

## Ecosystem services research in Latin America 2.0: Expanding collaboration across countries, disciplines, and sectors



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### ABSTRACT

Ecosystem services research in Latin America has been steadily growing and has advanced conceptual understandings, methodological approaches, and global policy applications. One key element for the success of ecosystem services research is expanding collaboration across disciplines, countries, and sectors. This paper sets the stage for the special issue on The state of the art of Ecosystem Services Research and Practice in Latin America that resulted from such collaborations and the resulting insights. To do so we: 1 – present a recent overview of ecosystem services research in Latin America, 2 – assess the role of the network organizing International Congresses on Ecosystem Services in the Neotropics (CISEN, from its initials in Spanish) in fostering collaborations across countries, sectors, research topics, and disciplines, 3 – describe how this special issue was conceived and operationalized to further break collaboration silos and advance understanding, and 4 – present an overview of the papers included in this special issue. Finally, we discuss the challenges and opportunities for future contribution of Latin American research to the rapidly evolving Ecosystem Services literature.

### 1. Introduction

Ecosystem services research is increasingly contributing to understanding of the interactions between people and nature, as well as to the design and implementation of policies and co-constructed interventions towards sustainability. This is particularly true for Latin America (LA), which hosts a large fraction of the world's biological and cultural diversity and exhibits sharp cultural and socioeconomic contrasts and very heterogeneous human-nature interactions (IPBES, 2018). The social-ecological heterogeneity found in LA provides a rich background for theoretical, methodological, and applied explorations of ecosystem services. Inequity, in socioeconomic conditions, in decision making power, and in access to the benefits from nature, is a key issue in a region marked by a long colonial history (McAfee, 2012; Brand et al.,

2016; Cáceres et al., 2016; Laterra et al., 2019). Also, there is a growing push for exporting commodities to satisfy the needs of populations in higher income countries, at high environmental and social costs especially for middle- and low-income countries in the region (Arsel et al., 2016; Levers and Müller, 2019; Svampa, 2015; Veltmeyer, 2016). Finally, the conservation of the unique biodiversity of LA, within and outside protected areas, financed in part by the most affluent economies of the world, has had mixed impacts on access to ecosystem services and on the livelihoods of rural and urban populations (IPBES, 2018).

Previous overviews of the state of the art of ecosystem services research in LA (Balvanera et al., 2012; Perevochtchikova and Oggioni, 2014) highlighted significant advances as well as challenges in ecosystem services research. The most notable advances include efforts towards documenting the supply of services, developments in

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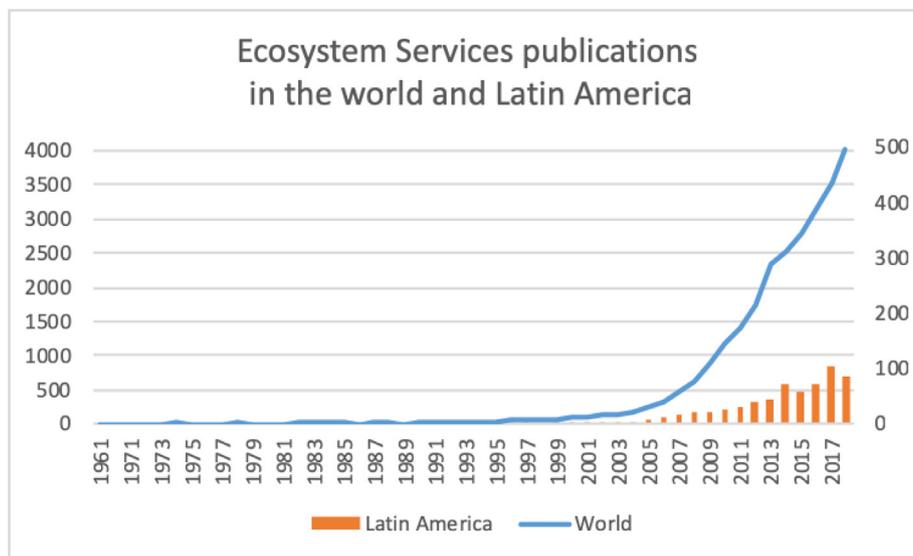


Fig. 1. Progress of the ecosystem services literature for the world and for Latin America. The figure depicts the number of papers published each year (not an accumulation of papers from past years). Source: Systematic review in SCOPUS.

interdisciplinary approaches to ecosystem services, exploration of tradeoffs among services, as well as the growing operationalization of programs making Payments for Ecosystem Services. Yet, important challenges were also identified. The most pressing ones include the need to disaggregate the different beneficiaries of ecosystem services, to assess alignment between interventions targeted at biodiversity conservation and at ensuring the flow of ecosystem services, as well as to analyze the complex interactions among stakeholders with contrasting power, priorities, and vulnerabilities. These reviews also emphasized the need to move towards a more system-wide understanding of socio-ecological systems. While policies such as Payment for Ecosystem Services have been growingly implemented, their societal and environmental impacts are not so clear, leading to controversy and the need to develop alternative policy mechanisms. The ecosystem services concept has been widely adopted in the design of policies and interventions in LA (de Blas et al., 2017). Yet, important challenges remain in the operationalization of the concept into governance, especially when involving diverse stakeholders (Flores Aguilar et al., 2018), strong power imbalances, and contrasting values, needs and world views (Schróter et al., 2014; Laterra et al., 2017; Nahuelhual et al., 2018).

