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Global environmental change policy priorities from the Americas and opportunities to bridge the science-policy gap

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ABSTRACT

Governments and intergovernmental organizations support scientific research to produce the knowledge and tools needed to monitor and mitigate global environmental changes (GEC). However, GEC-related policy decisions are often not based on scientific evidence, and GEC research is often not based on policy-relevant questions, resulting in a science-policy gap. Assessing the GEC policy priorities of researchers and policymakers is an essential step towards closing this gap. This task was undertaken by the Inter-American Institute for Global Change Research (IAI), an intergovernmental organization pursuing science and capacity building to reach the vision of a sustainable Americas. The assessment included survey consultations, listening sessions, and an analysis of policy documents for 17 countries of the Americas. Three key findings emerged from this assessment. First, the top current priority for policymakers was Climate action, and Biodiversity and ecosystem services for researchers, with a poor alignment between the priorities of these social actors at the country level. Second, clusters of non-neighboring countries had a profile of GEC priorities more similar than clusters of neighboring countries, although there were some sub-regional clusters around particular GEC goals. Third, researchers and policymakers agreed that the lack of cross-sectoral collaboration and communication between technical and non-technical actors are important barriers. A key opportunity for policymakers was the growing funding and international cooperation for GEC, while for researchers, the growing body of evidence to inform GEC decision-making. These findings have implications for the design of research and capacity-building actions targeted to the priorities and needs of the region.

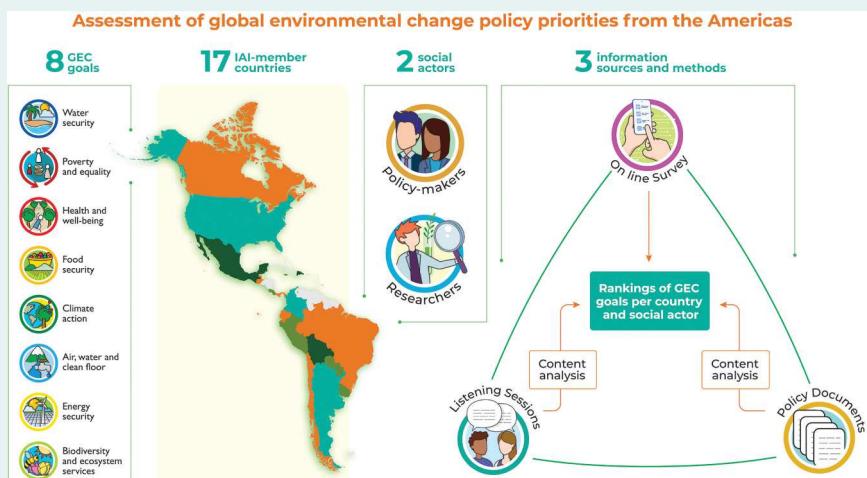Assessment of global environmental change policy priorities from the Americas

8 GEC goals — Water security; Poverty and equality; Health and well-being; Food security; Climate action; Air, water and clean floor; Energy security; Biodiversity and ecosystem services

17 IAI-member countries

2 social actors — Policy-makers; Researchers

3 information sources and methods — On line Survey; Listening Sessions; Policy Documents; Content analysis; Content analysis; Rankings of GEC goals per country and social actor

In this paper, we assessed the global environmental change policy priorities of policy-makers and researchers from 17 countries in the Americas using three information sources and methods.

POLICY HIGHLIGHTS
- The Inter-American Institute for Global Change Research (IAI) assessed policy priorities related to global environmental change (GEC) of policymakers and researchers in 17 countries of the Americas.
- Addressing GEC challenges requires science-policy interfaces with multi-directional interactions among social actors and multiple scales of intervention so that policy actions match the scale and complexity of GEC challenges.
- Science diplomacy emerges as a pivotal strategy to foster collaboration across sectors and seize policymakers' growing interest in transboundary and international cooperation.
- Creating incentives for developing and practicing transdisciplinary science is essential to overcoming the lack of communication between technical and non-technical audiences.
- Considering the growing severity of GEC challenges and the limited capacity of national and inter-governmental organizations, assessments of GEC policy priorities become essential to aligning scientific knowledge demand and supply and fostering regional cooperation.

1. Introduction

The major challenges that humanity faces today, such as climate change, biodiversity loss, and food insecurity, stem from human-driven environmental changes that have reached a global scale (Díaz et al. 2019). Confronting these global environmental changes (GEC) requires integrating new and evolving scientific knowledge into governance and decision-making processes in a timely manner (Cvitanovic and Hobday 2018). Governments are key in regulating human activities that harm the environment and supporting the production of scientific knowledge to design and implement effective, equitable, and legitimate environmental policies. However, policy decisions with consequences for the environment are often not based on scientific evidence, and research about the environment is often not based on policy-relevant questions (i.e. the science-policy gap). Because GEC operates at spatial scales exceeding country boundaries, national governments have reason to collaborate at sub-regional to global scales. Intergovernmental organizations can strengthen the capacity of national governments to address GEC by providing information to guide the prioritization of GEC objectives, fostering regional collaboration, and aligning science and policy agendas (Tosun and Peters 2018).

The relationship between science and policy has evolved rapidly, and as a result, various types of science-policy interfaces have emerged in the last decades (Wagner et al. 2023). Science-policy interfaces are social processes, organizations, or platforms that connect scientific knowledge production and policy decision-making (van den Hove 2007). Science-policy interfaces characterized by linear and directional interactions, with either science pushing or policy pulling knowledge across the interface, have shown limited effectiveness in addressing wicked global environmental problems (Roux et al. 2006; Sarewitz and Pielke 2007). Science-policy interfaces characterized by multi-directional interactions among researchers, policymakers, and other social actors have gained interest as a way to co-produce credible, relevant, legitimate, and actionable knowledge (De Leeuw et al. 2018; Balvanera et al. 2020). Co-production promises to increase the influence of knowledge on decisions through deliberation and collaborative management by fostering viable, fair, and inclusive decision options (Turnhout et al. 2020; Jacobi et al. 2022). The interest in co-production and transdisciplinary approaches has grown in parallel to the recognition of the influence of non-scientific factors, such as power relations and historical legacies, on agenda-setting and policy formulation (Lawton 2007; Cáceres et al. 2016). As a result, policymaking is increasingly seen as an iterative process involving many actors and types of knowledge, in which scientific knowledge is only one contributing element.

In the Americas, the integration of scientific information in policymaking faces several challenges at multiple scales. Building multi-national scientific cooperation in this hemisphere-wide region is challenging due to the large cultural and socio-economic heterogeneity found across sub-regions and countries. Historically, the prevalence of Western and colonial modalities of science, oriented to basic research, has underlined the misalignment between social needs and scientific production (Sala and Torchio 2019). In the last decades, science policies in the region have shifted towards promoting scientific production aligned with national interests, mainly to support economic development. These science policy shifts have seldom included the advancement of non-Western, indigenous modalities of science (Daza Aragón and Le Coq 2021). Despite the rise of applied research, the uptake of scientific knowledge in policymaking related to GEC in Latin America has been hindered by a lack of incentives and enabling institutional structures (Borquéz González, 2017). Unfortunately, there is little published evidence on the activity of science-policy interfaces working at the regional level in the Global South (Wagner et al. 2023), which prevents assessing their

potential to address these challenges for Latin America.

The alignment of interests and priorities between researchers and policymakers has been identified as a factor enabling considerable uptake of scientific evidence in policymaking on issues related to GEC (Sarkki et al. 2021; Wagner et al. 2023). Science-policy interfaces have various tools to foster such alignment. Assessing the policy priorities of the different social actors involved in GEC-related issues provides essential information to identify potential misalignments. Very few implementations of this kind of assessment are reported in the peer-reviewed literature, especially at the regional multi-country level (but see Rudd and Fleishman 2014). These assessments can be complemented with participatory methods, such as workshops, dialogues, or listening sessions, to get a richer and more nuanced picture of the policy and decision-making landscape. Once identified, science-policy interfaces can foster the alignment of priorities between policymakers and researchers by, for instance, targeting research funding to transdisciplinary projects addressing priority GEC goals and building new capacities in these social actors (Arnott et al. 2020). Capacity building in science diplomacy is a powerful tool for this purpose, as it provides avenues for more fruitful interactions between researchers and policymakers and for more scientific cooperation among countries looking for solutions to common problems (Soler 2021).

