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Sustainability in latin America: An analysis of the academic discursive field

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ABSTRACT

This article analyzes the modes of appropriation of the discourse on sustainable development in Latin America over the past four decades. Most studies on sustainability use qualitative methods of discourse analysis. Others use quantitative methods, such as the citation-based approach applied to the academic landscape of sustainability science at the global level, or to specific subfields. In this study, we use a hybrid approach that crosses quantitative methods (network analysis based on bibliometrics) and qualitative methods (discourse analysis and literature review) at different spatial and temporal scales.

Our research provides a mapping of academic activities in the discursive field of sustainable development in Latin America and shows the dynamics of regional authors within these debates as well as institutions hosting projects, research groups and programs.

The paper shows the active and critical participation of Latin American scholars in the debate about sustainability. It maps the consolidation of a Latin American network over time, highlighting the central actors and mediators who have their own discourse and interactions. We also analyze the links between different countries, revealing preferences in cross-national citations. Regarding the content of discussions, we show that reformist, even radical, approaches to sustainability find greater resonance among Latin American scholars.

1. Introduction: sustainable development as a global discursive field

Since the 1960s, growing awareness of an environmental crisis has made socio-environmental sustainability a fundamental issue for all societies. Over roughly forty years, the sustainability debate built up a network of divergent, convergent and parallel elaborations, that we name here 'sustainable development discourse'. Sustainable development discourse refers in this paper, to the field constituted by a body of academic work that aims to address the imperative of socio-environmental sustainability. This paper analyzes the dynamics and shape of this academic discourse in Latin America, through quantitative and qualitative methods.

Sustainable development has been a major catalyst for environmental debate and has become a central

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concept in various fields including public policy, civil society mobilizations and business strategies as well as theoretical and applied research in natural and human sciences (Adams, 2001; Dryzek, 2005; Elliott, 2006; Reid, 1995; Vivien, 2005; Zaccai, 2002). However, this concept is far from having a singular meaning and refers to a broad range of interpretations guided by specific world views (Lélé, 1991, 2013; Sneddon et al., 2006; Villalba, 2009).

From a pluralistic perspective (Arnason, 1991, 2003; Wagner, 2008, 2010), the multiplicity of interpretation is inherent (Connelly, 2007; Davison, 2008; Jacobs, 1999; Soini and Birkeland, 2014; Torgerson, 1995). Consequently, instead of marking-out a clear concept, the idea of sustainable development has forged a discursive field shaped by different appropriations (Villalba, 2009), each with their own hypotheses about the nature and causes of the sustainability issue and deriving proposals to address the latter (Adams, 2001; Dryzek, 2005; Hopwood et al., 2005; Sachs, 1997, 1999; Sneddon et al., 2006).

In the numerous analyses of the discourse surrounding sustainable development we find different ways of making sense of conflicting interpretations. For instance, John Dryzek considers environmental issues as an area of "continuing disputes" between actors with more or less distinct visions (Dryzek, 2005). Wolfgang Sachs also approaches sustainable development as a "discursive field" (Sachs, 1997, p. 71) and distinguishes different discourses according to their approach to development and their manner of linking ecology and social justice (Sachs, 1997, 1999). Hopwood et al. (2005) provide a valuable typology based on two main axes; one shows the classical anthropocentrism-ecocentrism dichotomy, while the other one represents the inequality-equality dichotomy on a *continuum*. This mapping shows the diversity of the discursive field of sustainable development and that it includes to some degree not only the environment but also social justice.

Hopwood et al. (2005) also draw a distinction between three ways of problematizing existing institutions to achieve sustainable development: (1) Status quo, (2) Reform and (3) Transformation. The Status quo option implies that answers to the fundamental issue of sustainability can be found within the existing structures (and therefore, no changes are required). Reformists call for a necessary shift, without a real break, from existing institutional arrangements. Finally, the transformative trend demands a radical transformation, defining economic and power structures along with contemporary modes of interrelations between humans and their environment as the root problem. We will use these three categories in our analysis, in particular the last two as they appear to be dominant in the Latin American sustainable development discourse.

Most studies on sustainable development discourse (Dobson, 2007; Litfin, 1994) use qualitative methods of discourse analysis, including at times sectoral or spatiotemporal cases studies. Here, we take a hybrid approach which crosses quantitative and qualitative methods at different spatial and temporal scales. In previous works, a citation-based approach has been applied to illustrate the academic landscape of sustainability science at a global level (Bettencourt and Kaur, 2011; Kajikawa et al., 2007, 2014). Others have identified the most influential publications in the field (*i.a.* Buter and Raan, 2012; Hassan et al., 2013; Kajikawa et al., 2007, 2014; Quental and Lourenço, 2012; Schubert and Láng, 2005) or in some specific subfields, such as ecological or environmental economics (Costanza et al., 2004; Ma and Stern, 2006). Finally, even if studies undertaking an environmental discourse classification have sometimes included some critical proposals from developing or emergent countries (*i.a.* Dryzek, 2005; Guha and Martinez-Alier, 1997; Hopwood et al., 2005), most focus on the discursive configurations of Western thought.

The scope of this paper encompasses the phases of reception and appropriation of sustainable development discourse in Latin America, including the normative dimension of these appropriations in the academic sphere. Indeed, we offer a quantitative and qualitative analysis of the participation and the critical appropriation of Latin American intellectuals in the global discursive field of sustainable development.

Some authors have analyzed Latin American participation in the debate surrounding sustainability, either adopting a general overview (da Costa Ferreira et al., 2006; Gudynas, 1999; Heyd, 2005; Leff, 2012) or focusing on a specific discourse or authors (*i.a.* Eschenhagen, 2012; Estenssoro, 2015; Herrera et al., 2004; Rozzi, 2012). However, a systematic study of the academic discourse of sustainable development in Latin America has not yet been carried out.

This research therefore aims to provide a relatively complete mapping of the main academic activities in the discursive field of sustainable development in Latin America. It also studies the dynamics of regional authors in these debates, as well as the vital role played by institutions which hosted projects, research groups and programs, supporting the construction of "Latin American environmental thought" (da Costa Ferreira et al., 2006; Heyd, 2005; Leff, 2012; Rozzi, 2012), with its own tone, harmony and dissonance within the global discourse.