In the face of these challenges, the growing scientific community undertaking ecosystem services research in LA has boosted its potential through fostering international, interdisciplinary, and transdisciplinary collaborations (Gibbons et al., 1999; Van Manen, 2001; Lara and Echeverría, 2007; Laterra et al., 2011a,b; Lara et al., 2013; Laterra and Nahuelhual, 2015). Such collaborations are critical for making comparisons across contrasting social-ecological contexts, understanding tradeoffs and synergies among ecosystem services and among stakeholders, moving towards a systemic perspective of the functioning of socio-ecological systems, and in-depth analysis of the processes underpinning successes and failures in the operationalization of the ecosystem services concept. Yet, ample room is still available for expanding and strengthening such collaborations (but see Merçon, et al. (2018) for the particular case of transdisciplinary collaborations).

This paper sets the stage for the special issue focused on The state of the art of Ecosystem Services Research and Practice in Latin America. To do so we: 1 – present a recent overview of ecosystem services research in LA, 2 – assess the role of a LA network on ecosystem services in fostering collaborations across countries, sectors, research topics, and disciplines, 3 – describe how this special issue was conceived and operationalized to further break collaboration silos and advance understandings, and 4 – present an overview of the papers included in this

special issue. The key challenges addressed by this special issue include: assessing the linkages between biodiversity, ecosystem services and beneficiaries, recent progress towards integrated system-wide perspectives, the role of inequalities among stakeholders, the challenges and opportunities posed by the theoretical premises towards practical applications, the specific challenges for linking theory to practice, and the design of new approaches to policies such as payments for ecosystem services. The papers in this special issue cover the aforementioned challenges through systematic literature review or through in depth case study analysis.

## 2. A systematic literature review

We performed a systematic literature review of ecosystem services research in LA. We used SCOPUS, a commonly used global search tool that has a very wide coverage. We focused on the period comprised between January 1961 and December 2018.

We started with a thematic search. We used the following search string: TITLE-ABS-KEY (“ecosystem service” OR “environmental service” OR “ecosystem services” OR “environmental services” OR “servicio ecosistémico” OR “servicio ambiental” OR “servicios ecosistémicos” OR “servicios ambientales” OR “serviço ecossistémico” OR “serviço ambiental” OR “serviços ecossistémicos” OR “serviços ambientais”). This search was targeted at the use of the above terms in abstract, title, or keywords. This search retrieved 26,772 documents. The engine retrieved mostly documents in English (91% of the publications retrieved), while only 7% and 2% were in the languages spoken in the region, Spanish and Portuguese, respectively. Scopus largely targeted articles in journals (92%), with a few books (5%), and some conference proceedings (2%), with no retrieval of grey literature. When using the same search string in Scielo, a search engine based in LA, only retrieved 1% of the papers, and did not provide a downloadable database, and thus was not further used.

We then filtered the retrieved documents by region. We used the terms “Latin America”, “Central America” or “Mesoamerica” as well as the names of all the countries in the region (The World Bank, 2019a,b). We only targeted authors with institutional affiliations in LA, or those documents for which the research was conducted in the LA region. This process resulted in 645 papers written by 2,062 researchers, starting in 1996, and for which 91.0% were written in English, 6.7% in Spanish, 1.8% in Portuguese, and 0.5% in French;

We found that LA contributes a small fraction (2.5%) of the global

literature on ecosystem services and the number of papers in the field is growing slowly (Fig. 1). We also found that the annual increase in publications on ecosystem services in LA (1961–2018) grew at only 0.05% per year on average, while the literature on ecosystem services is increasing globally at a rate of 8% per year (for the same period).

The leading institutions were based in LA, Europe, and the United States. In decreasing order of contribution these were the Argentinian research Council (Consejo Nacional de Investigaciones Científicas y Técnicas, National Council for Scientific and Technical Research – CONICET), the National Autonomous University of Mexico (Universidad Nacional Autónoma de México, National Autonomous University of Mexico – UNAM), the Austral University of Chile (Universidad Austral de Chile), the largest Brazilian university (Universidade de São Paulo, Sao Paulo University – USP), a Costa Rican research center (Centro Agronómico Tropical de Investigación y Enseñanza, Tropical Agronomic Center for Research and Teaching – CATIE), the Argentinian Agronomic Institute (Instituto Nacional de Tecnología Agropecuaria, National Institute of Agricultural Technology – INTA), the Catholic University of Chile (Universidad Católica de Chile), and the Chilean University at Concepción (Universidad de Concepción). These institutions contributed more than 30% of the publications and were closely followed by a few non-Latin American institutions with a strong presence in the region including Agricultural Research for Development (Centre de Coopération Internationale en Recherche Agronomique pour le Développement – CIRAD), Stanford University, and the Nature Conservancy, which contributed close to 10% of publications.

Ecosystem services research in LA was supported through a diverse array of funding sources (160 institutions reported in 239 of the 641 papers reviewed). Some of the most prominent sources of financial support include government agencies and private foundations. The Brazilian (Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq), North American (National Science Foundation – NSF), Mexican (Consejo Nacional de Ciencia y Tecnología – CONACYT), Argentinian (Consejo Nacional de Investigaciones Científicas y Técnicas – CONICET), and European (European Commission – EC) governmental funding agencies were the most frequently mentioned.

Research on ecosystem services in LA was undertaken by authors from within and from outside the region. The first authors of the identified papers belonged to 57 countries from LA and from other regions. Close to 50% of these first authors were based in LA while an additional 30% came from the United States of America, Germany, and the United Kingdom. They were based in institutions in USA (20% of papers), Brazil (18%), Mexico (9%), Argentina (6%), Chile (6%), Germany (5%), UK (5%), Colombia (4%), France (4%), and Canada (3%). The case studies mentioned were largely from Brazil (23%), Mexico (22%), Costa Rica (13%), Chile (9%), Colombia (7%), Argentina (7%), Ecuador (5%), Nicaragua (3%), Panama (3%) and Peru (2%). On average, four and a maximum of 27 authors collaborated per paper. Only 13.5% of papers were single authored, and 82% of papers included five or less authors. A total of 2,498 authors contributed to this body of research. Yet, this collaborative research was largely focused on case studies within a single country as (90.8% of papers), and only one paper considered seven LA countries (average = 1.15 countries).