The Inter-American Institute for Global Change Research (IAI) is an intergovernmental organization working in 19 countries of the Americas in international cooperation, science outreach, capacity building, and the exchange of scientific information relevant to GEC (Pittman et al. 2016; Ehlers et al. 2021). The IAI was established through a treaty in 1992, which established a Conference of the Parties comprised of national focal points of its member states. These focal points are government officials, mostly from the ministries of Environment, Science and Technology, and/or Foreign Affairs, who are designated by Ministry of Foreign Affairs. In its 30 years, the IAI has become one of the major science-policy interfaces in relation to global change issues for the Americas. The priorities and goals of the IAI are contained in its scientific agenda and strategic plan, which are periodically updated following a consultation process involving national focal points, science and science-policy advisory committees and the IAI Directorate. The IAI is evolving from a focus on interdisciplinary research (Pittman et al. 2016) to a transdisciplinary and science diplomacy approach to leverage the impact of science on government decision-making related to global environmental change issues.

In 2023, the IAI completed an assessment of GEC policy priorities to serve as input to guide science funding priorities and capacity-building activities and to facilitate collaboration among countries with similar needs and priorities. The assessment also identified opportunities and challenges to uptake science in national governmental decision-making processes. This article describes the approach used by the IAI to assess GEC policy priorities in interaction with government and scientific actors and presents the results of the assessment. The author team of this article includes members of the IAI Directorate and the IAI science and science-policy advisory com-

Table 1. Eight goals to address global environmental change contained in the strategic plan of the Inter-American Institute for global change Research (IAI).

| Goal	Description of the goal in the IAI Strategic Plan
Poverty and equality	The IAI community worked towards informing solutions to reduce poverty and increase equity and justice among citizens in the Americas
Food security	The IAI community was effective in working alongside policymakers and societal actors to find solutions to reduce food vulnerability and increase the adaptive capacity of food systems and the nutritional quality of available food in the Americas
Water security	The IAI has supported research, capacity building, and good governance that promotes sustainable access to quality water in the Americas
Energy security	The IAI has supported innovative research on existing and emerging renewable energy and has informed policies resulting in improved energy sustainability and security
Climate action	The IAI has supported a transdisciplinary research agenda on climate variability and climate change to propose adaptation and mitigation actions in different socio-economic and environmental sectors to improve the well-being of the Americas
Human health and wellbeing	Through interdisciplinary and transdisciplinary research, the IAI has informed policy and decision making resulting in fewer health crises and chronic diseases.
Biodiversity and ecosystem services	The IAI produced, and translated to decision-makers, high-quality science that integrates biodiversity and ecosystem services (BES) conservation, restoration, and sustainable use of resources, as a means to mitigate climate change impacts in the region
Clean air, water, and soil	The IAI has supported science-to-policy knowledge and tools on global and regional pollution issues to help inform Parties policies
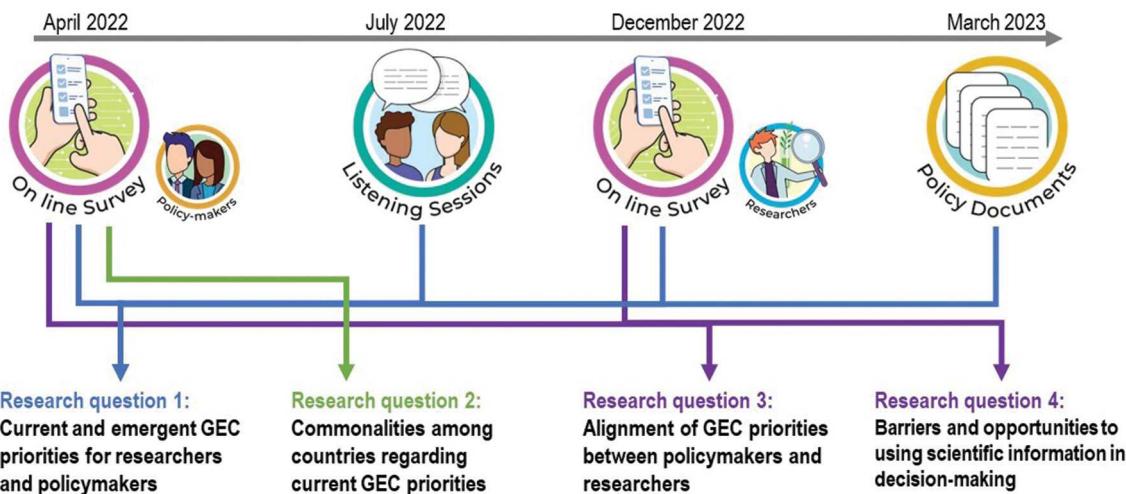
Figure 1. Overview of the methodological approach used to assess policymakers' and researchers' GEC policy priorities, as well as barriers and opportunities to using scientific information in decision-making, across 17 countries in the Americas. Arrows indicate how the information sources collected between April 2022 and March 2023 (upper row) were integrated to answer the four research questions addressed in the assessment (lower row).

mittees that lead the design and implementation of the assessment. We addressed the following questions: What are the current and emergent policy priorities related to GEC in the Americas? (RQ1), Which commonalities exist among countries regarding policy priorities related to GEC? (RQ2), How aligned are policy-makers and researchers regarding policy priorities related to GEC? (RQ3), and What are the barriers and opportunities to using scientific information in decision-making? (RQ4).

2. Methods

2.1. Overview of the methodological approach

We designed and implemented a methodological approach that combines multiple techniques and diverse information sources to produce a comprehensive picture of GEC policy priorities from the Americas. To capture the diversity of GEC policy priorities, we used the eight goals related to GEC contained in the IAI strategic plan (Table 1, henceforth 'GEC goals'), which are (i) Poverty and equality, (ii) Food security, (iii) Water security, (iv) Energy security, (v) Climate action, (vi) Human health and wellbeing, (vii) Biodiversity and ecosystem services, (viii) Clean air, water, and soil. To answer research questions 1, 2, and 3, we measured the relative importance that policymakers and researchers from 17 IAI-member countries assign to each of these eight GEC goals.

To capture current GEC priorities of policymakers we integrated data obtained through three different methods: online surveys, sub-regional listening sessions, and analysis of policy documents (Figure 1). Capturing the decision to prioritize one GEC goal over another

with a single methodological technique and metric would have been biased for at least two main reasons. First, policy prioritization is a decision influenced by various factors, such as the country's geopolitical position, socioeconomic status, and the ruling party. Second, communicating country's priorities depends on who speaks on behalf of the country (e.g. the president or technical staff) and in which context such declarations are made (e.g. electoral vs. non-electoral year). Ideally, we would have asked a representative sample of government officials across several years to get a robust measure of 'official' country policy priorities. However, government staff is often large and heterogeneous, and some countries in Latin America are characterized by presidential instability and frequent cabinet reshuffles leading to high staff turnover, making such methodological option unfeasible.

We found the best trade-off between the highly biased and the unfeasible options to capture GEC priorities of policymakers by i) integrating data of different types (i.e. qualitative and quantitative) and from different sources (i.e. primary and secondary) and ii) involving policymakers acting as focal points of their countries at the IAI both in deliberative (i.e. listening sessions) and non-deliberative (i.e. online surveys) processes of consultation, asking them to provide a representative view of their country's GEC priorities. Data integration also allowed for estimating how consistent 'official' priorities are within a national government by measuring the level of (dis)agreement between the different information sources. In this way, we obtained a measure of the importance that policymakers of a country assign to a GEC goal by combining three metrics (Appendix A): i) the ranking of GEC goals declared by IAI focal points

(henceforth 'policymakers') in online surveys delivered in April 2022 (i.e. primary quantitative data), (ii) the number of mentions to each GEC goal by government officials in sub-regional listening sessions held in July 2022 (i.e. primary qualitative data), and (iii) the relative importance given by national environmental policies to each GEC goal, measured through content analysis of policy documents retrieved in March 2023 (i.e. secondary qualitative data).

To capture current and emergent GEC priorities of researchers we delivered the same online survey sent to IAI focal points to a sample of researchers from IAI-member countries in December 2022 (Figure 1). To minimize bias, we selected seven to nine researchers per country, aiming for a balance between gender, age, and research focus (e.g. social, natural and inter/transdisciplinary). The sample of researchers included principal and co-principal investigators of past and present IAI-funded projects, members of IAI advisory committees, and researchers otherwise linked to the IAI community. We drew our sample from this population due to the availability of databases containing information (e.g. disciplinary orientation, contact information) allowing us to survey a balanced sample of researchers from the Americas.

