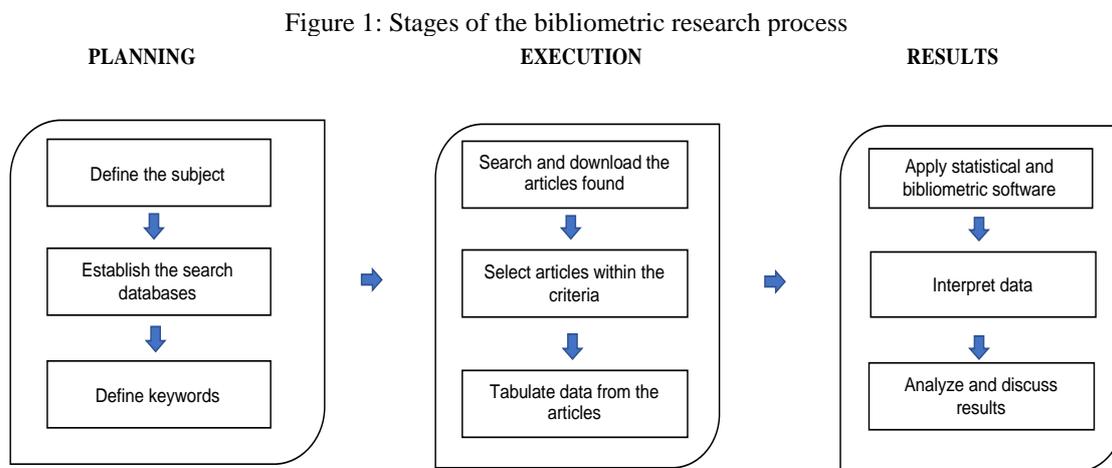
In addition to Law n° 6.938/81—which instituted the PNMA—and the Brazilian Constitution of 1988, other more specific rules were created to complement the standardization of environmental law. To address natural or physical resources, Brazil has enacted the Environmental Crimes Law (Law n°. 9.605/1998), Law n°. 12.305/2010 (which instituted the National Solid Waste Policy “PNRS”), the law to protect the Atlantic Forest (Law n° 11.428/2006), and the Forest Code (Law n° 12.651/2012), among others. In addition to the abovementioned regulations, there are state and municipal laws in the Brazilian legal system that complement and comprise Brazil’s environmental law.

3. RESEARCH METHOD

This is an empirical and exploratory study that seeks a better understanding of the subject of environmental law. This work uses a quantitative strategy or approach because it adopts indicators that quantify the data collected. As explained by Dzikowski (2018), bibliometric analyses apply a quantitative approach to evaluate scientific publications. The quantitative approach uses data collection and analysis techniques based on numerical measurements to answer research questions by establishing patterns of behavior in a population or sample.

This study adopted the method of bibliographic research to search for articles related to environmental law in online databases. Bibliographic or secondary source research is a survey that covers all the sources that have already been published on a subject of scientific study, from articles, books, papers, theses, and so on. Bibliographic research when it incorporates the use of computer software or applications is called bibliometrics.

The procedural steps of this study are presented in Figure 1 below:



Source: Prepared by the author

As illustrated in Figure 1, this empirical study was divided into three phases: planning, execution, and results. The first phase (i.e., the planning phase) is used to define the subject and keywords and to select the databases for research. The subject as the issue that one wishes to study or research, and its selection may be based on the researcher's aptitude, the importance of the subject at the moment, or the attention an object deserves in scientific investigation, among others. Once the subject is determined, databases, which are the places or virtual libraries used to search for sources on the subject, are

selected. Keywords are then selected to conduct a more effective and quicker search; they, in turn, facilitate the selection of the most appropriate texts for the researcher's interests.

As shown in Figure 1, once the research parameters are defined, the second phase (i.e., the execution phase) begins; the second phase consists of searching for and downloading the articles found in the databases selected in the planning phase. Subsequently, the downloaded articles are read and selected according to predetermined criteria. The selected texts are tabulated in an electronic spreadsheet according to the indicators intended for bibliometric analysis. The third and final phase (i.e., the results phase) is used to classify the data within the planning requirements and analyze the data through statistical and bibliometric software/applications. Thereafter, the results generated by the software/applications are interpreted for final analysis and discussion, by comparing its findings with those of other scientific studies on environmental law and bibliometrics.