The analysis of the journal articles co-authorship network authorship network showed the existence of a community that is structured into discrete teams and a few authors that connect them (Fig. 2; for network terminology and detailed methods see Appendix 1; Fig. 2). We found a big cluster, the main ecosystem services collaboration network, comprised of 850 researchers (Fig. 2). This large cluster was teased apart into eight clusters (see colors in Fig. 2, and see Appendix 1, Table S2 and Fig. S1 for further details). The most central cluster (see blue cluster in Fig. 2) grouped a few authors from France, Mexico and Chile. The rest of the 277 authors were spread in the remaining clusters. The average number of co-authorship ties was only 6.711, and only six prolific and highly interconnected researchers have collaborated with

more than 100 authors. The clustering coefficient (the tendency of indirect pair of neighbor's authors to be connected directly) was very high 0.926, but only 0.005% of the researchers shared more than four co-authorship ties. As a result, co-authorship network was very sparse, with a density of 0.003 (Fig. 2, clusters with no colors).

The analysis of the inter-country co-authorship network revealed limited collaborations among countries (Fig. 3; for network terminology and analysis see Appendix 1). The overall the density of collaboration among countries was low (density = 0.175). Most of the authors tended to collaborate with peers from the same country, with exception of those from USA and Brazil, who also teamed up with authors around the globe (for more details on collaboration within countries, see Fig. S1). The countries that mediated most of the flow of information on ecosystem services in LA were (in decreasing order of normalized Betweenness centrality) USA, UK, Brazil, Colombia, and Germany (see Table S2). These top five countries participated in collaborations with countries from separate parts of the network. The centrality of their position in the network (Fig. 2) confirms the role they play as bridges between the different clusters of countries (Fig. 2). At the regional level, Colombia and Brazil occupied the most prominent positions regarding their high number of connections with other LA countries.

Collaborations among countries within articles were structured into five distinct clusters that are densely interconnected (Fig. 3; see further methodological details and results in Appendix 1, Fig. S1 in Appendix 1). The first group (blue; n = 20) included collaborations between the LA countries with highest academic productivity (Brazil, and Mexico) and some of the developed countries that bridge countries among them (USA, the United Kingdom), as well as many other countries with minor contributions. The second group (orange; n = 14) was a mix of countries from across the planet: Germany, Peru, Italy, Indonesia, Australia, Kenya, and South Africa, among others. This second group likely emerged from collaborations mediated by distributed research centers (e.g. CGIAR global research partnership), large international Non-Governmental Organizations (e.g. The Nature Conservancy, World Wildlife Fund), and funding to large international collaborations (e.g. European Commission). The third group (yellow; n = 12) was largely composed of Spanish speaking countries: Colombia, Spain, Chile, Argentina, and Ecuador, but also included Canada. The fourth group (pink; n = 7) was a mix of European, Central America and Oceania countries: France, Costa Rica, Finland, Nicaragua, Norway, and New Zealand. Finally, the Czech Republic was found alone in the fifth group (grey; n = 1) due to its limited collaborations with other countries.

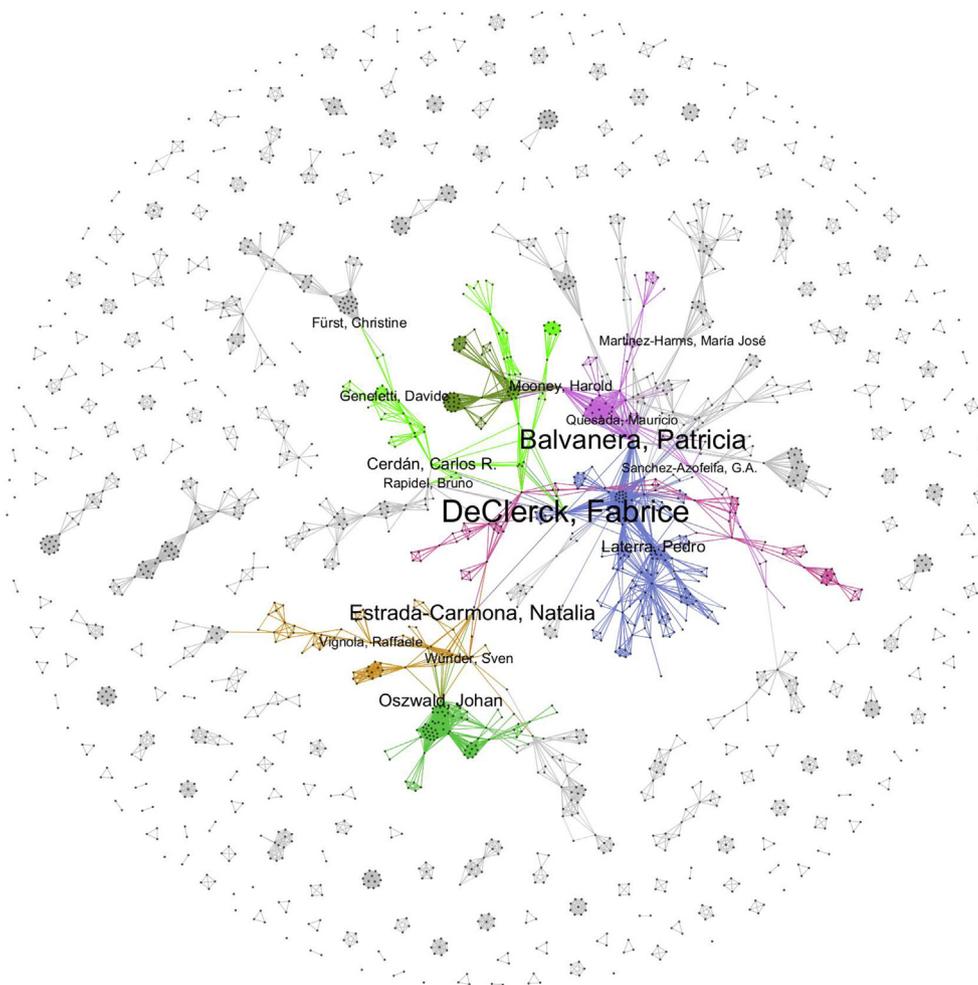
Overall, our results showed that research on ecosystem services in LA is advancing slowly, despite the rich biological and cultural diversity of the region (IPBES, 2018). Collaborations include authors from many LA countries, with a few leading countries such as Brazil, Colombia and Mexico. We found that countries outside the region, such as USA, the United Kingdom and Germany, played a key role in mediating collaboration among countries.