The consistency of policy priorities within a country´s research community was estimated by calculating the level of (dis)agreement among the rankings declared by the subset of researchers of the same country. Delivering the same survey to policymakers and researchers allowed for assessing the level of alignment around current and emergent policy priorities between these two social actors (RQ3) and also comparing the barriers and opportunities to using scientific information in decision-making identified by them (RQ4).

2.2. Data collection

2.2.1. Online survey
We sent the online survey to i) the focal points of 17 out of the 19 IAI-member countries (Cuba and Venezuela are IAI-member countries but haven´t designated a focal point), and ii) a sample of selected researchers from these 17 IAI-member countries. The survey questionnaire (Appendix B) consisted of 16 items, of which 13 were close-ended and 3 open-ended questions, contained in four sections: (i) characteristics of the respondent, (ii) a ranking of the eight GEC goals to assess current and emergent priorities of the respondent´s country related to global environmental change, (iii) policy decisions of the respondent´s country related to GEC priorities identified in (ii), and (iv) barriers and opportunities to using scientific information in decision-making.

2.2.2. Sub-regional listening sessions
For this assessment, we convened four listening sessions to obtain more in-depth insights into national and sub-regional policy priorities related to GEC for the Americas. We grouped 17 IAI-member countries into the following four sub-regions: (i) Southern Cone: Argentina, Brazil, Uruguay, Paraguay, and Chile; (ii) Andes: Bolivia, Peru, Ecuador, and Colombia; (iii) Central America and the Caribbean: Panama, Costa Rica, Guatemala, Jamaica and the Dominican Republic; and (iv) North America: Mexico, United States and Canada. We invited IAI focal points, members of IAI advisory committees, and other government officials from these 17 IAI-member countries to deliberate with their sub-regional peers around the following questions: (i) what are the priority decisions and policies related to environmental change in your country and your sub-region? (ii) what transboundary issues related to environmental change are priorities for your country and your sub-region? and (iii) how can we work together to overcome the barriers to using scientific information to inform decision-making in your country and your sub-region? Between six and eleven participants deliberated around these questions in each of the four 90-minute online sessions held in July 2022. Each of the 17 IAI-member countries participating in the assessment had at least one policymaker in the corresponding sub-regional session. When more than one policymaker participated per country (88% of the cases), opinions were mostly complementary rather than contradictory, and conflicting agendas were not apparent. A trained researcher from the IAI Directorate (i.e. the first author) facilitated the deliberations, recorded the listening sessions, and transcribed them based on the recordings. We analyzed the content of transcriptions using NVivo 12 (QSR International Pty Ltd 2018) to identify references to GEC goals during the listening sessions. Based on this, we tabulated the number of times each GEC goal was mentioned by each policymaker participating in the listening session.

2.2.3. Analysis of policy documents
We searched for documents describing current policies and decisions related to GEC for the 17 IAI-member countries, mainly national environmental legislation being enforced. We used country names (e.g. 'Panama') and keywords from the eight GEC goals (e.g. 'soil', 'biodiversity', 'health') in each country´s official language as search terms in Google Search. We retrieved 88 relevant and accessible environmental policy documents (five documents per country on average). We analyzed the whole content of these documents, paying special attention to the sections describing the objectives of the policy. As

each policy focuses on multiple GEC goals, we identified and ranked the three GEC goals given the highest priority by each policy. Most policies focused on the synergies rather than on the antagonisms among multiple GEC goals. We considered that a GEC goal was a policy priority when the policy established regulations, sanctions or incentives to advance such goal. Therefore, if a GEC goal was mentioned but not advanced, it was not considered a policy priority. For example, using the search terms 'Argentina' and 'biodiversidad' (biodiversity), we retrieved the National Forest Protection Act (*Ley 26.331 de Presupuestos Mínimos de Protección Ambiental de los Bosques Nativos*), whose objective is to '*promote the enrichment, restoration, conservation, and sustainable use of native forests, and the ecosystem services that these supply to society*' in a context of '*increasing deforestation rates driven by agricultural expansion*'. Thus, for this specific policy, Biodiversity and Ecosystem Services was considered the most relevant GEC goal, while Food Security was not considered a priority goal.

2.3. Data analysis

To answer RQ1, we employed three methods to integrate three complementary sources of information (Appendix A). First, each country's researchers and policymakers identified and ranked their countries' three top-priority GEC goals in online surveys. Second, we analyzed the content of listening sessions to identify and rank the three top-priority GEC goals mentioned by policymakers of each country. Third, we analyzed the content of policy documents to identify and rank the three GEC goals given the highest priority by the environmental legislation of each country. Then, we converted the rankings and number of mentions into ordinal scores to integrate and standardize data from the different sources using a 3-point scale. We averaged scores for those data sources where we had multiple samples (surveys to researchers and policy documents). We built a matrix of GEC goals x countries for each data source and averaged the scores matrices of the three data sources used to assess policymakers´ priorities.

To measure the level of agreement among the three information sources used to assess policymakers´ priorities, we calculated the standard deviation among the three independent scores for each country and GEC goal. In this way, (i) the higher the average across scores, the higher the importance of a GEC goal for a country, and (ii) the lower the deviation among scores, the higher the agreement among information sources used to measure such importance. Finally, we constructed balloon plots in R (R Core Team 2023) to visualize and compare policy priorities among countries,

where the size of the balloon indicates the importance given by each country to each GEC goal, and its color indicates its level of agreement.

To answer RQ2, we clustered the 17 IAI-member countries based on the similarities of their top three GEC goals (current) identified by policymakers in the online survey (section 2.2.1). We did this using a likelihood-based measure that models distances between categorical variables, including binary variables. We ran this two-step cluster procedure in the base module in SPSS 26 (IBM Corp, 2021). We also tested the association between the resulting clusters and socio-economic classifications of countries (e.g. World Bank´s income level classes) using Chi-square tests.

To answer RQ3, we analyzed the similarities between the GEC priorities (current and emergent) of policymakers and researchers for each country. We calculated the Jaccard similarity index for each pair of policymakers and researchers of the same country, which were then averaged to obtain a country-level similarity measure. The Jaccard similarity index ranges from 0 to 1, with values close to 0 indicating low similarity and values close to 1 indicating high similarity.

To answer RQ4, we plotted the frequencies of each barrier and opportunity to using scientific information in decision-making identified by policy-makers and researchers. We ran this frequency analysis for the barriers and opportunities identified by policymakers ($n = 17$) and researchers ($n = 65$) in the online survey (section 2.2.1).

3. Results

Seventeen focal points completed the survey (100% response rate), while 65 out of 136 researchers completed it (48% response rate). The sample was balanced in terms of nationality, gender, and disciplinary affinity. A minimum of three and a maximum of five researchers participated per country. Fifty-eight percent of respondents were male and 42% were female. Eight focal points worked in government offices related to the environmental sector, while seven worked in science and technology offices. Two-thirds of researchers focused on transdisciplinary and interdisciplinary sciences, 21% of them had a major focus on the social sciences and 12% on the natural sciences.