2. Data and methods

In academia, the debate surrounding the imperative of sustainability arises from interaction between scholars but also between different discourses. These links generate a network of relations that reveals positioning strategies among its members and highlights sustainable development as an academic discursive field. These dynamics leave imprints on the academic output, from which we can make observations on the density of the network, the core or peripheral location of scholars (and discourses), and even on the alliance-building process within a scientific field. Among these imprints, bibliographic citations are a central element allowing the network of references and relationships between scholars to be reconstructed (Latour, 2005; Leydesdorff and Amsterdamska, 1990; Vanhulst, 2015a).

In this context, we provide a network analysis (Wasserman and Faust, 1994) using bibliometric tools (specifically citations) (Bellis, 2009), to highlight the structure and characteristics of Latin American academic contributions to the discursive field of sustainable development. We review (1) the morphology and configuration of this network, (2) whether there is active Latin American participation in the discursive field of sustainable development, (3) whether the authors have developed interactions within Latin America (and which countries) or rather privileged connections with the outside world. We analyze the network at various levels, in three historical periods.

The data, upon which this analysis is based, stem from a set of documents published between 1970 and 2012 by a primary sample of 93 Latin American scholars. They were selected through a literature review, using the snowball technique. For each scholar, a bibliographic inventory was undertaken with the '*Publish or Perish*' software (which uses the *Google Scholar* database[1]). This work yielded a total of 7997 documents. Some 25.5% of this set was usable for the extraction of bibliographic references, accounting for a total of 68,459 citations. Among these citations, 16.5% (11,242) refer directly to Latin American scholars (7258 citations) and Foreign (*i.e.* non-Latin American) scholars (3983 citations) involved within the discursive field of sustainable development (see Table 1). This result varies at the individual scale, allowing us to distinguish between scholars who have greater or lesser interaction with others in the field (at the regional or global level). It also allows an identification of central authors (who are the most cited) and mediators (authors who are very active and quote many authors in the network). Additionally, the 16.5% result includes self-citations and falls to 9.6% (6617 occurrences) when self-citations are excluded.

Table 1 gives information on Latin American scholars publishing on sustainability between 1970 and 2012. In addition to total citations, we reported the results in terms of "connections", converting valued matrices into binary (or Boolean) matrices: the value of 1 is assigned when an author cites another author (without considering the total number of citations), and 0 is assigned when an author does not cite another author. This conversion allows correction of the overestimation of some authors (and their attributes) cited repeatedly by a single author.

In order to represent the academic network of the discursive field of sustainable development in Latin America, both the sample of 93 Latin American scholars and the foreign scholars quoted by them were considered as "nodes" (vertices represented by a circle in the graphs). The citations made by Latin American scholars are seen as "links" between scholars (edges represented by an arrow in the graphs). On this basis, we established the networks of scholars. The *Global* network is composed of 237 nodes. These nodes correspond to the 93 Latin American scholars (acting as emitters and receivers of citations) and the 144 foreign scholars acting only as receivers of citations. The global network contains a total of 6617 citations made between 1970 and 2012, whereas the *Latin American* network (which is limited to the 93 Latin American scholars) accounts for 2,633 citations. These networks were generated, from square and rectangular matrixes, with the *UCINET* software[2] for analysis of the network of scholars and their attributes. The *NETDRAW* software[3] was used to visualize the network and set the scholars in a two-dimensional Euclidean space based on centrality and closeness algorithms.

We then sorted these networks into three periods of time; the "pre-Brundtland" period, the "post-Brundtland" period and a "contemporary" period. The "pre-Brundtland" period began in 1970, with the

[1] Each research platform has advantages and disadvantages. Google Scholar is less precise and parameterized than ISI or Scopus, but its coverage is wider and allows the listing of authors and documents that are not (or rarely) published in ISI and Scopus indexed journals. Google Scholar also includes wider literature in languages other than English (which predominates in the ISI Web of Knowledge and Scopus databases) and in the social sciences, which are poorly covered by the ISI web of knowledge (especially for non-English journals) or the Scopus database.

[2] https://sites.google.com/site/ucinetsoftware/home

[3] https://sites.google.com/site/netdrawsoftware/home

Table 1
Information on Latin American scholars publishing on sustainability.

Description	Statistic
SAMPLE	
Latin American Academics	93
TIME	
Period of Publications	1970–2012
DOCUMENTS	
Whole list (extracted by *Publish or Perish* software from Google Scholar database)	7.997
Total number of documents used to extract citations	2.044
CITATIONS	
Total	68.459
Citations in the discursive field of sustainable development	
Global Network	11.242
Total citations	
Total citations minus self-citations	**6.617**[a]
Total connections	2.058
Total connections minus self-citations	**1.975**[a]
Latin American Network	
Total citations received by Latin American academics	7.258
Total citations received by Latin American academics minus self-citations	**2.633**[a]
Total connections	711
Total connections minus self-citations	**628**[a]
International Network	
Total citations received by international academics	3.984
Total connections	1.347

Source: elaborated by the authors with data from Google Scholar
[a] The values indicated in bold are those that will be most used in calculations of the networks (these are the total number of citations and connections of the square matrix of the Latin American network and of the rectangular matrix of the Global network).

emergence of widespread environmental concerns, and ended in 1987, with the publication of the report of the the Brundtland report (WCED, 1987). This report offered an institutional basis for ecologically sustainable development, put the notion of sustainable development at the center of the discussion, and subsequently had a strong influence on the political and intellectual landscape (Quental and Lourenço, 2012; Schubert and Láng, 2005). The "post-Brundtland" period streches from 1988 to 2002 (the Earth Summit in Johannesburg, when the Rio agreements (1992) lost influence over global policy priorities despite demonstrating results (Zaccai, 2011, 2012)). In academia, peak activity in the discursive field of sustainable development coincided with the decennial international summits which acted as catalysts for action and reflection (Bettencourt and Kaur, 2011; Hibbard et al., 2007; Quental and Lourenço, 2012; et al., 2011). Finally, the "contemporary" period covers the years between the Johannesburg and the 2012 'Earth Summit' in Rio de Janeiro (known as "Rio+20").

This quantitative method has some limitations. Despite revealing several phenomena it does not address other qualitative elements, such as the nature of the relation under study (*i.e.* agreement or disagreement). Similarly, this method does not include the content of discussions (which is central to the debate) or explain the privileged relationships that emerge from the analysis. Other tools were needed to further analyze these qualitative dimensions. We therefore combined quantitative methods with a content analysis of a selection of discourses to give relief to the results of our network analysis.