### 3. The role of the Latin American Network for Ecosystem Services: CISEN

#### 3.1. The history and impacts of the network

Collaborations among countries, disciplines, and sectors did not occur in a vacuum but rather, were fostered by initiatives that help connect researchers. To explore this issue in depth, we focused here on a key initiative that we have been a part of, whose importance in fostering collaborations has grown steadily, and that actually triggered this special issue and paper.

The *International Congress on Ecosystem Services in the Neotropics (CISEN for its name in Spanish Congreso Internacional de Servicios Ecosistémicos en los Neotrópicos)* has played a paramount role in LA research on Ecosystem Services since its inception in 2006. This initiative was developed by the FORECOS Foundation (FORECOS, 2019), an



**Fig. 2.** Journal articles co-authorship network for ecosystem services research in Latin America (1996–2019). Authors that have published together in the covered timeframe are connected with a tie (line): the thicker the thickness of the lines between two authors indicate the number of papers they co-authored. The size of labels (author names) indicates the Betweenness centrality of the top 15 authors in the network. This metric reflects the role of the authors in the flow of information in interconnecting separate groups of researchers (see further details in [Appendix 1](#)). Colors are used to depict the top eight larger clusters of authors that publish together.

interdisciplinary research team from the Austral University of Chile, whose work focuses on ecosystem services to insure the conservation of the Chilean natural and cultural heritage. The first international congress on ecosystem services was held in Valdivia, Chile, in 2006, under the leadership of Professor Antonio Lara and a highly motivated team of international collaborators (Lara and Echeverría, 2007). This event was very successful and created the momentum that has led to four additional congresses in Asunción, Paraguay (2011), Medellín, Colombia (2013), Mar del Plata, Argentina (2015; Laterra et al., 2017), and Oaxaca, Mexico (2017; CISEN-V, 2017a).

The CISEN network was often supported by external funding to strengthen research among LA countries and particularly with Spain. The Ibero-American Program of Science and Technology for Development (CYTED) partly funded the second, third and fourth meetings. Local organizers also sought funding within their own countries. This included Chile (funded by Iniciativa Científica del Milenio), Paraguay (partly funded by Fundación Moisés Bertoni), Colombia (funded by Universidad de Antioquia, Universidad Nacional de Colombia, and Conservation International), Argentina (partly funded by INTA, Fondo para la Investigación Científica y Tecnológica (FONCYT), and CONICET), and Mexico (funded by CONACYT, UNAM, and other national or regional organizations) (CISEN-V, 2017a).

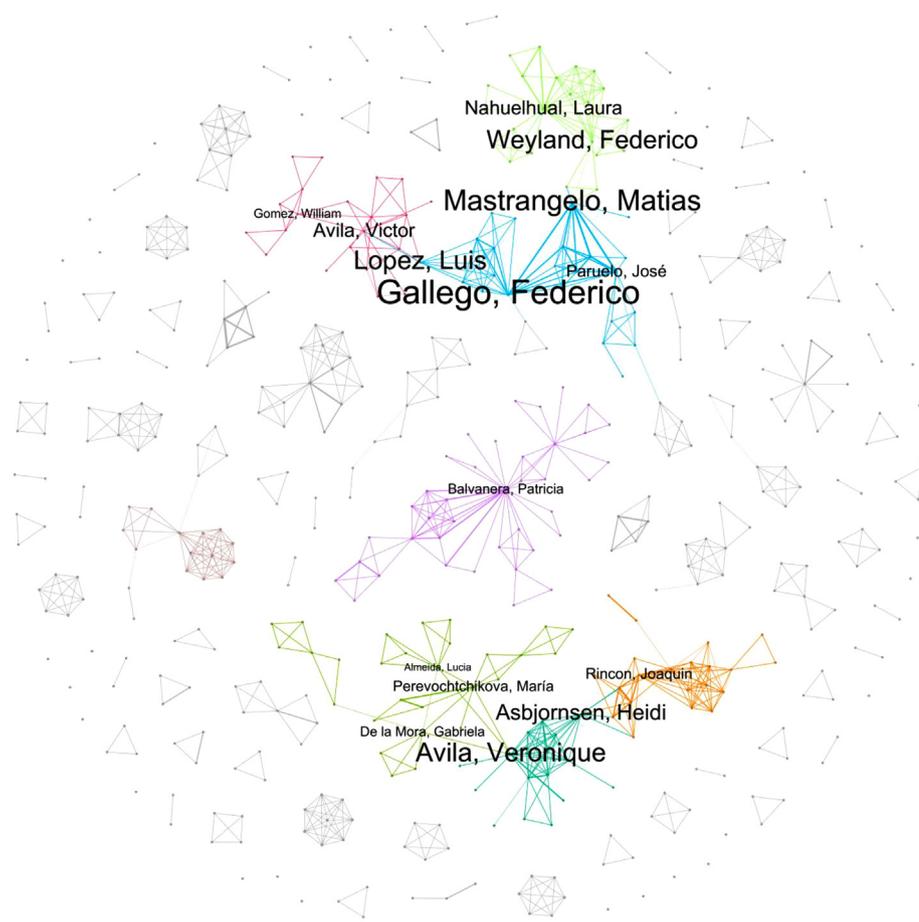
CISEN congresses have sought to promote the ecosystem services approach in LA, to generate a common research agenda, and link different actors involved in decision-making. The importance of this initiative may be roughly estimated through the more than 700 presentations, and some 1,000 participants from 30 countries in LA, the Caribbean and the rest of the world.