3.1. Current and emergent priorities across countries and actors

For policymakers, 'Climate action' was the current GEC goal with higher average importance across countries, followed by 'Biodiversity and ecosystem services' (Figure 2). These top two priorities were more than twice as important, on average, as the third one, which was 'Water security'. The high priority assigned to
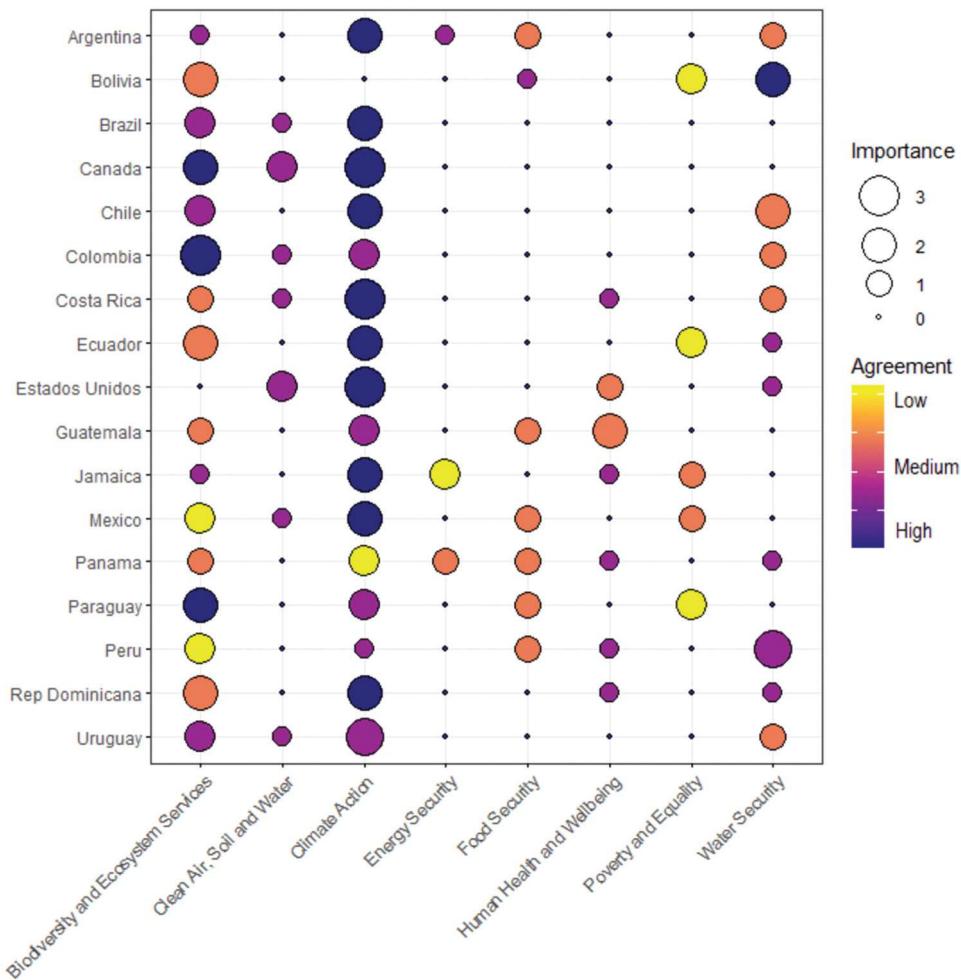
Figure 2. Balloon plot showing current global environmental change policy priorities per country as identified by policymakers.

'Climate action' is consistent across the three sources of information (high agreement, high priority). The goal 'Biodiversity and ecosystem services' was identified as a high priority by many countries; however, there was less agreement about the importance of this goal (medium agreement, high priority). Certain shared priorities emerged at the sub-regional level. The goal 'Water security' was a high priority for the countries with the largest share of Arid Andes (Chile, Bolivia, and Peru), while the goal 'Clean air, water, and soils' was a priority for North America (the United States and Canada).

For researchers, 'Biodiversity and ecosystem services' and 'Water security' were the current GEC goals with higher average importance across countries (Figure 3). Unlike policymakers, policy priorities identified by researchers were more distributed across GEC goals. Similar to policymakers, researchers from countries with a large share of Arid Andes (Argentina, Chile, and Bolivia) agreed about the prioritization of 'Water security'. Researchers from highly biodiverse countries (Bolivia, Ecuador, and Colombia) agreed about the prioritization of Biodiversity and Ecosystem Services.

Regarding emergent priorities, policymakers and researchers agreed on the importance of most GEC goals (Figure 4). The exceptions to this pattern were

(i) the goal 'Poverty and equality' was the top emerging priority for researchers, who assigned twice more importance to this GEC goal compared to policy-makers, (ii) 'Health and wellbeing' was the top emerging priority for policy-makers, who assigned 60% more importance to this GEC goal compared to researchers, and (iii) 'Climate action', the lowest emerging priority for researchers and policy-makers, but three times more important for the former compared to the latter.

3.2. Country groupings based on common priorities

Clustering countries based on shared current policy priorities yielded three groups. The clustering quality was good, as the average silhouette coefficient value was close to 0.5. Cluster I (green, Figure 5) encompassed seven countries having the following shared current priorities: Food security, Energy Security, and Climate action. Argentina, Peru, Panama, Mexico, Paraguay, Guatemala, and Jamaica belong to this cluster. Cluster II (red, Figure 5) encompassed six countries having Climate action, Clean air, water and soil, and Biodiversity and ecosystem services as the most frequently shared
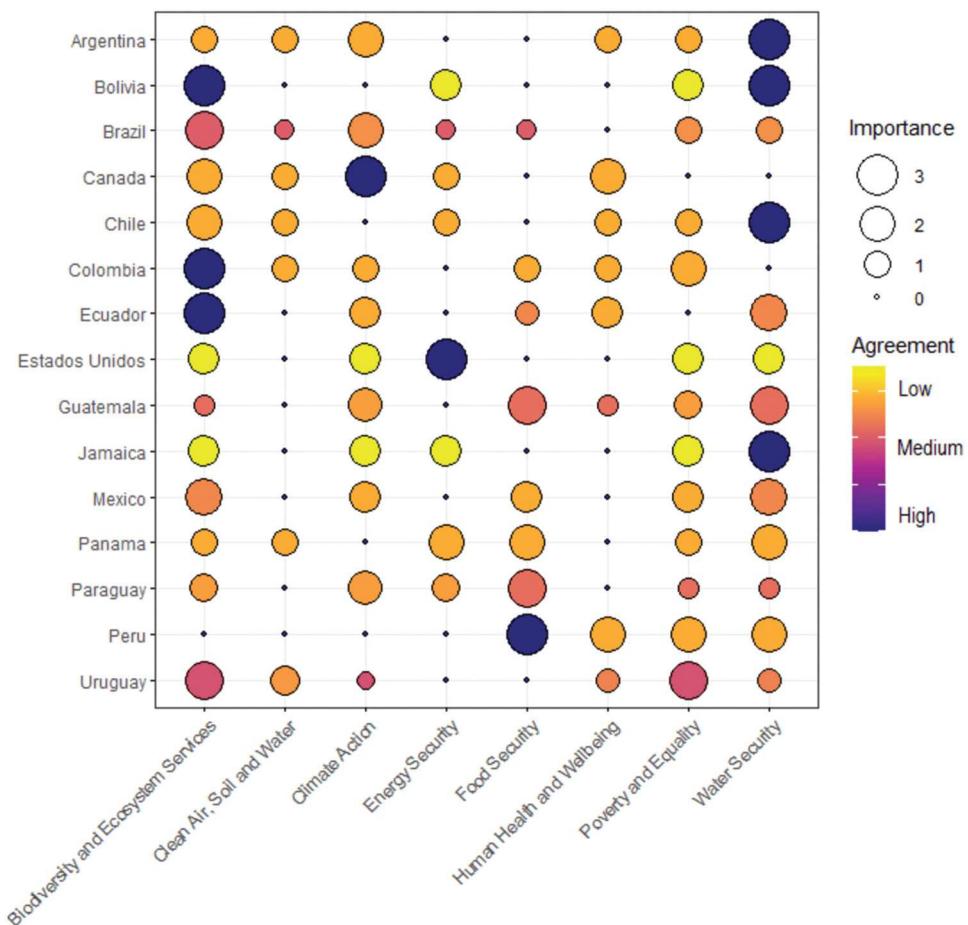
Figure 3. Balloon plot showing current global environmental change policy priorities per country as identified by researchers.
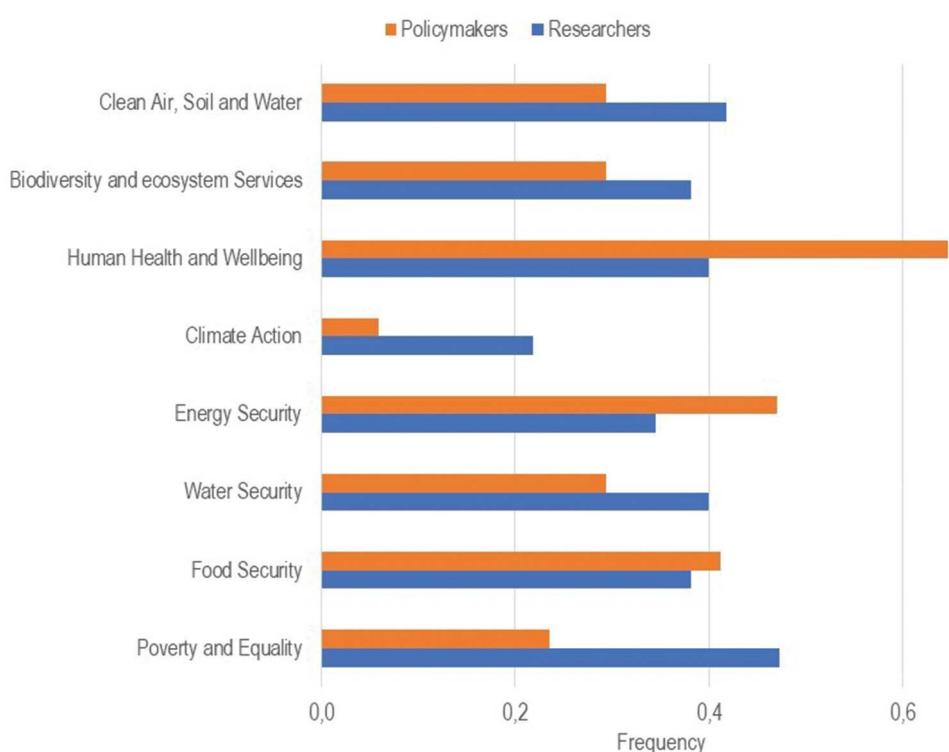