We formulated three broad hypotheses: Firstly, that Latin American intellectuals participate actively (with a central position in the regional network) and critically (with their own proposals) in the academic discursive field of sustainable development; secondly, that the different definitions of sustainable development are culturally situated and reflect (among other things) the debate derived from post-Eurocentric criticism; and finally, that the discursive interactions reflect the major trends of broader scientific connections between countries and regions. The results of the analysis are presented in the following section.

3. Results: the discourse of sustainable development in latin America

3.1. Historical construction of the regional network

3.1.1. The "pre-Brundtland" period (1970–1987)

During this first period, Latin America had a rather peripheral position. The central and mediating positions were computed with *UCINET* using the *Indegree* and *Betweeness* algorithms respectively. The network was diffused and organized around a small number of core foreign and Latin American scholars (particularly Ignacy Sachs, Amilcar Herrera, Osvaldo Sunkel David Barkin and Nicolo Gligo). It also included mediating scholars such as Pablo Gutman, a member of the Center for Urban and Regional Studies of Buenos Aires, who connected environmental concerns with issues of urban and regional development at an early stage (see Gutman (1985, 1986), among others). Eduardo Viola (Viola, 1987, among others) and Gilberto Gallopin (a researcher at the Bariloche Foundation from where he participated in the "Latin American Global Model"; see also Gallopin (1980)) also fall in the category of mediating scholars, who played a central role in the network, despite the fact that its active members remained sparsely cited.

Fig. 1 represents the network in the first period. Each scholar is represented by a circle (or "node") the size of which varies according to its degree of centrality. In the table, the ten most central and mediating authors are ranked for each category.

In this first, "pre-Brundtland" period, the most central Latin American scholars were affiliated with various international and regional institutions, such as the regional offices of the United Nations, the United Nations Environment Program/Regional Office for Latin America and the Caribbean (UNEP/ROLAC) and the Economic Commission for Latin America and the Caribbean (ECLAC), the *Bariloche Foundation* and the *Dag Hammarskjöld Foundation*.

Indeed, following a meeting convened in 1970 in Rio de Janeiro to present and discuss the "World Model 3", developed by an MIT team (which would lead to the report *The Limits to Growth*; Meadows et al. (1972)), Latin American countries adopted a critical stance and decided to construct an alternative model in response to the MIT model, which they considered incompatible with the reality of the Latin American "periphery". Between 1972 and 1975, under the institutional guidance of the Bariloche Foundation, a group of scientists led by Amilcar Herrera, worked on the development of what was later called the "Latin American Global Model" or "Bariloche Model". The Bariloche Foundation report was finally published in 1976 (Herrera et al., 1976).

Interestingly, these early core scholars were relatively far apart from each other in the network (with the exception of Nicolo Gligo and Osvaldo Sunkel, who forged an important mutual relationship, foreshadowing an important collaboration that emerged from the "*Unidad de Desarollo y Medio Ambiente*" at the ECLAC and the UNEP/ROLAC). However, they were connected not only to a number of peripheral scholars but also to a

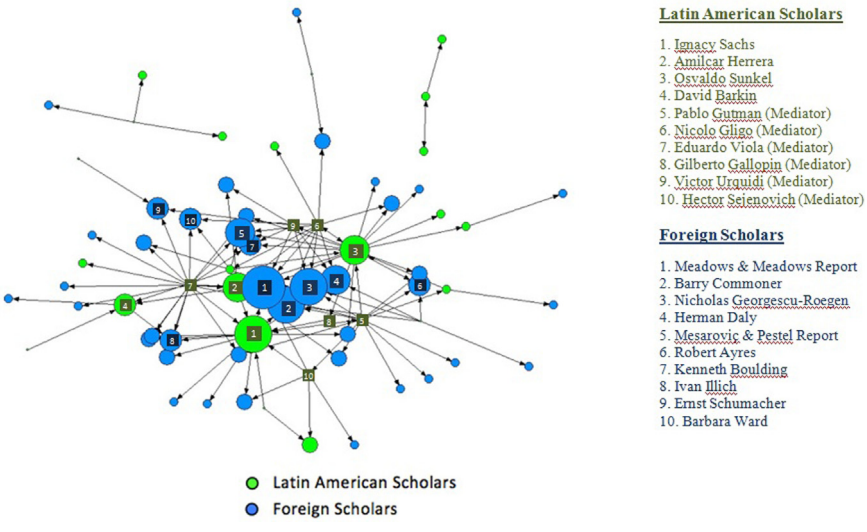

Fig. 1. Relative positions of Latin America in the Global network during the 'Pre-Brundtland' period (weighted by *Indegree*). *Source*: elaborated by the authors with data from Google Scholar (see Table 1).

number of important international reports (such as the two reports to the Club of Rome: Meadows et al., 1972; Mesarović and Pestel, 1974).

Finally, based on the morphology of the network and on the results of the *Indegree* coefficient, we see that the participating Latin American scholars relied heavily on external references, even though few privileged internal relationships were still developing. At the time, the foreign scholars were more influential, while the regional discursive field and its epistemic core were still under construction. In addition, the role of major public institutions and reports as "mediators" to promote the debate around sustainability was remarkable.

The Latin American countries that participated most actively in this dialogue were Argentina, Brazil, Chile and Mexico. These countries first welcomed research centers and educational institutions dedicated to the issues of sustainability, acting as front-runners at the regional level. The participants in this first period were mainly economists and natural scientists, explaining the preponderance of (critical) economics, natural sciences and international reports in international references. The social sciences were still virtually absent from the debate.

3.1.2. The "post-Brundtland" period (1988–2002)

In the second or "Post-Brundtland" period, the discursive field of sustainable development in Latin America quickly consolidated. As we can observe in Fig. 2, the network intensified, increasing its degree of connectivity and taking a concentric form. There were no longer a number of vague centers around which the network was organized but a more homogeneous whole with central, as well as peripheral scholars.

Latin America, while beginning to share the center with the United States and Europe, developed more internal dialogues, resulting in a stronger regional discursive field. Thus, almost all scholars of this second period interacted with both foreign and Latin American scholars. However, the strongest relationships detected by our data analysis were forged at the regional level.