The CISEN network has contributed to the creation and

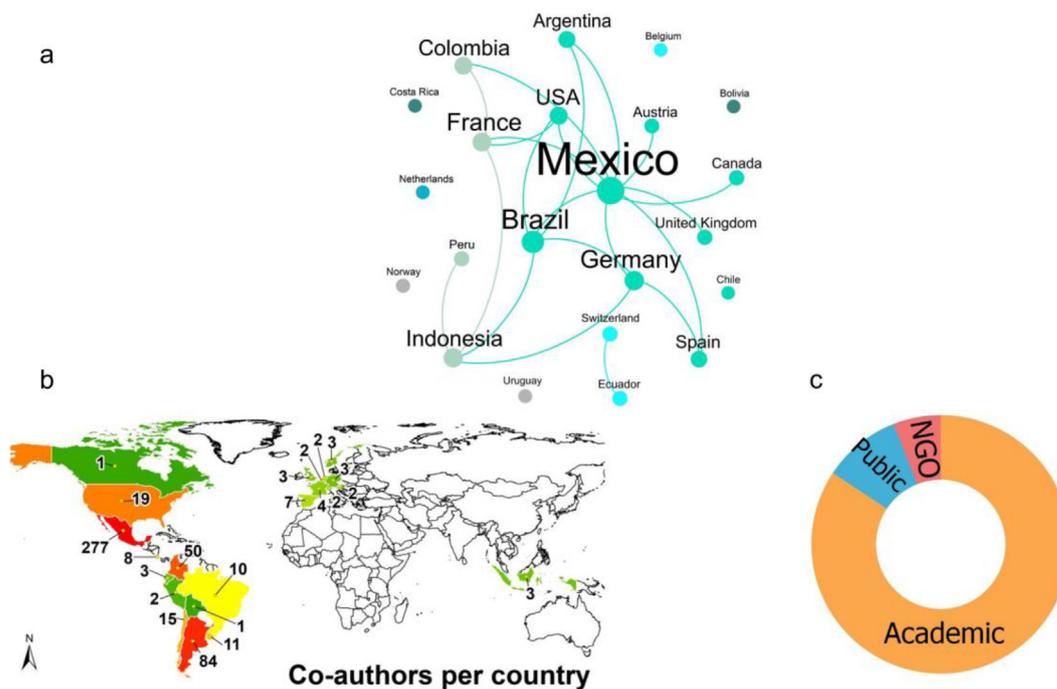
consolidation of several LA Research Networks, capacity building programs, as well as a wide range of transdisciplinary initiatives. The first one was the LANES network (Latin American Network of Studies on Ecosystem Services; Red Latinoamericana de Estudios de Servicios Ecosistémicos) that was created in 2006 to promote the development of conceptual frameworks knowledge and capacities towards the management and conservation of ecosystem services to ensure the well-being of societies in LA (Lara and Echeverría, 2007). This was then followed by the ProAgua (ProaWater in English) network that gathered scientists within different Iberoamerican countries to assess the social-ecological dynamics of selected watersheds (Lara et al., 2013). Later, the VESPLAN network (Vulnerability, Ecosystem Services, and Planning of the Rural Territory; Vulnerabilidad, Servicios Ecosistémicos y Planeamiento del Territorio Rural) was created in to foster exchanges among Iberoamerican countries regarding a broad assessment of ecosystem services, including their quantification, modeling, valuation, and mapping, with emphasis on the vulnerability of social-ecological systems in the face of declining ecosystem services (VESPLAN, 2016).

The research networks, capacity building programs, and transdisciplinary initiatives fostered by CISEN contributed to the generation of several joint products. These joint products were not identified by the literature searches discussed in the previous section, probably because they were published by editorial houses that are not systematically screened by Scopus. One book compiled the results of social-ecological research on ecosystem services provided by watersheds (Lara et al., 2013). The second book identified opportunities to internalize ecosystem services research into territorial planning (Laterra et al., 2011a,b). Both books were published as open access online publications to insure their use by a wider community. A mapping tools to assess





**Fig. 4.** Co-authorship network of presentations at CISEN-V. Authors that participated together in a presentation at CISENV are connected with a tie (line); the thicker the thickness of the lines between two authors indicate the number of papers they co-authored. The size of labels (author names) indicates the Betweenness centrality of the top 15 authors in the network. This metric reflects the role of the authors in the flow of information in interconnecting separate groups of researchers (see further details in Appendix 1). Colors are used to depict the top seven clusters of authors that collaborated in a presentation.



**Fig. 5.** Characteristics of the presentations at CISEN-V, the fifth edition of the Latin American Congress on Ecosystem Services in the Neotropics. a – Inter-country co-authorship of presentations at CISENV; the size of nodes and labels indicates their betweenness centrality in the network; node colors depict the different clusters that emerged from modularity analysis in which particular countries collaborate more with each other. b – Country of origin of co-authors of presentations at CISEN-V. c – The type of stakeholder participant at CISEN-V.

