AMR Policy Accelerator

Science Policy Interfaces in Global Environmental Governance:

Policy Lessons and Trade-Offs for Building the Independent Panel on Evidence for Actions against AMR

Draft April 21, 2025

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EXECUTIVE SUMMARY

Most countries are not on track to achieve the new global AMR target –a 10% reduction in AMR associated deaths by 2030– endorsed by the international community at the 2024 United National General Assembly High Level Meeting (UNGA HLM) on AMR. In fact, more than two-thirds of countries have not started implementing their National Action Plan (NAP), indicating that more investment and targeted action will be needed to curb AMR. Countries face difficult policy decisions on AMR. By providing clear guidance on how to best address AMR, countries can ensure they use their resources effectively.

The political declaration of the 2024 UNGA HLM calls for the Quadripartite to establish an **Independent Panel for Evidence on Action against Antimicrobial Resistance (IPEA)** "*to facilitate the generation and use of multisectoral, scientific evidence to support member states in their efforts to tackle AMR*". The creation of a formalized global structure to assess the science that guides policymaking is not new, and many lessons can be drawn from experience in global environmental governance, where scientific panels, or science policy interfaces (SPIs), have been operating for decades.

This report presents evidence on **policy options and trade-offs that decision-makers must consider in the design of IPEA**. It is based on a scoping review of academic and grey literature, including learnings from the realm of environmental governance. The report shows that the effectiveness of SPIs stems from their credibility, relevance, and legitimacy, which in turn depends on the SPIs organizational structure. It describes the key principles — or normative building blocks— that underlie the credibility, relevance, and legitimacy of SPIs, and the impact pathways by which they can be maintained (see Figure 1). Because credibility, relevance, and legitimacy can reinforce or undermine each other, this report also explores the policy trade-offs informing IPEA design elements that emerge from the process of creating and maintaining context-specific principles for effective SPIs.

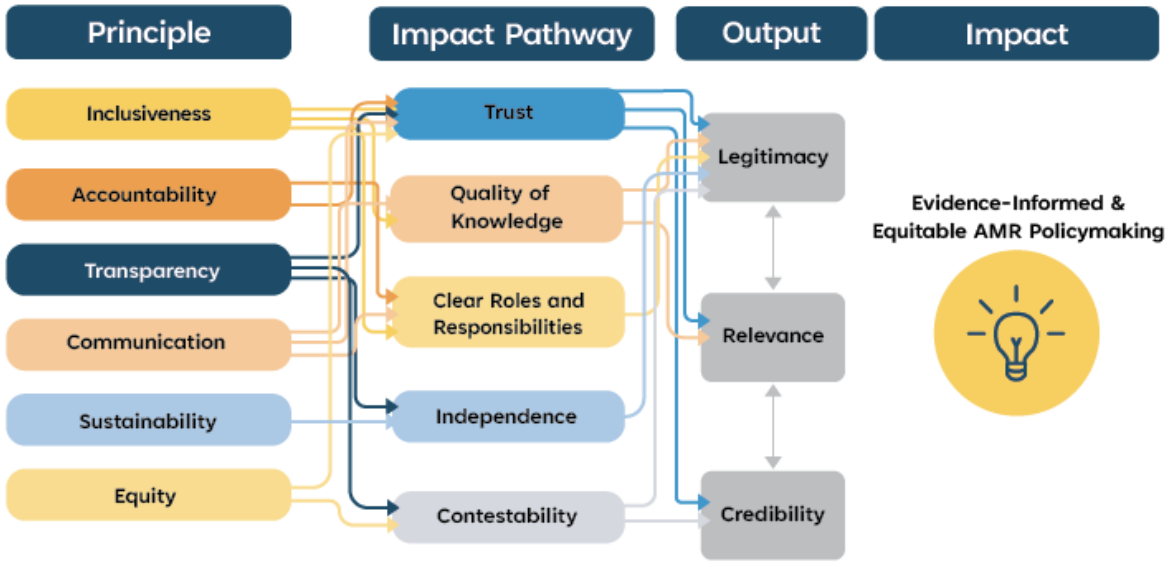
Key Take Aways

Lessons Learned from a Generalizable Conceptual Framework Drawn from Evidence of Environmental SPIs Effectiveness

Legitimacy, Credibility, and Relevance for Effective SPI Operation

Legitimacy is a central determinant of whether SPI findings are accepted, trusted, and acted upon by policymakers, civil society, and the wider public. To be considered effective and to function as a global public good, SPI knowledge products must be perceived as scientifically rigorous, reliable, valid, methodologically sound (credible), driven by policy and societal needs, and applicable in widely different social contexts (relevant). These output qualities are foundational to effective SPIs and depend on the institutional and governance processes in place at SPIs. Without them, SPI-generated knowledge risks being dismissed, mistrusted, or disconnected from real-world policy needs.

Figure 1. Conceptual Framework for SPI Effectiveness



Inclusiveness, Accountability, Transparency, Sustainability, and Equity are Essential Principles

These principles –or normative building blocks– promote the conditions in which a panel such as IPEA can maintain its effective functioning (see Figure 1). Structuring SPIs is inherently a political process which takes place in an evolving global architecture where trade-offs are required. Choosing to emphasize a specific normative building block may undermine another block and ultimately affect the overall legitimacy, credibility, and relevance of a SPIs such as IPEA. For example, credibility requires time-consuming and rigorous knowledge synthesis, while policy relevance demands rapid, policy-responsive, and contextualized recommendations for action. How the Quadripartite choses to calibrate these building blocks when making decisions on IPEA's design elements –setting the mandate, governance structure, external engagement structures, and knowledge products– will influence how effective IPEA becomes and if it benefits the policymaking process for all national governments.