The most important reciprocal interaction arose from the consolidation of the connection between Enrique Leff and Arturo Escobar, the two most influential scholars during the third period. In contrast to the relationship between Osvaldo Sunkel and Nicolo Gligo in the pre-Brundland period, the one between Leff and Escobar was more epistemic than institutional, given the radical counter-hegemonic discourse shared by these two authors. According to Enrique Leff (Leff, 1999, 2004, 2009) "environmental rationality" went beyond the greening of thought and the provision of a set of tools for the efficient management of the environment. He contrasted this "environmental rationality" to the "economic rationality" dominant in the West, and sought to guide practice through the subversion of principles established and legitimized by the theoretical and instrumental rationality of modernity. He called for a new rationality that would include values, reason and sense, and would welcome differences and diversity, in order to deconstruct the unitary logic of Eurocentric modernity. There were noticeable synergies with the "post-development" proposal of Arturo Escobar.

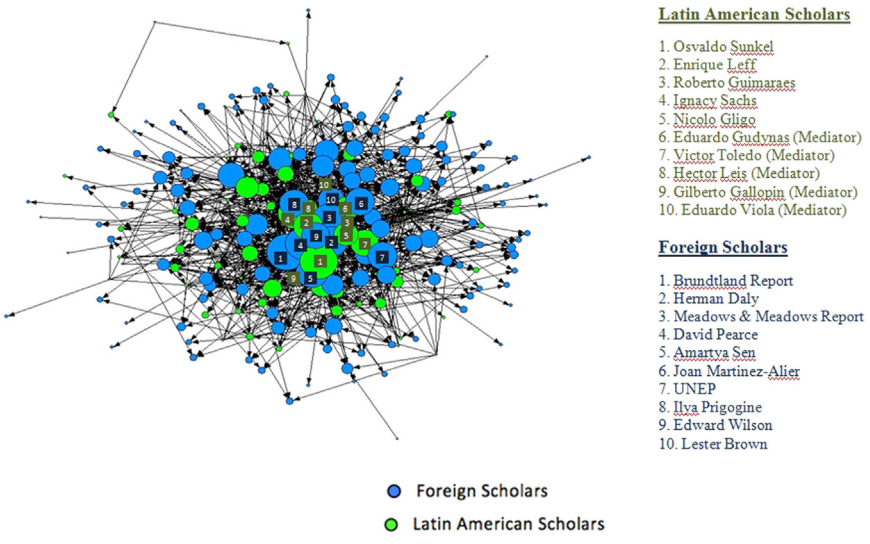

Fig. 2. Relative positions of Latin America in the Global network during the 'Post-Brundtland' period (weighted by *Indegree*). *Source*: elaborated by the authors with data from Google Scholar (see Table 1)

There also existed also mention an important reciprocal relationship between Enrique Leff and Carlos Walter Porto Gonçalves, a Brazilian human geographer who worked on issues of environmental education and political ecology. Porto-Gonçalves developed the idea of an "environmental geography" (see, among others, Porto-Gonçalves (1989, 1996, 2001)), stemming from his work with the *seringueiros* (rubber tappers) of the Amazonian forest, especially his collaboration with his friend and colleague Francisco "Chico" Mendes in Xapuri. This perspective was directly connected to those of both Enrique Leff and Arturo Escobar, who built an important critical subnet that grew stronger during the Contemporary period (Fig. 3).

Similarly, there were strong relationships between Latin American and Foreign scholars (these appear to be essentially unilateral as citations emitted by the latter were not considered in this study). This is the case for Roberto Guimaraes and Clovis Cavalcanti towards Herman Daly, for Enrique Leff and Victor Toledo towards Joan Martínez-Alier (mostly as a Hispanic representative of ecological economics), for Arturo Escobar (to a strong degree) and Edgardo Lander (to a lesser degree) towards Vandana Shiva (from a post-development perspective focusing on the empowerment of local communities with their own identity, knowledge and experience) and, finally, of Gilberto Gallopin towards Paul Raskin and Silvio Funtowicz.

The three Latin American scholars who were central in the first period (Sachs, Herrera and Sunkel) reinforced their positions. The Brundtland report became an essential reference immediately after its publication, mainly among the principal scholars, (Gilberto Gallopin, Victor Toledo, Eduardo Viola and Enrique Leff), but also Manfred Max-Neef (especially invoked by proposals revolving around the idea of human-scale development), Roberto Guimaraes and Nicolo Gligo (who were both linked to the ECLAC and developed a strong criticism of the neoliberal model; see *e.g.* Gligo (2001) and Guimarães (1994, 2003)).

As noted, in this second period, the relative position of Latin America began to coincide with the historical centers of academic production. The ECLAC (in Latin America), the Brundtland Report and to a lesser extent the UNEP (internationally) continued to influence the institutional policy work within the academic discourse on sustainable development. In terms of participation, Brazil, Colombia and Mexico were the most active countries. In terms of centrality, the countries that received the most citations were Mexico (26%), Brazil (21%), Chile (15%), Argentina (14%) and Colombia (12%).

3.1.3. *The "contemporary" period (2003–2012)*

The "Contemporary" period followed the tendencies outlined during the second period; (1) the intensification of the field, (2) the relative coherence and concentric shape of the field, (3) the centrality of Latin America (4), the privileged relations between Latin American scholars and (5) the centrality of Brazil, Mexico, Colombia, Chile and Argentina.

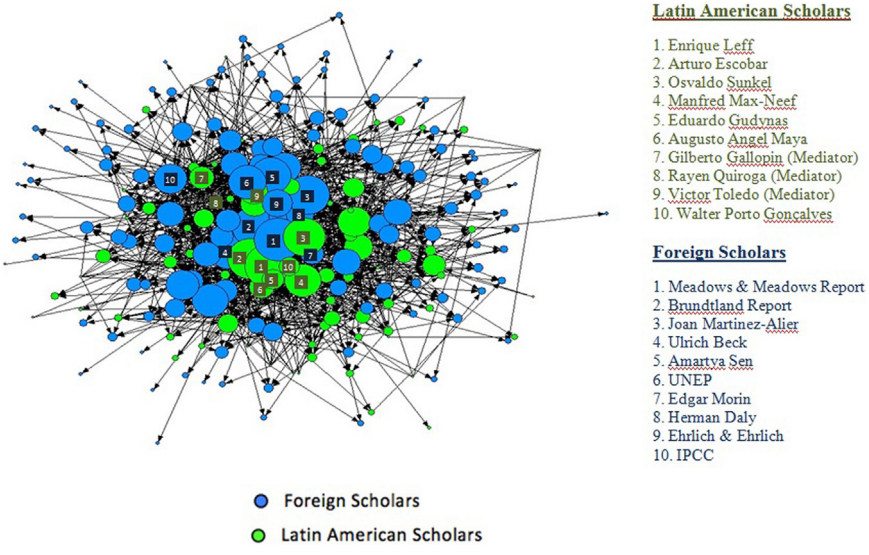

Fig. 3. Relative positions of Latin America on the Global Network during the 'Contemporary' period (weighted by *Indegree*). *Source*: elaborated by the authors with data from Google Scholar (see Table 1)

As we can see, the establishment of the Latin American discursive field of sustainable development was confirmed. At regional and national levels, Latin America shared the center with the rest of the world. This demonstrates that the idea of an exogenous imposition of the discourse (at least at the academic level) does not hold after the first period where it was partially verified.