3.1 Data Collection

Data collection is part of the execution stage of scientific and academic research. Here, the first step was selecting the subject of environmental law. The second step was selecting online databases to search for scientific articles. The following databases were chosen because they are considered the most important databases for locating articles on South American countries: SciELO and CAPES *Portal de Periódicos*. A period of 10 years was selected for the scope of this work (January 1, 2010–December 31, 2019). To complete the planning phase, keywords were determined for the searches as well as where they should be located within the article. The terms “*direito ambiental*” (in Portuguese), “*derecho ambiental*” (in Spanish), or “environmental law” (in English) had to be included in the abstract, title, or keywords of the article found.

Subsequently, the second phase (i.e., the execution phase) of this study began. In this phase, scientific articles that contained one of the keywords in the abstract or title and that were also reviewed and evaluated by peers were downloaded. In the abovementioned databases, a total of 468 articles were found, 44 of which were found in SciELO and 424 in CAPES *Portal de Periódicos*. From the total of articles found and downloaded, 331 were eliminated because they did not meet the proposed criteria or appeared more than once in the same database or in multiple databases. This step was referred to as the article selection stage, which followed predetermined criteria (scientific articles; South

American journal; 2010–2019; keywords in the title, abstract, or keywords). The total number of articles in this study considered all articles located in the search. However, given that some articles appear in multiple databases, the total number of articles per database may not reflect unique articles; for example, the CAPES *Portal de Periódicos* includes several other databases, such as SciELO.

To complete the second phase of execution, a spreadsheet was created to tabulate the data for the articles found, which includes the following indicators: publication year of the article, name of the journal, the journal's publisher, the first author's entity of origin, number of authors, central subject, theory addressed, nature of the article (empirical or theoretical), research approach (qualitative or quantitative), type of research (exploratory, descriptive, or explanatory), research method (bibliographic and documentary, survey, etc.), research period (longitudinal or transversal), data collection technique (interview, questionnaire, etc.), data source (primary or secondary), data analysis technique (descriptive statistics, content analysis, etc.), language of the article, Qualis-Capes classification (quadrennium 2013–2016), scientific area of the journal (law, environment, multidisciplinary, etc.), and the field of law studied. This stage was used to list the articles found in the database search and selected for inclusion in the study.

3.2 Data Analysis

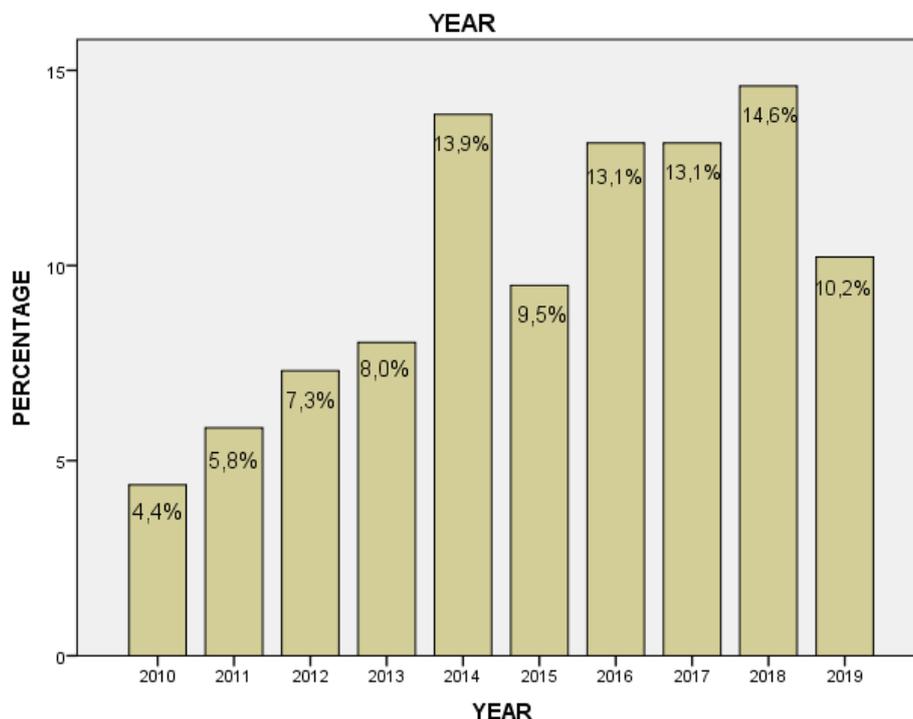
The final phase of this study was to apply a statistics-related computer software to quantify the data tabulated in the spreadsheet. After excluding articles according to the criteria above, 137 articles found in the two databases were analyzed. Descriptive statistics were used to analyze frequencies, modes, and cross-tabulation of data from the indicators adopted in the study. The results were presented in the form of tables and graphs, and then analyzed and compared with the literature.