Figure 4. Bar plot comparing emerging global environmental change policy priorities as identified by policymakers and researchers.
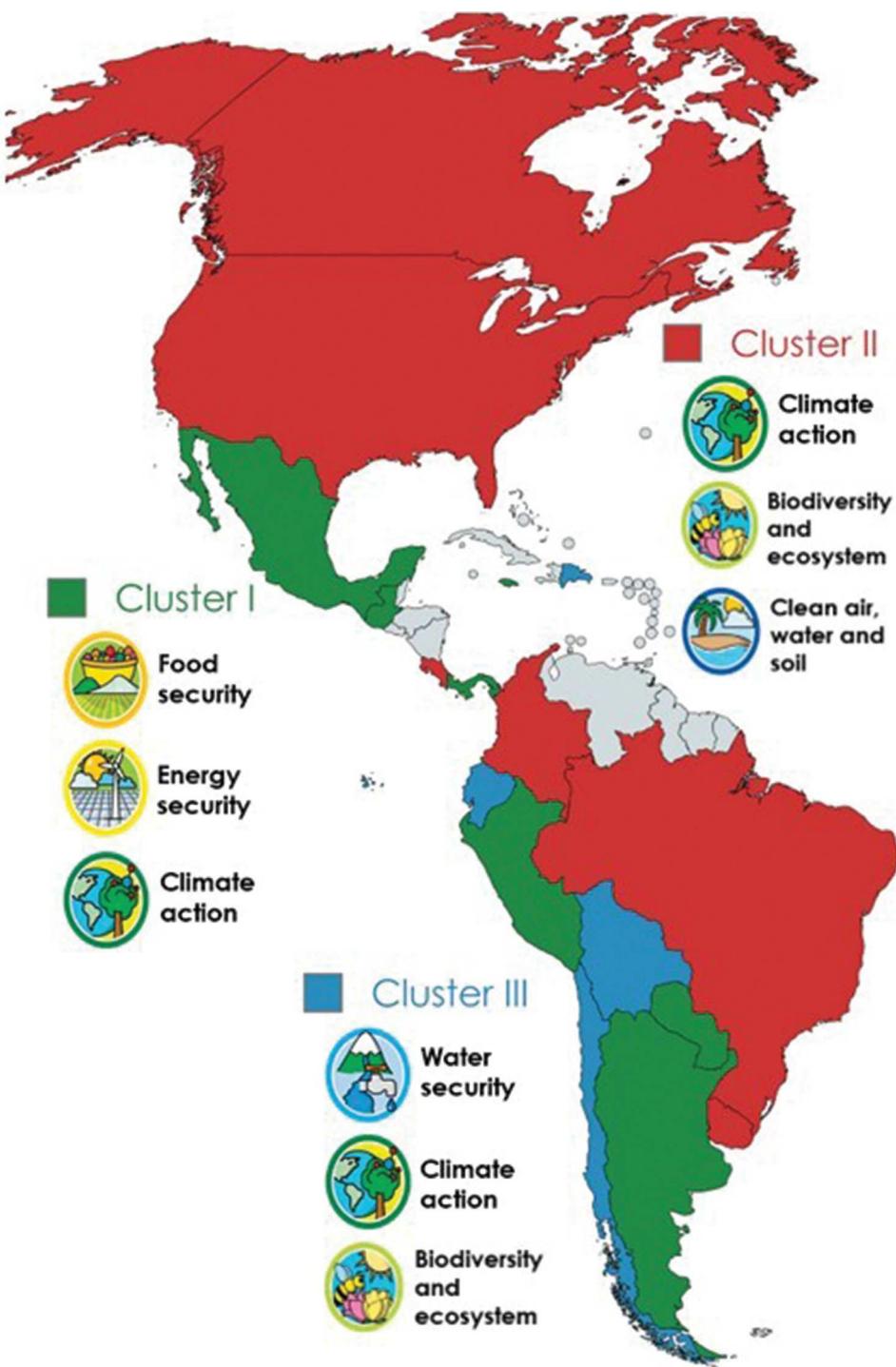
Figure 5. Clusters of IAI-member countries sharing current global environmental change policy priorities. Countries in grey did not participate in the assessment either because they have not designated a focal point (Cuba and Venezuela) or are not IAI-member countries.

priorities. Canada, the United States, Costa Rica, Colombia, Brazil, and Uruguay belong to this cluster. Finally, cluster III (blue, Figure 5) encompassed four countries having Biodiversity and ecosystem services, Climate action, and Water security as the most frequently shared priorities. Bolivia, Ecuador, Chile, and the Dominican Republic belong to this cluster.

There was a significant association between countries´ membership to the above-described clusters

and to the income classes defined by the World Bank ($X^2 = 9.65$, $p = 0.02$). Six out of seven countries belonging to Cluster I are middle-income countries. All countries belonging to Cluster II are either high-income ($n = 3$) or middle-income countries ($n = 3$). In turn, only half of the countries belonging to Cluster are middle- or high-income countries ($n = 2$).

Although the three clusters are composed mainly by non-neighboring countries, some sub-regional

Table 2. Similarities between policymakers and researchers regarding policy priorities for each country. The Jaccard similarity index ranges from 0 to 1, with values close to 0 indicating low similarity and values close to 1 indicating high similarity.

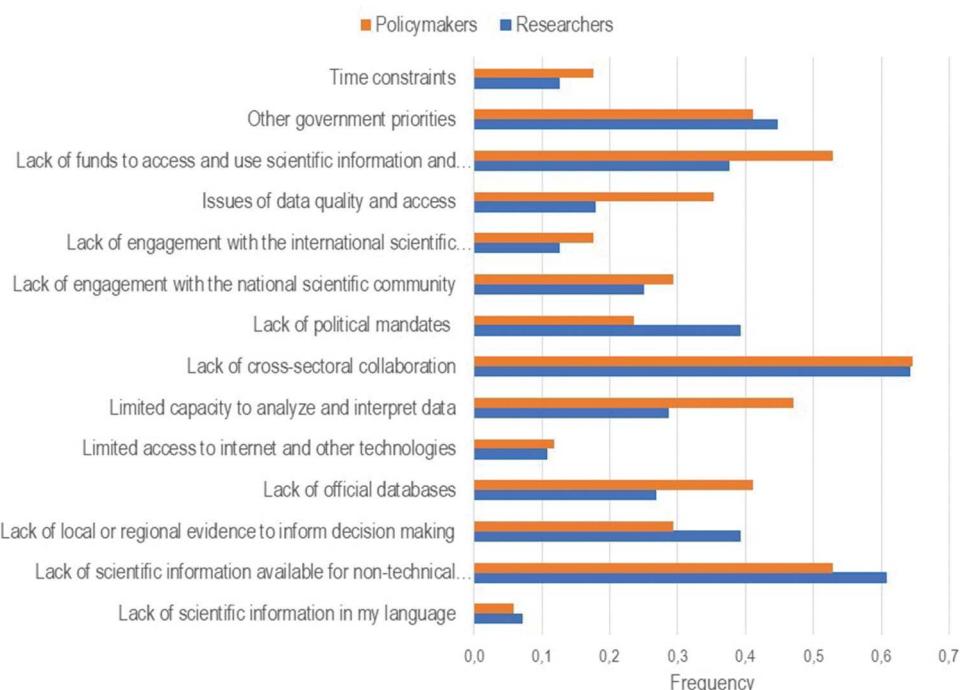| Country	Similarity between researchers and policymakers in current priorities (mean ± standard deviation)	Similarity between researchers and policymakers in emergent priorities (mean ± standard deviation)
Argentina	0,13 ± 0,11	0,20 ± 0,01
Brazil	0,50 ± 0,20	0,05 ± 0,13
Canada	0,42 ± 0,43	0,16 ± 0,19
Chile	0,40 ± 0,17	0,25 ± 0
Colombia	0,40 ± 0,17	0,06 ± 0,11
Ecuador	0,35 ± 0,17	0,42 ± 0,15
Guatemala	0,38 ± 0,16	0,30 ± 0,27
Jamaica	0,35 ± 0,21	0,35 ± 0,21
Mexico	0,35 ± 0,17	0,22 ± 0,20
Panama	0,56 ± 0,40	0,4 ± 0,17
Paraguay	0,18 ± 0,11	0,38 ± 0,16
Peru	0,66 ± 0,28	0,5 ± 0
United States	0,10 ± 0,14	0,10 ± 0,14
Uruguay	0,28 ± 0,13	0,22 ± 0,20

Figure 6. Barriers to using scientific information in decision-making for policymakers and researchers from survey responses.

clusters emerged. Some examples are i) two North American countries (Canada and the United States) shared Climate Action as their top GEC-related policy priority, ii) three Andean countries (Chile, Bolivia and Peru) shared Water Security as their top priority, and iii) two Southern Cone countries (Argentina and Paraguay) shared Food Security as their top priority.