Colombia stood out in this third period, driven by some very active Colombian philosophers and the creation of the IDEA, *Instituto De Estudios Ambientales* (Institute for Environmental Studies). Indeed, from the late 1980s, various institutes were created to address the issue of sustainability, including the IDEA at the National University (in 1989 in Bogotá and then in 1991 in Manizales with Augusto Angel Maya). Since then, the need to construct a critical environmental thought imposed itself against the reductionism and technocentrism of the Eurocentric discourse.

In common with the second period, the privileged relations are concentrated almost exclusively among Latin American scholars. Thus, the strongest relations were regional, such as the ones between Ana Patricia Noguera and Augusto Angel Maya (which takes place in the IDEA) and between Alberto Acosta and Eduardo Gudynas around the discourse of "*Buen Vivir*". Drawing on the traditional repository of the continent's indigenous cultures, this discourse was theorized in the academic sphere and translated into normative principles, which started to penetrate not only the public sphere, but also the political one, especially in Ecuador and Bolivia (Gudynas, 2011, 2016; Gudynas and Acosta, 2011; Vanhulst, 2015b; Vanhulst and Beling, 2013, 2014). During this third period, Enrique Leff consolidated his core position in the network, above any foreign scholar or international report. However, the Brundtland and Meadows reports still remain central references, next to the reports of the IPCC (International Panel on Climate Change).

3.2. Global dialogues stemming from latin America

Fig. 4 shows the *Global* network for the entire period covered by our bibliometric analysis (1970–2012). The size of the nodes in the graphs is weighted by the degree of centrality according to *Indegree*. As we can see, the texture is quite concentrated and the morphology is concentric, evidencing the existence of a discursive field of sustainable development and the active participation of Latin American scholars in this field in a fairly mixed way. The scholars of the core group dominate the field in terms of activity, mediation and centrality. This core group is composed of 33 Latin American scholars[4] and 24 foreign scholars[5] (accounting for 22% of the total number of scholars) who made 70,83% and received 46,48% of all citations in the network. The semi-peripheral and peripheral groups are connected to the network by mediation of the core group. Of course, this does not mean that the work of scholars who do not belong to the core group lacks interest but simply that it is less influential in the discursive field of sustainable development. In short, we can say that the scientific capital (Bourdieu, 1976, 1984) is dominated by a small group of scholars at the core of the network.

Over the whole period, the Brundtland report "*Our Common Future*" (WCED, 1987) and the Meadows report "*The limits to growth*" (Meadows et al., 1972) were the most central references. These reports had a very strong global resonance and it is not surprising to find them as a cornerstone of the Latin American discursive field. What is remarkable, is that these publications share the center with Latin American scholars.

Most foreign scholars who were cited and occupied a core position are part of a line of thought that is at least reformist, if not outright transformative (Hopwood et al., 2005), in the face of prevailing development models. Most of them are economists, such as Herman Daly, Joan Martínez Alier (pioneers of ecological economics), Ernst Schumacher (*"Small is beautiful"*), and Nicholas Georgescu-Roegen (pioneer of the theory of Degrowth through the inclusion of the principles of thermodynamics in economics and the idea of a bio-economy). We also find more reformist economists such as David Pearce (environmental economics), or even Amartya Sen (and his idea of development as freedom). We also detect the physicist and science philosopher Ilya Prigogine (particularly his work in collaboration with Isabelle Stengers, introducing a profound questioning of science and certainty, *i.e.* the Cartesian conception of nature), as well as various authors such as Edgar Morin (defender of "Complex Thought"), James Lovelock (and the Gaia hypothesis) or Edward Wilson (the father of the "Biodiversity" neologism). Paul Ehrlich and Anne Ehrlich (and their book "The Population Bomb" published in 1968) as well as the German sociologist Ulrich Beck (and the concept of "Risk Society") were also highly cited. On the other hand, we can mention the obvious influence of documents published by international organizations and especially the UNEP and its regional version. All these foreign scholars coexist with Latin American scholars in the center of the network.

[4] See Annex 1.
[5] See Annex 1.

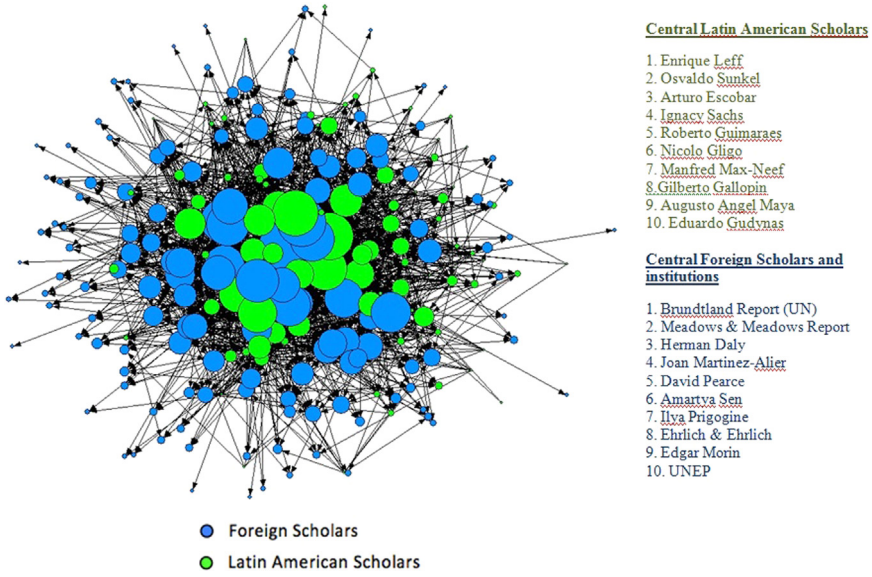

Fig. 4. Relative position of Latin America in the Global academic network of the discourse of sustainable development. *Source*: elaborated by the authors with data from Google Scholar (see Table 1)

3.3. *Differentiation by latin american countries*

The pattern of references circuits between continents for the discursive field of sustainable development in Latin America reproduces the wider framework of global academic production, polarized in the US and Europe (Beigel, 2013; Leydesdorff and Persson, 2010; Narvaez-Berthelemot, 1995; Narvaez-Berthelemot et al.,1992; UNESCO - ISSC, 2010).