4. RESULTS AND DISCUSSION

In this section, the results of the study on environmental law are presented and discussed, along with graphs and tables. The first indicator of this study was the year of publication, which is why scientific articles were searched from 2010 through 2019, that is, from the last decade. Figure 2 shows that 2018 was the year with the most publications (14.6%), followed by 2014 (13.9%), and 2016 and 2017 (13.1%). A small decrease was observed in 2019. Figure 2 demonstrates that the number of publications on

environmental law has been increasing since 2010, with a slight decrease in 2015 and 2019. There is no theoretical explanation for this phenomenon, but it may be due to increasing worldwide concern for the environment and the survival of humans and other living beings. Deforestation, forest fires, and the extinction of animal and plant species are causes of apprehension among several researchers, environmental organizations, governments, and countries.

Figure 2: Publication year of the articles



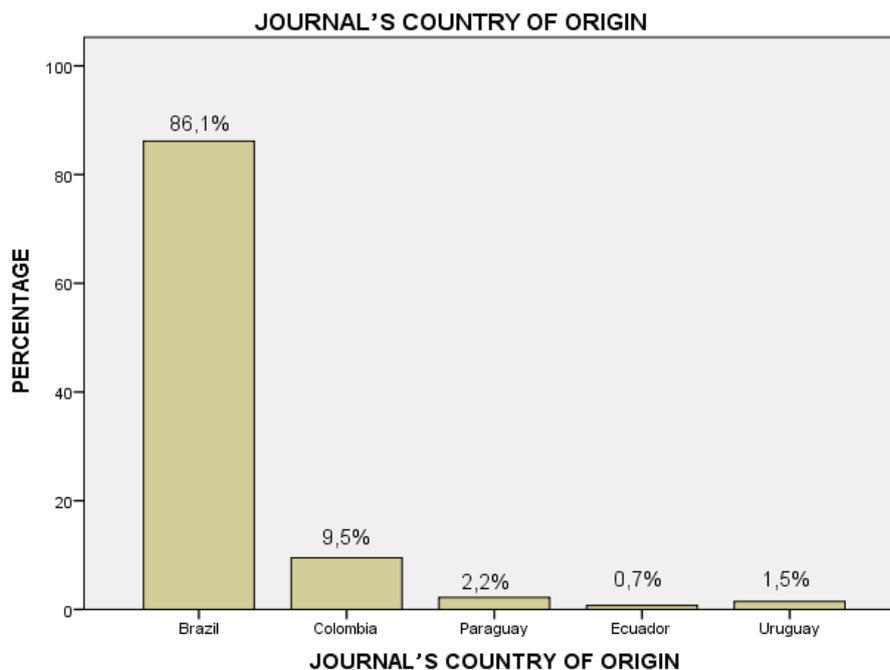
Source: Prepared by the authors

The second indicator for analysis was the name of the journal publishing material on the subject. *Revista de Direito Econômico e Socioambiental* published 10.2% of the articles found in the search, followed by *Revista Direito e Justiça: Reflexões Sociojurídicas* and *Revista Sequência – Estudos Jurídicos e Políticos*, both with 5.1%, and then *Revista Ambiente & Sociedade* and *Revista de Direito Brasileira*, both with 4.4%. The journals *Atas de Saúde Ambiental*, *Revista de Direito Ambiental e Socioambientalismo*, and *Revista Direito GV* each accounted for 3.6% of the publications in environmental law. Overall, a wide variety of journals published material on the subject, as articles were found in 82 different journals.

Another indicator is the journal's country of origin. Figure 3 demonstrates that most of the articles were published by journals in Brazil, with 86.1% of the total surveyed

articles published there. Colombia was second with 9.5%, and journals in Paraguay, Ecuador, and Uruguay also published articles on environmental law. No theoretical reason or explanation for this result was found, but the fact that Brazil has a larger educational structure and promotes more training for doctors and researchers than other countries in South America may have influenced this finding (SOUZA, 2018).