3.3. Alignment between policymakers and researchers

The level of alignment between policymakers and researchers regarding current and emergent policy priorities varied widely among countries. For Panama and Peru, for instance, policymakers and researchers prioritized GEC goals in a very similar way, both for current and emergent priorities

(Table 2). Researchers and policymakers of countries such as Brazil and Canada coincided in selecting Climate action and Biodiversity and ecosystem services as current priorities but differed in their countries' emergent priorities. Finally, focal points and researchers countries such as Argentina and the United States differed substantially regarding their countries' current and emergent priorities.

3.4. Opportunities and barriers at the science-policy interface

With respect to the barriers to using scientific information in decision-making, policymakers and researchers coincided in highlighting the lack of inter-sectoral collaboration, the lack of scientific information available for non-technical audiences, and the presence of
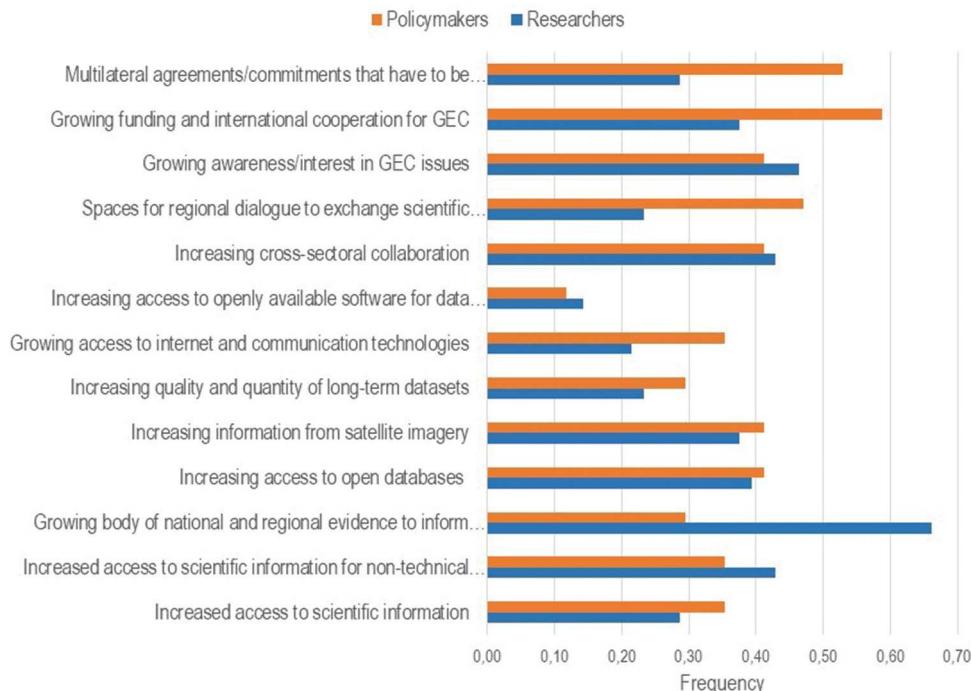
Figure 7. Opportunities to use scientific information in decision-making for policymakers and researchers from survey responses.

Table 3. Actions implemented by the IAI to overcome the barriers and seize the opportunities identified by policymakers and researchers from the Americas.

Barriers and opportunities to using scientific information in decision-making	Actions implemented by the IAI
Barriers shared by researchers and policy-makers	
Lack of cross-sectoral collaboration	Organization of regional workshops to bring together diverse sector leaders on topics like early warning systems. Training of early career scientists in science diplomacy
Lack of communication between technical and non-technical actors	Training in science communication; training and financial support for transdisciplinary networks that bring together technical and nontechnical actors in projects to address critical global change issues.
Opportunities identified by policy-makers	
Multilateral agreements/commitments and spaces for regional/transboundary dialogue	Strategic engagement in multi-lateral agreements and regional conventions aligned with top priorities (e.g. United Nations Framework Convention on Climate Change, Convention on Biological Diversity, among others). Launching of a regional science diplomacy center, with training for policy makers and scientists.
Growing funding and international cooperation	Involvement in funding transdisciplinary research funding calls on priority topics identified by this regional assessment, such as Collaborative Research Actions of Belmont Forum.
Opportunities identified by researchers	
Growing body of evidence to inform decision-making	Provide information and encourage IAI Parties to nominate experts in inter-governmental platforms such as IPCC and IPBES to increase regional representation; communications efforts to bring key findings to a non-technical and multilingual audience (e.g. policy briefs, webinars).

other governmental priorities (Figure 6). Researchers identified the lack of political mandates and the lack of local or regional evidence to inform decision-making more frequently than policymakers. Unlike researchers, policy-makers highlighted the limited capacity to analyze and interpret data and the lack of official databases as barriers.

With respect to the opportunities to using scientific information, researchers frequently identified the growing body of national and international evidence to inform decision-making (Figure 7). In turn, policy-makers identified international funding and cooperation and the presence of multi-lateral agreements and

spaces for transboundary dialogues more frequently as opportunities for using scientific information in decision-making, compared to researchers.

The IAI is implementing multiple actions to overcome the barriers and seize the opportunities to using scientific information in decision-making shared by policymakers and researchers from the Americas (Table 3).

4. Discussion

A critical step toward bridging the science-policy gap around GEC involves aligning the priorities of researchers and policy-makers to promote the

appropriate use of scientific information and tools to inform decision-making in governments (Wagner et al. 2023). At the same time, addressing global environmental changes requires effective science-policy collaboration beyond national boundaries so that policy actions match the scale of GEC challenges (Cumming et al. 2006). A large diversity of GEC priorities exists in such a vast region as the Americas due to particular GEC challenges determined by countries' histories, geographies, and economies and also due to dissimilar perceptions and values of social actors involved in GEC research and policy. The IAI assessed such diversity of GEC priorities at the regional scale while disaggregating for country-level and actor-level factors. This helped uncover challenges and opportunities to close the science-policy gap and foster multi-country collaboration around GEC in the Americas.

Three key findings relevant to science-policy regional planning emerged from our assessment. First, Climate action was the top current priority for policymakers and Biodiversity and ecosystem services for researchers at the regional level. We observed a generally poor alignment between the priorities of policymakers and researchers at the country level, especially regarding emergent GEC issues. Second, we observed that clusters of non-neighboring countries had a profile of GEC priorities more similar than clusters of neighboring countries. However, we also identified some sub-regional clusters around particular GEC goals. Third, the key barriers to using scientific information in decision-making agreed upon by researchers and policymakers were the lack of cross-sectoral collaboration and communication between technical and non-technical actors. A key opportunity for policymakers was the growing funding and international cooperation for GEC, while for researchers, it was the growing body of evidence to inform GEC decision-making.

The poor alignment between the GEC priorities of policy-makers and researchers of the same country might be explained by dissimilar influences, interests, and dynamics between these social actors (Weyland et al. 2019). For policy-makers, the formation of priorities may be driven by 'top-down' factors, such as international and national commitments (e.g. nationally determined contributions for climate change, UN Sustainable Development Goals), or by 'bottom-up' factors, such as local pressure to solve social-environmental conflicts (Fuso Nerini et al. 2019). While these factors may also influence researchers who are responsive to policy issues, researchers´ priorities are more often driven by the incentive structure prevalent in academia, which rewards standard academic outputs and promotes hierarchical project organization (Weyland and Von Below 2021). Objectives

and timeframes often differ substantially between these social actors, influencing how their priorities are formed. While policy-makers generally require information to solve practical problems in the short term, most researchers are focused on collecting and analyzing data to advance knowledge in the long term (Choi et al. 2005). For this reason, bringing policy-makers and researchers to work together and learn from each other in shared projects and dialogic networks can help align their priorities and reduce the science-policy gap (Broström and McKelvey 2018; Lutz-Ley et al. 2021).