Fig. 5 shows the relative position of Latin American authors in the network, differentiated by countries. The center is mainly occupied by Mexico, Brazil, Colombia, Chile and Argentina but also Uruguay, Venezuela and Ecuador. If we expand the analysis to semi-peripheral countries, other countries are represented, such as Bolivia, Peru and Ecuador. Finally, Panama, Cuba and Costa Rica remain as peripheral countries in the regional network.

We can corroborate these observations with the numbers of citations emitted and received on a national basis (Table 2). There are three large core countries (Brazil, Colombia and Mexico) which are closely followed

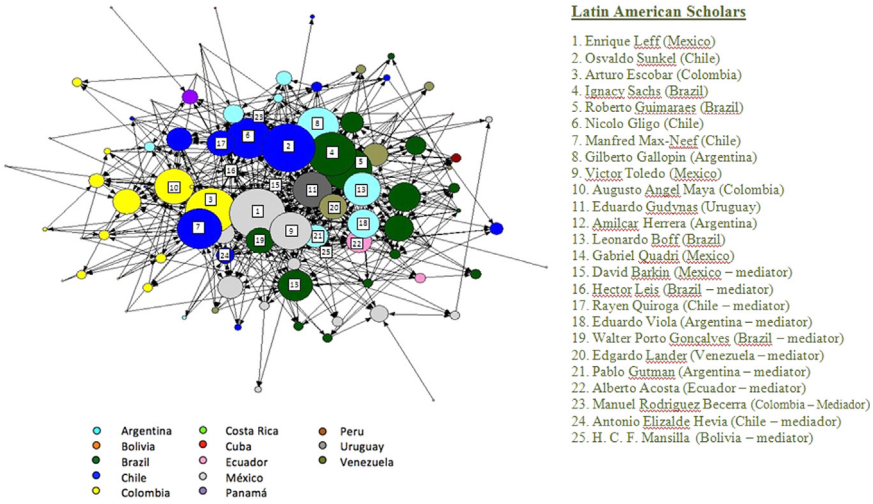

Fig. 5. Relative positions of different countries in the Latin American Network (1970–2012). *Source*: elaborated by the authors with data from Google Scholar (see Table 1)

Table 2
Distribution of emitted citations by country (intensity of participation) and received citations by country (degree of centrality) in Latin America from 1970 to 2012.

Country	Connections	Proportion (%)	Total citations	Proportion (%)
a) Measures by attribute: emitted citations by country				
Brazil	143	22.77	615	23.36
Colombia	124	19.75	731	27.76
Mexico	101	16.08	389	14.77
Chile	82	13.06	255	9.68
Argentina	58	9.24	134	5.09
Venezuela	39	6.21	93	3.53
Uruguay	37	5.89	169	6.42
Ecuador	16	2.55	139	5.28
Bolivia	11	1.75	68	2.58
Peru	7	1.11	22	0.84
Cuba	5	0.80	7	0.27
Panama	4	0.64	9	0.34
Costa Rica	1	0.16	2	0.08
TOTAL	628	100.00	2633	100.00
b) Measures by attribute: received citations by country				
Brazil	149	23.73	533	20.24
Chile	121	19.27	339	12.88
México	109	17.36	626	23.78
Colombia	90	14.33	526	19.98
Argentina	83	13.22	235	8.93
Venezuela	31	4.94	104	3.95
Uruguay	19	3.03	107	4.06
Ecuador	14	2.23	68	2.58
Panamá	6	0.96	15	0.57
Bolivia	3	0.48	14	0.53
Peru	3	0.48	66	2.51
Costa Rica	0	0.00	0	0.00
Cuba	0	0.00	0	0.00
TOTAL	628	100.00	2633	100.00

Source: elaborated by the authors with data from Google Scholar (Table 1)

by Chile and Argentina. The other countries are peripheral or entirely absent. The results are relatively similar in terms of participation (emitted citations, noted in the left column) and centrality (received citations, noted in the right column). These results are coherent with, although more extended than, those found by a large study of sustainable science in the entire world which showed a similar pattern to that found in the Latin American region (Bettencourt and Kaur, 2011).

Although these national results are based on a relatively small number of authors, they agree with those of several studies on scientific production and cooperation in the region in several fields of research (see Beigel (2013), Fernández et al. (1998), Ríos Gómez and Herrero Solana (2011), Sancho et al. (2006) and Santa and Herrero Solana (2010)). These studies highlight the influence of different socio-economic factors on the national dynamics of scientific production, such as GDP, public and private investment for research, and the number of research centers or researchers. The influence of cultural factors, such as national education systems, the scientific policies of governments and private enterprises, is also emphasized.

Thus, in a context where global science is dominated by the world's major economic powers, the countries of the region (especially those whose populations and economic growth are the highest and most sustained) have the potential to partially overcome the unfavorable conditions that dominate the global science dynamic. At the regional level, scientific production is strongly dominated by large countries like Brazil, Argentina and Mexico. Chile also participates actively, especially in relation to the number of publications per capita (Ríos Gómez and Herrero Solana, 2011). Furthermore, we see that some countries that have hosted national, regional and/or international institutions related to sustainable development, are also located in the center of the field.

However, Latin America has little scientific weight compared to the US, Japan, the UK, Germany and other European countries. This could be explained by the lack of Latin-American investment in research, which represented about 0.78% of the Gross Regional Product in 2011 (against 1.95% for Europe) (RICYT, 2013). According to the same report, the region is characterized by low private sector participation in the funding of research.