Figure 3: Journal's country of origin



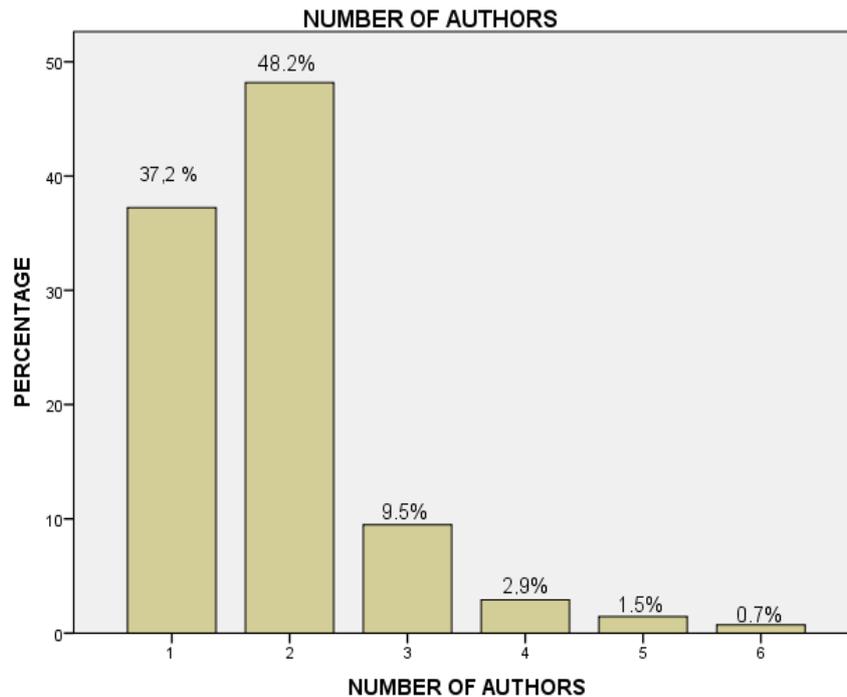
Source: Prepared by the authors

As for the first author's entity of origin, the National Council for Research and Graduate Studies in Law (*Conselho Nacional de Pesquisa e Pós-graduação em Direito*, "CONPEDI") stood out the most with 12.4% of the publications found, followed by the Pontifical Catholic University (*Pontifícia Universidade Católica*, "PUC") of Paraná (10.2%), the Regional Integrated University of Upper Uruguay and Missions (*Universidade Regional Integrada do Alto Uruguai e das Missões*, "URI") with 8%, and the Federal University of Santa Catarina with 5.8%. No theoretical explanation or significant reason was found for this result.

As for the number of authors per article, Figure 4 shows that 48.2% of the articles were written by only two authors, followed by 37.2% written by one author, and 9.5% written by three authors. This combined result shows that the absolute majority (94.9%) of the published articles on environmental law in South America were written by three or fewer authors. This is a good indicator for the area as it evidences that co-author inflation,

which is the inclusion of co-authors who did not properly contribute to the study, has been avoided. Co-author inflation is considered to be dishonest, irresponsible, and unethical, and demonstrates a lack of scientific integrity; it is reflective of a trend in the academic/scientific community stemming from the pressure for scientific production, including in the area of law (VASCONCELLOS, 2020).

Figure 4: Number of authors per article



Source: Prepared by the authors

As for the nature of the articles (theoretical or empirical) found, the overwhelming majority (92.7%) were theoretical and only 7.3% were empirical, as shown in Table 1. This reveals that there is much more theoretical discussion and little scientific empirical research in this research area. Although the hermeneutic discussion is a cultural issue in the field of law in general, Silveira and Sanches (2016) highlight that there is a “book culture” in law, to the detriment of scientific production through journal articles. These authors criticize the epistemological, dogmatic paradigm applied by law programs that base their teachings on legal doctrines and rules. Thus, Silveira and Sanches (2016) understand that this phenomenon is a structural problem in Brazilian legal education. These authors continue their criticism by stating that many professors in law programs are not familiar with scientific parameters such as participating in research groups, conducting field research, and adopting methodological techniques for data collection and

analysis, among others. Regardless, these professors prefer hermeneutic, individualized discussions without scientific coherence.