#### 4. Breaking collaboration barriers: an experiment during CISEN-V towards the special issue in ecosystem services

We decided to further promote collaboration in the region via a call for a special issue. We did so without a clear diagnosis such as the one we present above. We decided to promote a synthesis around The State of the Art of Ecosystem Services Research and Practice in Latin America (*Journal Ecosystem Services*, 2017). This call was designed in early 2017 to foster publications from LA authors in the peer reviewed literature in English, taking advantage of the CISEN-V congress at the end of 2017 to:

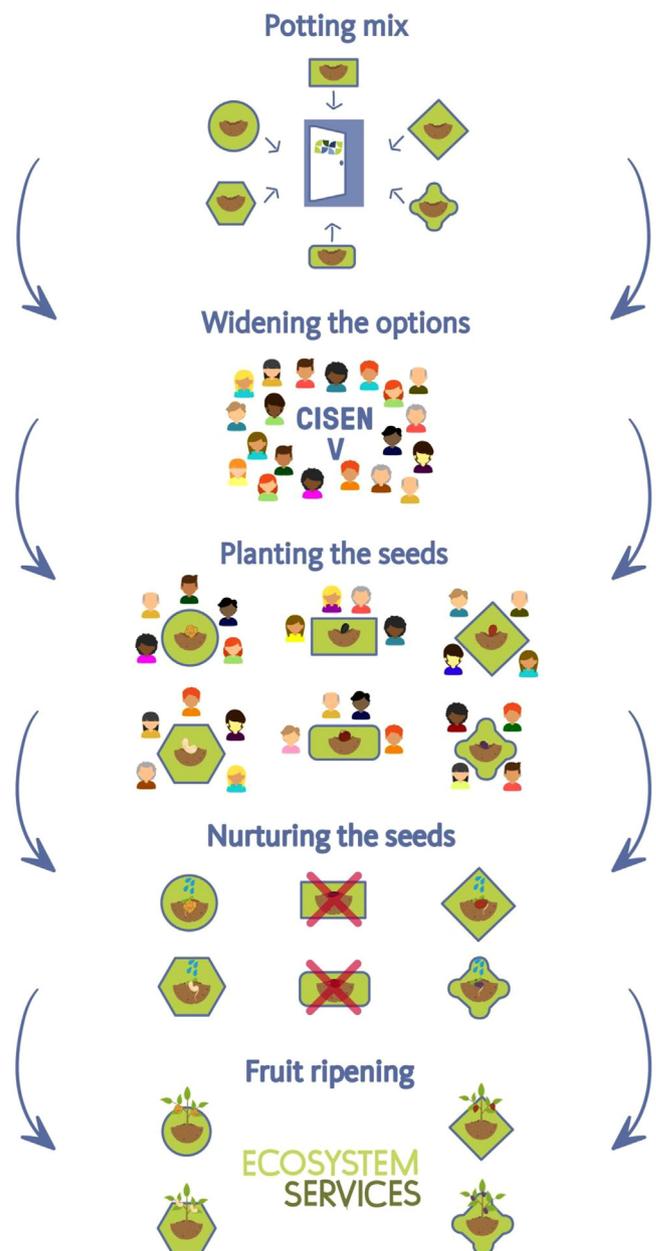
- attract a large fraction of the scientific community from the region,
- include a mix of attendees, including those well versed in publishing peer reviewer papers in English, and others within or outside academia that had not published any academic paper,
- include attendees within established collaboration networks (such as those described above), as well as others that connected the different networks or could enrich either of them.

To do so, the call for manuscripts (CISEN-V, 2017b) aimed at:

- promoting collaboration among countries, as proponents were asked to show that authors were from at least three different countries;
- fostering institutional diversity, as proponents were asked to ensure that authors belonged to at least three different institutions, and had different backgrounds;
- using different comparative tools to learn from the heterogeneous contexts across LA, as proponents were asked to include either systematic literature reviews or comparisons among at least three study sites in different countries; and finally,
- addressing topics that were most relevant for LA: 1 – ecosystem service co-production, 2 – beneficiaries of ecosystem services, 3 – governance and public policy for ecosystem services, 4–interactions across spatial and temporal scales and teleconnections among social-ecological systems.

Beyond just a simple call for papers, we also set up an innovative “collaboration experiment”. This collaboration experiment included five steps described below using the analogy of planting seedlings and their development (Fig. 6).

- **1-Potting mix.** The process started with the launch of the call for proposals of papers for the special issue. We received 18 such proposals that were revised by the editors of the special issue. Based on the previously described criteria and overall proposal quality 16 of them were approved.
- **2-Widening the options.** Several steps were designed to incorporate a large number of participants in this experiment.
  - **A.** Preparation of the proposals. The lead proposal co-authors worked prior to the meeting to refine their proposals through iterative interactions with journal editors and discussions with core co-authors. They also designed mechanisms that would take advantage of the collaborative opportunities during CISEN-V.
  - **B.** Preparations for CISEN-V. Accepted and refined proposals (16) were posted online prior to the CISEN-V meeting. All attendees were invited to register their interest in participating in the discussions around any of the proposals to potentially become collaborators. A total of 108 (34% of those registered for CISEN-V) attendees signed up with some proposal attracting more interest than others. For instance, in average 6.5 people registered, but some sessions had 22 registered participants.
  - **C.** During CISEN-V. All CISEN-V attendees, including those that had not previously registered, were invited to sit a one discussion table. A full two-hour session was dedicated to this activity with no other simultaneous meeting activities.