Remarkably, we find that privileged connections at the national level take place in the four core countries (Brazil, Colombia, Mexico and Chile). The representative scholars of these countries mostly refer to their national peers (Annex 2). Various studies show that the United States are the main scientific collaborator of countries in the region followed by the countries of the European Union (Fernández et al., 1998; Narvaez-Berthelemot et al., 1992; Ríos Gómez and Herrero Solana, 2011).

4. Conclusions

In this paper, we have offered an in-depth analysis of the phases of reception and appropriation/reformulation of the academic discourse of sustainable development in Latin America. Our three broad hypotheses were validated. Latin American intellectuals participate actively and critically in the academic discursive field of sustainable development. Its meanings are culturally situated and reflect, among others, debates derived from post-Eurocentric criticism. The discursive interactions reflect the main trends of broader scientific connections between countries and regions.

More precisely, our results show that this continent has always been part of the discursive field at the global level, and that Latin America has solidified as a sub-field with an internal structure that has grown over time. Not only do the actors involved in the field gradually increase in number, but they also forge increasingly stronger links. The central and mediating scholars, as well as the institutions involved in projects, research groups and different types of programs, have played a vital role in the construction of a "Latin American environmental thought".

Based on an extensive analysis of authors, we found that the dominant tone of this thought falls within a critical stance towards dominant status quo discourses, most, if not all leading core scholars, are aligned with a transformative viewpoint (according to the Hopwood et *al.* typology). Although the strategies implemented in the business and public policy fields are closer to the preservation of the status quo or to incremental reform, critical academic discourses tend to inspire a number of social movements and progressive public policies, in addition to their input in the academic realm.

The results also indicate a strong international polarity. Outside Latin America, almost all references are directed towards the United States and Europe, reproducing the framework of global academic production concentrated at the centers of power in world. This strengthens the argument of knowledge colonization and appears to contradict the previous argument that outlines the specific appropriation of sustainability discourse in Latin America. However, central discourses in Latin America generally adopt a critical stance towards Eurocentric modernity. The discourses of sustainable development in Latin America reflect not only the debates on multiculturalism or social justice but also the struggles for recognition and autonomy led by numerous cultural models marginalized by Eurocentric modernity.

Debates in the region are mainly located along the axis of equity and social justice, rather than along the axis of tension between anthropocentrism and ecocentrism. This feature constitutes an important difference from Western discourses, even though some similarities with the critical discourses of Western experiential frames can be found. As we have seen, Latin American scholars are closer to the critical discourses of social ecology, complex thought, ecological economics, and political ecology, among many others.

The main objective of this paper was to analyze, structure, and map Latin American participation in the discursive field of sustainable development. Further research on central and intermediate scholars and institutions (that emerged from the analysis) as well as a more comprehensive analysis of the links between the discourses and their sociocultural context could be an interesting step forward. Thus, the introduction of a qualitative variable reflecting the multiple connections and the disciplines of the scholars could be explored. In a more conceptual perspective, a broad analysis of the links between the ways of problematizing global modernity in these discourses and the specificity of the Latin American context would enrich reflections on the cultural dimension of sustainable development, complementing the social, economic and environmental perspectives.

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Annex

Annex 1
Measures of centrality and intermediation[a] of the Latin American and foreign scholars of central group for the whole period.

Global network (1970–2012)			**Latin America total network (1970–2012)**		
Measures of centrality			**Measures of betweenness**		
Authors		**Indegree**	**Authors**		**Betweenness**
1	BRUNDTLAND Report	40	1	LEFF Enrique	3230,636
2	MEADOWS & MEADOWS (COR)	40	2	GUDYNAS Eduardo	2331,309
3	LEFF Enrique	39	3	ESCOBAR Arturo	1939,252
4	SUNKEL Osvaldo	33	4	TOLEDO Víctor	1359,286
5	DALY Herman	32	5	GALLOPIN Gilberto	1273,948
6	MARTINEZ-ALIER Joan	32	6	SACHS Ignacy	1187,84
7	ESCOBAR Arturo	28	7	BARKIN David	1163,644
8	PEARCE David	28	8	GUIMARAES Roberto	1141,675
9	SEN Amartya	28	9	LEIS Hector Ricardo	923,589
10	PRIGOGINE Ilia	27	10	GLIGO Nicolo	796,893
11	EHRLICH Paul & EHRLICH Anne	26	11	ANGEL MAYA Augusto	741,896
12	MORIN Edgar	26	12	QUIROGA MARTINEZ Rayen	606,852
13	BECK Ulrich	25	13	SUNKEL Osvaldo	571,283
14	SACHS Ignacy	25	14	VIOLA Eduardo	560,384
15	The UNEP	24	15	PORTO GONCALVES Carlos Walter	504,195
16	GUIMARAES Roberto	23	16	LANDER Edgardo	471,198
17	SCHUMACHER Ernst	23	17	da VEIGA Jose Eli	451,209
18	WILSON Edward O.	23	18	FOLADORI Guillermo	421,558
19	GLIGO Nicolo	22	19	MANSILLA Hugo Celso Felipe	346,186
20	MAX-NEEF Manfred	22	20	PADUA Jose Augusto	327,517
21	GALLOPIN Gilberto	21	21	ELIZALDE HEVIA Antonio	325,509
22	GEORGESCU-ROEGEN Nicholas	21	22	RODRIGUEZ BECERRA Manuel	288,727
23	LOVELOCK James	21	23	GUTMAN Pablo	282,972
24	TOLEDO Victor	21	24	GOMEZ-POMPA Arturo	278,142
25	ANGEL MAYA Augusto	19	25	ACOSTA Alberto	278,024
26	BROWN Lester	19	26	NOGUERA de ECHEVERRI Ana Patricia	255,498
27	GUDYNAS Eduardo	19	27	GONZALEZ GAUDIANO Edgar	252,286
28	IPCC	19	28	BOFF Leonardo	250,545
29	ODUM Eugene P.	19	29	BRAILOVSKY Antonio Elio	248,096
30	GORZ Andre	18	30	CASTRO HERRERA Guillermo	242,82
31	BOOKCHIN Murray	17	31	CARRIZOSA UMANA Julio	242,267
32	CARSON Rachel	17	32	HERRERA Amilcar	236,676
33	ALTIERI Miguel	16	33	REBORATTI Carlos	235,334
34	COSTANZA Robert	16	34	PALACIO CASTANEDA German	183,47
35	HERRERA Amilcar	16	35	CAVALCANTI Clovis	173,692
36	WARD Barbara	16	36	SEJENOVICH Hector	172,034
37	BOFF Leonardo	15	37	BRONDIZIO Eduardo	149,299
38	PADUA Jose Augusto	14	38	DRUMMOND Jose Augusto	144,382
39	VIOLA Eduardo	14	39	ALIMONDA Hector	140,085
40	LEIS Hector Ricardo	13	40	MAX-NEEF Manfred	139,757
41	LANDER Edgardo	12	41	ABRAMOVAY Ricardo	134,097
42	PORTO GONCALVES Carlos Walter	12	42	CORAGGIO Jose Luis	129,217
43	QUIROGA MARTINEZ Rayen	12	43	GARCIA GUADILLA Maria Pilar	117,003
44	ACOSTA Alberto	10	44	BURSZTYN Marcel	106,766
45	ELIZALDE HEVIA Antonio	7	45	CAROSIO Alba	87,162
46	GUTMAN Pablo	6	46	ESTEVA Gustavo	84,188
47	GONZALEZ GAUDIANO Edgar	5	47	GUTIERREZ NAJERA Raquel	73,299
48	BURSZTYN Marcel	4	48	SABATINI Francisco	61,706
49	DRUMMOND Jose Augusto	4	49	SAWYER Donald	57,007
50	FOLADORI Guillermo	4			
51	RODRIGUEZ BECERRA Manuel	4			
52	SABATINI Francisco	4			
53	CAVALCANTI Clovis	3			
54	FLORIANI Dimas	3			
55	MANSILLA Hugo Celso Felipe	3			
56	ESCHENHAGEN Maria Luisa	1			
57	SAWYER Donald	1			