Table 1: Nature of the article

	Frequency	Percentage (%)
Theoretical	127	92.7
Empirical	10	7.3
Total	137	100.0

Source: Prepared by the authors

Table 2 presents the quantitative results concerning the research approach (qualitative, quantitative, or qualitative-quantitative) of the articles. The vast majority (89.8%) of the authors did not specify the type of approach used in their articles; only 9.5% stated that they employed a qualitative approach, and 0.7% affirmed that they employed a quantitative approach. The low number of articles employing quantitative approaches may be associated with difficulties law professionals may have using mathematics and statistics in their scientific work or reflective of a lack of training in their education. The very high percentage of authors who do not specify their research approach might be associated with flaws in the scientific training of researchers in the field of law, as noted by several authors, including Silveira and Sanches (2016), Sampaio (2013), and Rodrigues (2005).

Table 2: Research approach

	Frequency	Percentage (%)
Unspecified	123	89.8
Qualitative	13	9.5
Quantitative	1	0.7
Total	137	100.0

Source: Prepared by the authors

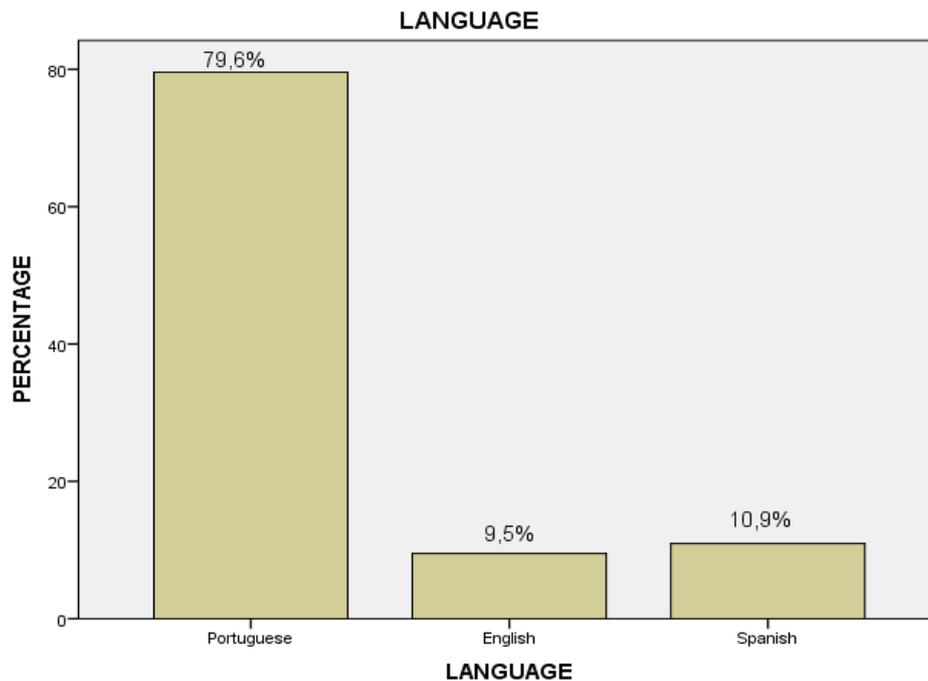
With regard to the indicators of the theory addressed by the articles, the type of research, level of depth (exploratory, descriptive, and explanatory), research method (bibliographic/documentary, survey, case study, and others), research period (longitudinal, transversal, and others), data collection techniques (bibliographic/documentary, interviews, questionnaires, observation, and others), data analysis techniques (descriptive statistics, multivariate statistics, content analysis, discourse analysis, and others), and data source (primary or secondary), a considerable

majority of the articles with the term “environmental law” did not specify these criteria. Over 85% of the articles were “unspecified” in the above-mentioned indicators, meaning they did not explain how they processed their studies from a methodological point of view.

The findings of this study corroborate those of Sampaio (2013, p. 231), who demonstrates a concern with this phenomenon: It “reveals and demonstrates the state of legal research and the difficulties in using methodology, especially, due to the evident relation to procedural and judicial work, and the need to break with this addiction.” According to Sampaio (2013), scientific work is different from procedural/judicial activity, including its structure and purpose, even though they are interconnected by the same science. Rodrigues (2005) complements this by noting a confusion in the perception of the breadth of what scientific methodology is in law programs, which explains why they reduce it to the normalization of academic studies. As a result, they forget that a final paper, be it a final thesis or even a dissertation, goes beyond the format of the rules established by the Brazilian Association of Technical Standards (*Associação Brasileira de Normas Técnicas*, “ABNT”) and that it is necessary to explain the research method, approach, and data collection and analysis techniques. In this way, any researcher who reads or evaluates the paper will understand how it was planned and executed, thereby giving more credibility to the results found and presented. Nevertheless, Sampaio (2013, p. 239) affirms that “the research problem is elaborated in the selection of the subject and the pillars of the study are found in the methodology.”