**Fig. 6.** Diagram describing the steps involved in an innovative “collaboration experiment” that led to this Special Issue and that was designed to break collaboration barriers. These included: 1 – Potting mix: call for proposal; 2 – Widening the options: preparations for CISEN-V attendees to participate; 3 – Planting the seeds: actual discussions during CISEN-V; 4 – Nurturing the seeds: elaboration of the manuscripts; and finally 5 – Fruit ripening: publication in the special issue of *Ecosystem Services* journal.

- **3-Planting the seeds.** The collaboration seeds resulted from the discussion held during CISEN-V. The dynamics at each discussion table were very different as designed by proposal proponents. Some teams prepared cards and poster boards to organize input from potential collaborators. Others shared their databases in their computers. Others organized small discussions groups around key topics. There was a wide variation in number of attendees sitting at any tables: one table only had one additional participant, and one had 24 participants.
- **4- Nurturing the seeds.** The discussion held during CISEN-V were then taken to the elaboration of actual manuscripts. During this phase, the editors revised up to three versions of manuscripts to help the authors produce a stronger manuscript. Several manuscripts did

not succeed (“germinate”) during this period. Editors rejected five papers that did not meet journal quality standards or were able to address the feedback provided. The editors requested a robust presentation of a conceptual or analytical framework, a clear research question and a rigorous analysis of the evidence (from comparisons of case studies or a systematic literature review). Additionally, two of the proponent teams faced personal or academic challenges that hindered their ability to complete their manuscripts. These authors argued that research was not a priority at their institutions, and they could not find the time to take the manuscripts in construction to full fruition.

- **5- Fruit ripening.** The manuscripts were submitted to the journal and went through the standard review process required for publication. In the end, seven of these papers were published and are included in this Special Issue. This process took between 1 and 1.5 years for papers to be ready for publication after CISEN-V. Authors took a long time to prepare their drafts, and the editors revised the manuscripts in several iterations, even prior to submission, to help the authors provide strong manuscripts.

This “collaboration experiment” helped to further expand the collaboration networks involved in research on ecosystem services in LA. The papers in this special issue were comprised of very diverse teams, including a total of 90 authors. An average of 13 and a maximum of 30 authors collaborated in these papers, which is clearly above levels found in our initial literature review. On average, authors belonged to five, with a maximum of 10, different countries. Here we should note that the list of countries of co-authors went well beyond those identified as the most productive in our systematic literature review. Guatemala and Paraguay were important additions to the list of participant countries. Also, collaborations with Germany and the United Kingdom were notable in this effort. Paper co-authors belonged to an average of 9.5 institutions with a maximum of 14. These institutions included the most prominent ones identified by in our literature review (the National Autonomous University of Mexico, the Catholic University of Chile, CONICET). They also included other national universities (e.g. Universidad de Buenos Aires, Argentina), as well as smaller universities (e.g. Universidad de Antioquia, Colombia). Co-authors also came from governmental research centers (e.g. Instituto Humboldt in Colombia), large environmental organizations (e.g. The Nature Conservancy), and a large number of small society organizations (e.g. Instituto Nectandra in Costa Rica).

The contributions were based on systematic reviews or case study analyses. Two of the papers undertook systematic reviews of the literature on particular topics (including 57 and 21 papers). Most, however, conducted in depth analyses of case studies (average of 13 and a maximum of 21 case studies). These case studies were located mostly in countries that had been identified during our systematic literature review. Yet, they but also included Guatemala and Paraguay, as well as a comparison between countries in the Caribbean, Europe, Asia, and Africa.

The experiment revealed some important obstacles faced by LA authors. Poor quality and lack of time to commit to writing the paper contributed to the low rate of success (39%) of the proposal. Also, the elaboration and review process took quite long, taking an average of 1.5 years from CISEN-V to publication, along which the manuscripts went through several iterations. Papers within special issues in the journal take in average 184 days for review once they are submitted (Elsevier, 2019).

##### 5. The special issue: the state of the art of ecosystem services research and Practice in Latin America

The unique ecological, socioeconomic, and political characteristics of LA permeate the papers that are included in this special issue. The special issue draws from an in-depth analysis of 63 case studies and 128

published articles across LA, and one with sites outside the region. The seven papers within this collection offer a critical analysis of the latest discussions on the ecosystem services approach, suited to the particular conditions of the LA context. Given the design of the collaboration dynamics, and the explicit requests by the editors, all the articles compiled in this special issue utilize an interdisciplinary approach and were strongly enriched by the diversity of perspectives from collaborating co-authors from very different institutional settings and with experience in very diverse environmental, socioeconomic, and political contexts.

The papers in the special issue cover a wide range of contexts and highlight some important advances as well as key research gaps. While Quijas et al. (2019) focused on tropical dry forests to show that more is needed on understanding the beneficiaries of ecosystem services, Alonso-Roldán et al. (2019) explored the land-sea interface to address the obstacles to practical applications of ecosystem services. Weyland et al. (2019) analyzed the relationships among sectors involved in implementing an ecosystem services approach across contrasting contexts: conservation initiatives in the Southern Cone Grasslands, semi-communal land tenure communities within a river basin in Mexico, and water governance in Chile and basin management in Colombia. Perevochtchikova et al. (2019) focused instead on system-wide integrated research and showed that more is needed to go beyond particular aspects of biodiversity or particular ecosystem services to fully apprehend the complexity of social-ecological systems at different scales.

Some papers offered new conceptual frameworks and approaches. Several of the papers challenge scientists’ engagement in research and practice in weak institutional contexts (Lattera et al., 2019; Rincón-Ruiz et al., 2019; Weyland et al., 2019). Weyland et al. (2019) addressed the obstacles and opportunities in mainstreaming ecosystem services within public policy in the context of governmental economic incentives. They conclude that the lack of information is not enough to explain the moderate adoption of the ecosystem services approach in policy design, and rather identified some of the cultural and institutional factors that are likely to explain this pattern. Lattera et al. (2019) proposed and tested a social-ecological conceptual model, exploring the feedback mechanisms between ecosystem services, natural capital, and the ultimate causes of socioeconomic inequality. Rincón-Ruiz et al. (2019) showed that integrated valuation of nature can represent a fundamental tool to compensate power asymmetries between social actors by giving voice to stakeholders typically excluded from discussions. Brownson et al. (2019) explored the different ways in which communities are engaged in payment for ecosystem services and how these led to a community-based program with novel implications in terms of its design, operationalization, and outcomes.