Source: elaborated by the authors with data from Google Scholar and analyzed with UCINET software (see Table 1)

[a] Indicators of power identify the most important vertices within a graph (here: the most influential authors in the network in term of centrality and intermediation). We can distinguish centrality based on In-degree (when an actor in the network receives many ties) from centrality based on Out-degree (when an actor in the network emits many ties to many others actor, here based on the *Betweenness* algorithm). A high result for *Indegree* means that the authors is *prominent*, or has a high level of *prestige*. That is, many other authors seek to direct rely to them, and this indicates their importance. Authors who have high *Out-degree* play an important role as mediators and they are often said to be *influential* actors.

Annex 2
Proportion of total number of connections and citations between countries (percentage of total citations in each country).[a]

	Cited country														
		Argentina	Bolivia	Brazil	Chile	Colombia	Costa Rica	Cuba	Ecuador	México	Panamá	Peru	Uruguay	Venezuela	Total	
Citing country	**Argentina**	**Connections**	21%	0%	**28%**	26%	5%	0%	0%	2%	12%	0%	2%	2%	3%	100%
		Total Citations	22%	0%	**28%**	26%	2%	0%	0%	1%	11%	0%	3%	4%	2%	100%
	Bolivia	**Connections**	9%	0%	9%	9%	9%	0%	0%	9%	**45%**	0%	0%	9%	0%	100%
		Total Citations	1%	0%	1%	6%	6%	0%	0%	1%	35%	0%	0%	**49%**	0%	100%
	Brazil	**Connections**	13%	0%	**50%**	10%	7%	0%	0%	2%	13%	1%	0%	3%	2%	100%
		Total Citations	14%	0%	**46%**	7%	11%	0%	0%	1%	17%	1%	0%	1%	3%	100%
	Chile	**Connections**	12%	1%	12%	**43%**	12%	0%	0%	2%	15%	0%	0%	1%	1%	100%
		Total Citations	11%	1%	9%	**53%**	8%	0%	0%	4%	13%	0%	0%	1%	0%	100%
	Colombia	**Connections**	10%	0%	10%	15%	**38%**	0%	0%	1%	16%	2%	0%	3%	5%	100%
		Total Citations	3%	0%	7%	5%	**48%**	0%	0%	1%	29%	0%	0%	1%	6%	100%
	Costa Rica	**Connections**	0%	0%	0%	0%	0%	0%	0%	0%	0%	**100%**	0%	0%	0%	100%
		Total Citations	0%	0%	0%	0%	0%	0%	0%	0%	0%	**100%**	0%	0%	0%	100%
	Cuba	**Connections**	0%	0%	20%	**40%**	0%	0%	0%	0%	0%	0%	0%	20%	20%	100%
		Total Citations	0%	0%	14%	**57%**	0%	0%	0%	0%	0%	0%	0%	14%	14%	100%
	Ecuador	**Connections**	6%	0%	**25%**	19%	13%	0%	0%	6%	6%	0%	6%	6%	13%	100%
		Total Citations	4%	0%	6%	7%	1%	0%	0%	1%	5%	0%	**43%**	29%	4%	100%
	Mexico	**Connections**	14%	0%	17%	14%	12%	0%	0%	2%	**33%**	1%	0%	3%	5%	100%
		Total Citations	7%	0%	20%	7%	14%	0%	0%	1%	**47%**	1%	0%	2%	2%	100%
	Panamá	**Connections**	25%	0%	0%	**50%**	25%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Total Citations	22%	0%	0%	**67%**	11%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Peru	**Connections**	14%	0%	**29%**	**29%**	0%	0%	0%	14%	0%	0%	0%	14%	0%	100%
		Total Citations	5%	0%	23%	**45%**	0%	0%	0%	18%	0%	0%	0%	9%	0%	100%
	Uruguay	**Connections**	16%	3%	19%	**22%**	3%	0%	0%	5%	**22%**	3%	3%	0%	5%	100%
		Total Citations	12%	6%	**20%**	12%	6%	0%	0%	**20%**	16%	1%	1%	0%	5%	100%
	Venezuela	**Connections**	18%	3%	18%	13%	8%	0%	0%	0%	13%	0%	0%	5%	**23%**	100%
		Total Citations	14%	1%	14%	8%	18%	0%	0%	0%	22%	0%	0%	3%	**20%**	100%
	Total	**Connections**	13%	0%	24%	19%	14%	0%	0%	2%	17%	1%	0%	3%	5%	100%
		Total Citations	9%	1%	20%	13%	20%	0%	0%	3%	24%	1%	3%	4%	4%	100%

Source: elaborated by the authors with data from Google Scholar.
[a] Numbers in bold correspond to the highest values for each citing country.