As for language, Figure 5 reveals that Portuguese predominated in articles on environmental law (79.6%), followed by Spanish (10.9%), and English (9.5%). This shows that the journals are limited to those who understand the Portuguese language. Ideally, journals in the field should be in English because it is the common language in the international academic community. Indeed, if the articles were in Spanish, they would have wider coverage than Portuguese because Spanish is the official language of most South American countries, Mexico, and Spain, and it is also widely spoken in the United States and Europe. According to Pereira, Lobão, and Lucas (2017), one of the necessary criteria for the internationalization of national journals and inclusion in foreign databases is that the article must be written in English. Articles written in Portuguese limit the readership and dissemination of studies and research produced in Brazil; thus, it is difficult for the international community to access these articles.

Figure 5: Language of the published articles



Source: Prepared by the authors

As for the classification of journals by the Coordination for the Improvement of Higher Education Personnel (*Coordenação de Aperfeiçoamento de Pessoal de Nível Superior*, “CAPES”), an agency of the Brazilian Ministry of Education responsible for evaluating graduate programs in Brazil, Table 3 shows that 21.2% of the published articles about environmental law were distributed by journals in stratum A1 of the Qualis-CAPES classification, while 19.7% were in stratum A2, and 19% were in stratum B1. The highest stratum is A1, and the lowest is C, according to the classification on the Sucupira/CAPES platform for the 2013–2016 quadrennium. Therefore, approximately 60% of the journals that publish material on the subject were above B1, which means that they have an academic quality in accordance with the standard required by institutions at that level. There is no theoretical explanation for these findings, only an indication that the studies reflect the scientific academic standards required by CAPES.

Table 3: Qualis – CAPES classification for the journal

Qualis	Frequency	Percentage (%)
Without Qualis	15	10.9
C	8	5.8
B5	9	6.6
B4	6	4.4
B3	10	7.3
B2	7	5.1
B1	26	19.0

A2	27	19.7
A1	29	21.2
Total	137	100.0

Source: Prepared by the authors

Another indicator is the area of law studied in the retrieved articles. Table 4 shows that environmental area was the area that appeared the most (50.4%), followed by constitutional law (24.1%), and international law (8.8%). This was expected given the subject of the search, the environment's relationship to fundamental constitutional rights, and the subject's international impact. However, a variety of legal areas were found in the articles, such as criminal, labor, economic, and agricultural.

Table 4: Area of law covered by the articles

	Frequency	Percentage (%)
Environmental	69	50.4
Constitutional	33	24.1
International	12	8.8
Criminal	5	3.6
Agricultural	5	3.6
Economic	5	3.6
Civil	3	2.2
Labor	2	1.5
Administrative	2	1.5
Tax	1	0.7
Total	137	100.0

Source: Prepared by the authors

When a cross tabulation was conducted between the indicators “journal” and “language,” some journals were found to publish articles in two languages, such as *Revista de Direito Brasileira*, *Revista de la Secretaría del Tribunal Permanente de Revisión*, *Revista Direito e Justiça: Reflexões Sociojurídicas*, and *Revista Direito GV*, in Portuguese and Spanish. Some journals published articles in Portuguese and English, such as *Revista Sequência – Estudos Jurídicos e Políticos*, *Revista Thesis Juris*, *Revista HOLOS*, *Revista de Estudos Constitucionais, Hermenêutica e Teoria do Direito*, and *Revista Ambiente & Sociedade*. In addition, *Revista Veredas do Direito* published articles in three languages: Portuguese, English, and Spanish. This demonstrates that these journals are concerned with internationalization and seek to reach higher strata or classifications by CAPES standards.

A second cross tabulation of data compared the year to the area of law studied in the article, as illustrated in Table 5. The year 2014 registered the most publications in the area of environmental law with an environmental focus, with 10 articles each year and 69

articles out of a total of 137 articles. The area of constitutional law experienced a dispersion of publications over the course of the 10-year period, with 33 articles in total on the subject. There was a concentration of articles focused on international law in 2018, with a total of 12 articles found. The areas of agricultural, criminal, and economic law each presented five publications in total across the 10-year period. There is no theoretical or logical explanation for these findings, but they can provide those interested in producing research on environmental law with suggestions on where to focus their studies.