Several of the papers in this special issue emphasized key political issues. The problem of inequalities and asymmetrical access to ecosystem services appeared more than once in this special issue probably because of the particular LA social and economic contexts (e.g. Brownson et al., 2019; Lattera et al., 2019; Rincón-Ruiz et al., 2019; Weyland et al., 2019). In this sense, Brownson et al. (2019) showed that further community engagement was needed to ensure that policy agendas are not imposed on communities. Such engagement can increase the legitimacy of the policy interventions. In very different geographic contexts such as land-sea interfaces, Alonso-Roldán et al. (2019) proposed that using ecosystem services as a boundary concept could improve integration between sectors and, that such approach can help to introduce ecosystem relations to stakeholders in ways that explicitly link their own interests to the trade-offs identified.

Most articles in the special issue urged for the translation of knowledge into action. For example, Weyland et al. (2019) analyzed why the knowledge generated in different institutional and political landscapes did not necessarily produce favorable impacts on policies. Also, Lattera et al. (2019) suggested that public awareness about the consequences of inequality in the access to ecosystem service benefits is

a necessary first step towards enhancing virtuous links between the social distribution of benefits and nature conservation.

Many of the papers call attention to the processes that occur in the science-policy interface (Alonso-Roldán et al., 2019; Perevochtchikova et al., 2019). Scientific knowledge is poorly translated into sound policies largely due to inappropriate briefing of policymakers by scientists (Weyland et al., 2019). The involvement of boundary institutions or organizations was shown to play a key role in connecting scientists, communities, policy makers and managers. The development of partnerships including scientists and a network of social actor sharing similar interests could be promising strategies towards more just and sustainable futures (Alonso-Roldán et al., 2019; Perevochtchikova et al., 2019). Ultimately, this set of papers is a call and road map for fostering inter- and transdisciplinary and co-productions of knowledge (Alonso-Roldán et al., 2019; Quijas et al., 2019; Perevochtchikova et al., 2019; Rincón-Ruiz et al., 2019).

The articles covered in the special issue acknowledged that decision makers are not necessarily rational actors that design policies for the common good by drawing upon the information they gather in relation to a certain social-ecological issue. Like other actors, they also have their own priorities, interests, and political agendas. The translation of interdisciplinary research or co-produced knowledge into policies is a complex and multi-faceted process. The nature of the problems being addressed is very varied, and the prevailing power balances among the social actors involved in particular cases (e.g., consensus, disputes, alliances and/or power asymmetries) can hinder progress. In other words, the translation of knowledge into policies and into positive actions, depends on what is at stake in every particular situation as well as on whose interests may be affected or compromised.

## 6. Challenges and opportunities for future contributions of Latin America to ecosystem services research

Ecosystem services research in LA has been developing for the last decades and collaboration has been key to achieve this. We found solid evidence of the increase of journal articles, books, and capacity building initiatives. We found that some authors, some countries (within and outside LA) and collaboration opportunities provided by CISEN have played a key role in interconnecting a large community. Collaborations among authors, countries, and institutions are increasing, and should help to overcome inequities in funding, capacities, language, and institutional settings. The leading research institutions in the region have been fostering collaboration with colleagues in developed countries in Europe and North America, but also important regional networks have been established that promote intra-regional interactions among LA countries, with Spain, and beyond. Funding for scientists to meet and collaborate cannot be emphasized enough and should be increased the future. CISEN, a LA network focused on ecosystem service research has been critical. The Ecosystem Services Partnership, now with chapters for Central America and the Caribbean, and South America, is playing an increasingly important role in the region in this regard. More regional networks, allowing researchers to communicate in their native languages, to travel less, and to share common issues are urgently needed.

Research on ecosystem services in LA faces important challenges. Funding is a key limiting factor. Funding for research in LA and the Caribbean (0.76% of GDP in 2016) is nearly three times lower than the global average (2.23%), imposing an important limitation. While funding has slightly increased over the last decade (from 0.55% in 2000), recent political changes in highly productive countries such as Brazil, Mexico, and Argentina are likely to reverse this trend. Publishing in English is difficult for many authors of the region. Better outlets to make visible publications in Spanish are needed.

The special issue presented here allowed to address some of the important challenges. These include the need for more system-wide social-ecological research, more systematic comparisons across case

studies, the development of new conceptual and analytical frameworks, as well as making more visible and the identification of the specific challenges across particularly regional contexts. Yet, more is needed. Assessing the role of socioeconomic inequality, particularly regarding the historical processes that have led to the current power imbalances, and how to leverage such imbalances through the design of policies promoting sustainability, is urgently needed. The design and operationalization of policies that are mindful of the social-ecological characteristics of the region is key in this regard.

Ultimately ecosystem services research in LA will only be relevant if it actually contributes to addressing the key challenges people face in the region. Transdisciplinary approaches are increasing, as shown by the configuration of attendees to CISEN-V and their participation in the special issue. Attendance from governments and non-governmental organizations to CISEN-V was significant and also quite visible during the drafting of the papers in this special issue. Yet, as in many other regions, further transdisciplinary work will be critical to fully incorporate the different perspectives and types of knowledge in the co-construction of alternative human-nature relationships that are more just and more sustainable.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. Supplementary data

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