When we analyzed countries that shared GEC priorities, we found that there were similarities among neighboring and non-neighboring countries. This suggests that the factors influencing the formation of GEC priorities at the country level are multiple and can seldom be reduced to geographic proximity. The size of the country, its population, and its economy strongly determine the relationships between people and the environment and, consequently, the prioritization of GEC issues. In large countries of middle and high income levels, such as Canada, Brazil, and the United States belonging to cluster II, industrial agriculture and forestry are major economic activities bringing large economic gains at the cost of environmental pollution (Smith et al. 2016). Accordingly, the goal 'Clean air, water, and soil' was a priority GEC goal for these countries. For this reason, fostering multi-country science-policy collaboration at the continental and transcontinental levels is important to address environmental problems that transcend national and sub-regional boundaries.

There were strengths and limitations to our methodological approach to assessing GEC priorities across countries and social actors in the Americas. One of the main drawbacks of policy prioritization studies is that they often rely on a single method and source of information, that is, structured surveys delivered remotely using directories of government officials and/or researchers (e.g. Rudd and Fleishman 2014). Our assessment model overcomes this limitation by integrating data obtained from multiple methods (i.e. quantitative and qualitative) and sources (i.e. primary and secondary) (Posner and Cvitanovic 2019), which allows for measuring and communicating a level of confidence indicated by the agreement among information sources. The community of researchers from which we drew our sample is balanced in terms of nationality, gender, and disciplinary orientation due to efforts of the IAI Directorate to implement the principles of equity, diversity, and inclusion in the selection of projects and researchers. However, the extent to which the IAI community of researchers is representative of the larger community of researchers from the Americas is unknown, and our sample is probably biased.

Expectedly, a larger sample size of policymakers and researchers participating in surveys and listening sessions would have reduced potential biases associated with the sectoral affiliation of policymakers (e.g. science, environment, international relations, etc.) and disciplinary orientation of researchers (e.g. social sciences, natural sciences, interdisciplinary). Future iterations of the regional assessment should target larger sample sizes and/or assess the influence of sectoral affiliation and disciplinary orientation on responses to survey questions and opinions in listening sessions. Also, other social actors from civil society and the private sector should be included in future assessments.

4.1. Towards bridging the science-policy gap in the Americas

The barriers and opportunities to using scientific information in decision-making identified in this assessment highlight key action areas and strategies for intergovernmental organizations working at the science-policy interface (Table 3). Science diplomacy emerges as a pivotal strategy to foster collaboration across sectors and to seize the growing interest in international cooperation. In the Americas, diverse initiatives aiming at strengthening the role of science in regional cooperation are emerging under the umbrella of science diplomacy. Including science professionals in ministries, exposing government officials to science and technology, training scientists to communicate with policymakers, and creating institutions and professions in this matter are some science diplomacy actions occurring in the region (Soler 2021). Notably, the IAI created a regional Science Diplomacy Center and is implementing the Science, Technology, Policy Fellowship (STeP) program, which has trained 66 early-career professionals from 14 countries of the Americas to become brokers of knowledge across sectors in their home countries and across countries in the region. Integrating these science diplomacy agents into regional networks of ministries, research agencies, universities, and diplomat academies is a promising avenue for advancing an articulated regional agenda for science and policy around GEC (Soler 2021). Creating incentives for the development and practice of transdisciplinary science is also essential for overcoming the barriers and seizing the opportunities to use scientific information in decision-making. The active collaboration between researchers and policymakers from the early stages of transdisciplinary projects and networks fosters alignment of priorities and effective communication between these social actors (Lemos and Morehouse 2005; Huggel et al. 2015; Jacobi et al. 2022). Integrating values and knowledge from diverse social actors through co-production is essential for making decisions under the uncertain conditions posed by GEC (Dilling and Lemos 2011; Moallemi et al. 2023). The IAI

promotes transdisciplinary and co-production approaches in several ways. First, the institute funds transdisciplinary research through, for instance, the Collaborative Research Actions of the Belmont Forum. These funding calls are targeted to regional priority topics identified by policymakers, such as the nexus between climate, environment, and health. Second, the institute trains researchers in science communication to increase their capacities to bring policy-relevant scientific knowledge to non-technical audiences. Third, the institute brings key findings from scientific assessments (e.g. those from IPBES and IPCC) to multi-lingual audiences through policy briefs, webinars, and other communication materials. By advancing these multi-directional interactions, the IAI spans the boundaries between science and policy, providing governments with the scientific information needed to prioritize and address GEC issues.

The impact of IAI activities on GEC-related policies of IAI-member countries is influenced by various factors. On the one hand, the knowledge and skills produced by IAI activities have mostly influenced the initial and final stages of the policy cycle, with limited impact on policy formulation, adoption, and implementation. Scientific outputs of IAI-funded research have positively impacted on the identification and definition of policy priority issues, the evidence-building phase that informs and shapes policy thinking, and the final stages of policy monitoring and evaluation (Ehlers et al. 2021). On the other hand, virtuous interactions between science and policy require strong institutions, that is, informal and formal rules and procedures that are effectively enforced in practice and stable over time (Levitsky and Murillo 2009). Institutional strength is highly variable across the Americas, with low levels of policy enforcement and high political instability often limiting the formation of durable science-policy interfaces (Weyland et al. 2019). The IAI is taking steps to overcome these limitations by, for instance, training early-career researchers to become knowledge brokers with the capacity to meaningfully incorporate scientific inputs into the formulation, adoption, and implementation of GEC-related policies.

In light of the growing severity of GEC challenges and the limited capacity of national governments and regional intergovernmental organizations to address them in isolation, assessments of GEC policy priorities become essential to matching scientific knowledge demand and supply and foster regional cooperation (Sarkki et al. 2021). With the appropriate information and tools, governments and regional intergovernmental organizations can make more informed resource allocation decisions and implement more cost-effective actions to respond to GEC challenges (Iltis et al. 2017). Through this assessment, the IAI continues spanning the boundaries

between science and policy in the Americas by identifying current and emerging GEC priorities in policy decision-making to foster the alignment with scientific research efforts (Bednarek et al. 2018; Posner and Cvitanovic 2019). Implementations of this assessment at regular intervals will be critical to keep track of evolving policy priorities and science-policy interactions.

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Appendix A.