Table 5: Year vs. Area of law covered

Year	Environmental	Constitucional	Agricultural	Labor	Economic	International	Criminal	Administrative	Tax	Civil	Total
2010	5	0	0	0	1	0	0	0	0	0	6
2011	2	2	1	0	1	0	0	1	0	1	8
2012	5	4	0	0	0	1	0	0	0	0	10
2013	5	4	0	1	0	0	0	0	0	1	11
2014	10	4	2	0	1	0	0	1	0	1	19
2015	9	3	0	0	0	0	1	0	0	0	13
2016	10	5	1	0	0	0	2	0	0	0	18
2017	7	4	0	0	2	3	1	0	1	0	18
2018	8	3	0	1	0	7	1	0	0	0	20
2019	8	4	1	0	0	1	0	0	0	0	14
Total	69	33	5	2	5	12	5	2	1	3	137

Source: Prepared by the authors

In sum, some findings were consistent with other studies in the scientific and academic literature. Other findings were unexplainable given the existing literature because they involve indicators that would require a more in-depth approach and, perhaps, a search in other scientific areas outside of legal science. The following section presents the conclusions and recommendations based on the results of this study.

5. CONCLUSIONS AND FINAL CONSIDERATIONS

The objective of this study was to map research on environmental law through a survey of articles in databases of scientific journals in South America between 2010 and 2019. Specifically we aim: a) to construct indicators derived from scientific production (i.e., research articles) on environmental law; b) to analyze scientific production on

environmental law between 2010 and 2019 according to those indicators; and c) to describe the main trends in studies on environmental law in Brazil and South America in the last decade.

The study attained its general objective given that the search for articles about environmental law in South American journals in the SciELO and CAPES *Portal do Periódicos* from 2010 through 2019 was effectively mapped, as described in the methodology section. The study met its first specific objective by constructing the indicators to be used, which were presented and tabulated in a spreadsheet. The second specific objective of this study was related to the analysis of scientific production on environmental law from 2010 through 2019, based on the indicators defined in the methodology. The results of this analysis were discussed above. This study also fulfilled the third and last specific objective, which was to report the main trends in studies on environmental law in Brazil and South America in the last decade. The results of this study were compared with those of other studies, and trends in academic and scientific papers were reported in the area of legal science in general as well as environmental law.

The findings of this research, such as the publication year of the articles, the area of law that studied the most, the number of authors per article, the name of the journal, the field of law studied, and the scientific area of the journal, do not have a theoretical explanation. They only indicate a past phenomenon that may be a trend for future research, but there is no scientific explanation for these results. By contrast, some of the results related to methodological indicators such as structural methodological flaws were highlighted by Rodrigues (2005), Sampaio (2013), Epstein and King (2013), Silveira and Sanches (2016), Pereira, Lobão, and Lucas (2017), among others.

Some authors, such as Rodrigues (2005) and Sampaio (2013), highlight some confusion among professors regarding procedural and scientific research, which have very different objectives and structures. The aforementioned authors attribute these problems to the teaching-learning process of methodology in undergraduate and graduate programs in law or the lack of interaction between scientific research activity and the legal content taught in the classroom. Another aspect identified in this study was the consequence of publishing in Portuguese only, as previously indicated by some authors. This fact hampers the internationalization of journals and knowledge produced in Brazil, as the English and Spanish languages have a greater range of communication in the academic/scientific community than Portuguese.

Conversely, some indicators pointed to the exceptional quality of the publications in environmental law, given that a significant percentage of the articles were classified in the A strata of the Qualis-CAPES classification and were written by either one or two authors. Furthermore, the indicators relative to the Qualis-CAPES classification, the number of authors, and the area of law and the journal can help those interested in the subject search for the best journals for publication.

This study had some methodological limitations. The first limitation relates to improving the quality of the analysis using techniques related to social networks, to unveil the interconnections between authors, journal publishers, and academic and research institutions. The second refers to the use of multivariate statistical techniques that may increase the robustness of the analysis.

As a way to further study the subject of environmental law, an agenda for future research, related to the limitations presented in the previous section, is as follow: to search more databases to evaluate not only for South America, such as Scopus, Web of Science, Google Scholar, and Microsoft Academic Search, to amplify the scope of the study; the second is to use social media software as a tool to evaluate the performance of scientific research and production through its social network interconnections.

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