Workflow of the methodological stages of data collection, processing, and visualization to answer research question 1. For data collection (upper row), we used three complementary sources of information. First, researchers and policymakers of each country identified and ranked the three top-priority GEC goals of their countries in online surveys. Second, we analyzed the content of listening sessions to identify and rank the three top-priority GEC goals mentioned by policymakers of each country. Third, we analyzed the content of policy documents to identify and rank the three GEC goals given the highest priority by the environmental legislation of each country. For data processing (middle row), we converted the rankings and number of mentions into ordinal scores to standardize data from the different sources using a 3-point scale. We averaged scores for those data sources where we had multiple samples (surveys to researchers and policy documents). We built a matrix of GEC goals x countries for each data source and averaged the scores matrices of the three data sources used to assess policymakers´ priorities. Finally, we converted the scores matrices describing researchers´ and policymakers´ priorities into balloon plots for data visualization (lower row). Notes: the figure shows the flow of data from collection to visualization using arbitrary values for the priorities of Ecuadorian researchers and policymakers as an example. Only 6 of the 17 countries involved in the assessment are shown for illustrative purposes.
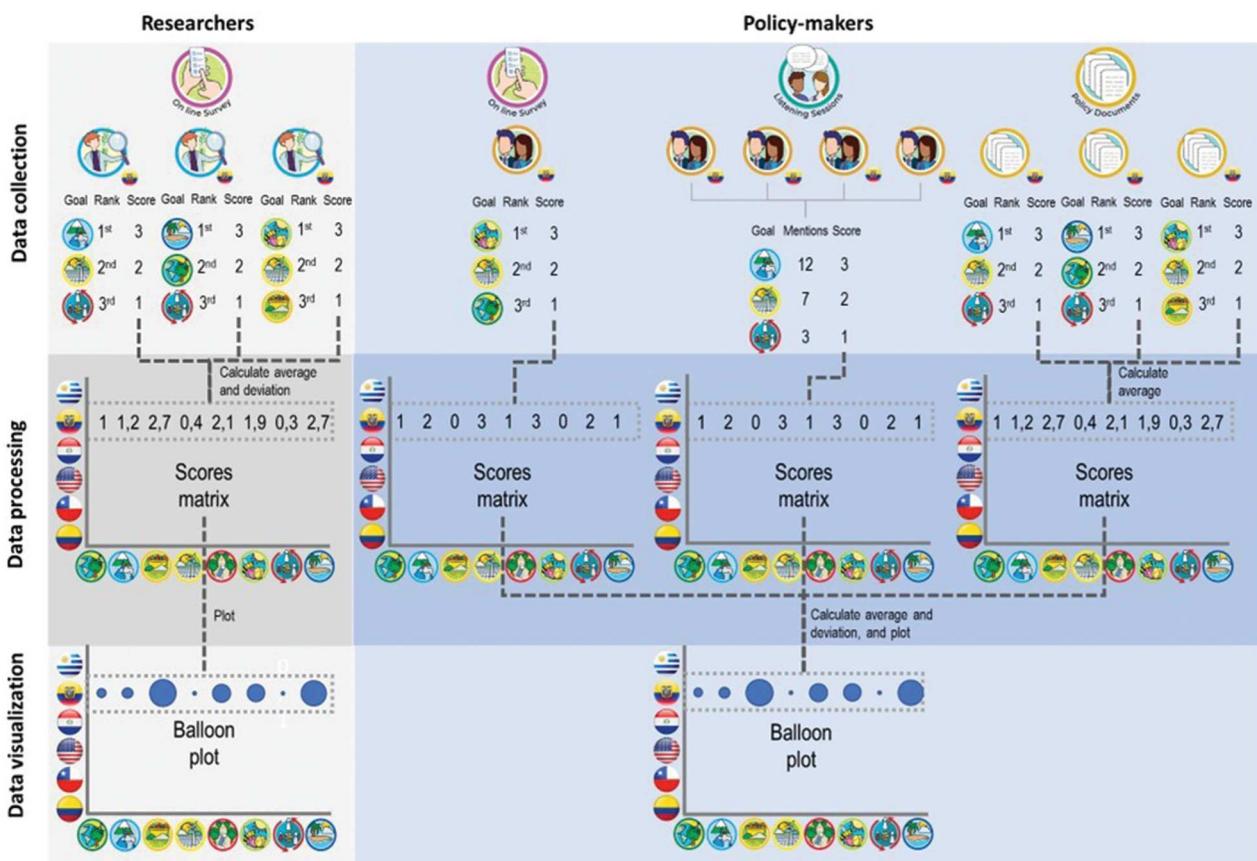
Appendix B. Questionnaire

(1) -Please indicate that you 1) understand to your satisfaction the information provided to you about your participation in this survey, and 2) agree to participate
- Yes
- No

(2) - What IAI party do you represent?
- Argentina
- Bolivia
- Brazil
- Canada
- Chile
- Colombia
- Costa Rica
- Cuba
- Dominican Republic
- Ecuador
- Guatemala
- Jamaica
- Mexico
- Panama
- Paraguay
- Peru
- United States of America
- Uruguay
- Venezuela.

(3) -How do you describe yourself?
- Male
- Female
- Non- binary/Third gender
- Prefer to self- describe:
- Prefer not to say.

(4) - Please select the type of organization that best describes your ministry, institution, etc.
- Intergovernmental organization
- National Government
- Subnational Government
- Local Government
- Other

(5) - Please tell us what is your main role in your ministry, institution, etc.?
- Decision maker
- Policy maker
- Science advisor
- Scientist
- Technician
- Analyst
- International relations
- Institutional national and local engagement
- Capacity building programs development and management
- Communication
- Indigenous affairs
- Other

(6) - Please tell us the name of your ministry, institution, etc.

(7) - What are the top three current priorities of your ministry, institution, etc., linked to global environmental change? Please rank the top three current priorities in order of importance (*Please note that these science priorities were identified in the IAI's Strategic Plan, adopted by Parties in 2019*)
- Poverty & Equality
- Food security
- Water security
- Energy security
- Climate action

	International/transboundary	National/nationwide	State/Province	Local: County, Municipality or City
Decision or policy 1				
Decision or policy 2				
Decision or policy 3				

- Human health and wellbeing
- Biodiversity and ecosystem services
- Clean air, water, and soil

(8) Are any new emerging priorities linked to global environmental change for your ministry, institution, etc.? Please rank the top three emerging priorities in order of importance. (*Please note that these science priorities were identified in the IAI's Strategic Plan, adopted by Parties in 2019*)

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I consider that Global Environmental Change (GEC) is a top priority in my ministry, institution, etc.					
I have enough information on GEC to understand how decisions and policies are or will be impacted by GEC					
I frequently use scientific information to inform my decisions and actions as they relate to GEC					
I have adequate resources to access necessary scientific information regarding GEC					
Senior leaders in my ministry, institution, etc. consider that GEC is a top priority in the ministry, institution, etc.					
My ministry, institution, etc. has adequate expertise and capacity to evaluate its decisions/policies in light of GEC					
My ministry, institution, etc. has a climate mitigation or adaptation plan, or both					
My ministry, institution, etc. uses the climate mitigation or adaptation plans, or both, to inform policies and decisions					
My ministry, institution, etc. has sufficient financial resources to implement decisions and policies related to GEC					
My ministry, institution, etc. has the institutional framework or mandate to implement decisions and policies related to GEC					

- Poverty and equality
- Food security
- Water security
- Energy security
- Climate action.
- Human health and wellbeing
- Biodiversity and ecosystem services
- Clean air, water, and soil.

(9) Please list 1-3 decision(s) or policy(ies) that your ministry, institution, etc. makes, or would like to make, for the priority area:
  Decision or policy 1Decision or policy 2Decision or policy 3

(10) Please select the scale or location at which each decision or policy listed is, or would be, implemented

(11) - As defined at the IAI science agenda, Global Environmental Change (GEC) refers to the interactions of biological, chemical, physical and social processes that regulate changes in the functioning of the Earth system, including the particular ways in which these changes are influenced by and impact on human activities.

To what extent do you agree or disagree with each of the following statements about Global Environmental Change (GEC)? Please select one answer per row

(12) Please provide an example of how scientific information can be used to improve decision making in your ministry, institutions etc. or the ministries that you work with

(13) In your opinion, what are the top 5 barriers to use scientific information to inform decision/policy making related to global environmental change? Please select up to 5.
- Lack of scientific information in my language
- Lack of scientific information available for non-technical audience
- Lack of local or regional evidence to inform decision making
- Lack of official databases
- Limited access to internet and other technologies
- Limited capacity to analyze and interpret data
- Lack of cross-sectoral collaboration
- Lack of political mandates
- Lack of engagement with the national scientific community
- Lack of engagement with the international scientific community
- Issues of data quality and access
- Lack of funds to access and use scientific information and databases
- Other government priorities
- Time constraints
- Other

(14) In your opinion, what are the top 5 opportunities to use scientific information to inform decision/policy making related to global environmental change? Please select up to 5
- Increased access to scientific information and conferences
- Increased access to scientific information for non-technical audience through social media
- Growing body of national and regional evidence to inform decision making
- Increasing access to open databases
- Information from satellite imagery
- Increasing quality and quantity of long-term datasets gathered by government organizations
- Growing access to internet and communication technologies
- Increasing access to openly available software for data analysis
- Cross-sectoral collaboration
- Spaces for regional dialogue to exchange scientific information on transboundary issues

- Growing awareness/interest in GEC issues
- Funding and international cooperation for GEC
- Multilateral agreements/commitments that have to be addressed like NDCs
- Other

(15) - Which international frameworks or agreements or conventions are a priority for your ministry, institution, etc.?

- Sustainable Development Agreements/Framework: SDGs
- Climate Change Agreement/Frameworks: UN Convention on Climate Change (UNFCCC), Paris Agreement, Conference of Parties, etc.
- Biodiversity Agreements/Frameworks: Convention on Biological Diversity, Ramsar, etc.
- Wildlife Trade Agreements/Frameworks: CITES or other
- Indigenous and Human Rights Agreements/Frameworks: ILO, UNDRIP, Human Rights Declaration, etc.
- Economic Regional Agreements/Frameworks: Mercosur; Mexico, Canada and United States Free Trade Agreement, etc.
- Research and Open data Agreements/Frameworks: IAI, Aguas Calientes Declaration, etc.
- Other

(16) Is there something else you would like to share with us that we haven't asked?