SPIs Must Embed Equity Across Governance, Communication, and Knowledge Synthesis Processes

Equitable representation across all structures of a SPI promotes legitimacy and enhances the credibility and contestability of their scientific knowledge products by integrating diverse knowledge systems, perspectives, and expertise into the policy landscape. Due to the disproportionate impact of AMR in low- and middle-income (LMIC) contexts, and in order to ensure that IPEA's outputs galvanize the resource commitments and policy actions needed, **LMIC voices must be prominently engaged and centrally represented in IPEA decision-making and agenda-setting processes**. These formal inclusion processes must also be balanced with considerations for efficiency in the decision-making and knowledge synthesis process.

Applying Lessons Learned to Inform Policy Options and Trade-offs in Designing IPEA

Options for Setting IPEA's Mandate

An **intergovernmental body representing national governments and OH stakeholders** should include adequate representation of underrepresented voices, particularly those from LMICs. A coalition of national governments with limited input from non-state actors but closely integrated with international organizations would help avoid a situation where some countries or powerful actors could stall its inception. This would offer a lighter structure while still offering a broader coalition of expertise and perspectives during initial conception. However, it is possible to further promote inclusiveness in the IPEA mandate setting process by explicitly including non-state actors and One Health stakeholders (e.g., academic institutions, civil society organizations, and private sector representatives). This option would allow IPEA to benefit from a **broader coalition of expertise and perspectives during initial conception of the panel, positioning it as an inclusive and legitimate global body** capable of addressing the cross-sectoral challenges of AMR while maintaining strong intergovernmental support.

Options for Funding IPEA

Positioning IPEA as a global public good requires **sustainable funding mechanisms to promote its independent operation** and long-term survival, but sustainable operations require multi-source funding models that draw on public and private sources of funding. It should be noted though, that the **inclusion of some sources of private sector funds can undermine credibility, and in turn, the legitimacy** of SPI operations. To address this trade-off, IPEA could be established as an intergovernmental panel through an international agreement that seeks funding commitments by governments. This process could be led by a coalition of governments and **include public sector funding commitments to ensure a basic funding package for independent knowledge synthesis**, while exploring project-specific funding commitments from private actors to support activities where conflicts of interest may be less pronounced (such as knowledge translation and dissemination, or logistical support to subsidize LMIC participation in IPEA activities).

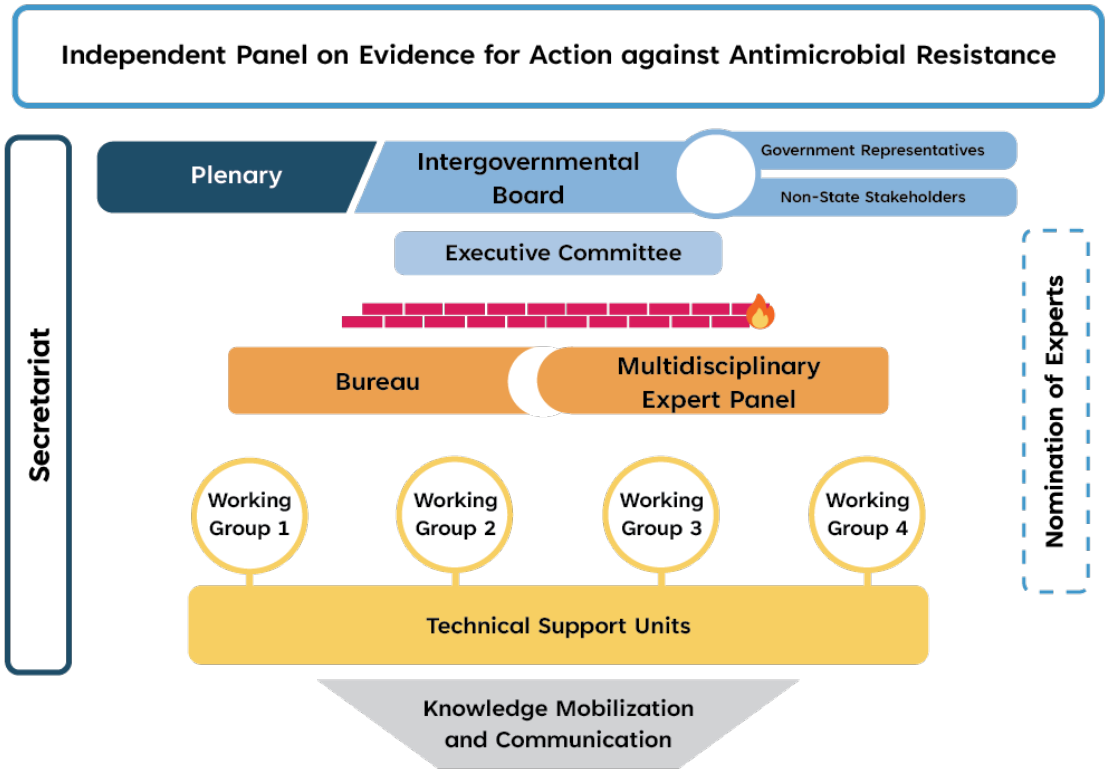
Options for the Plenary, the Main Governing Body

When reflecting on the design of the plenary, two mutually exclusive options can be considered, with each presenting different trade-offs. IPEA needs to facilitate stakeholder engagement across all levels, from global to national and local levels, to **promote legitimacy through the integration of diverse perspectives**. The level of political control over policy summaries afforded to governments can improve clarity and policy relevance but may be a source of political conflict and raise questions about scientific independence and credibility. For instance, having a more state-centric decision-making process where a plenary would integrate non-state stakeholders such as civil society and relevant private sector One Health bodies as observers but without voting rights, with opportunities for direct participation in plenary discussions (less inclusive but more efficient). A second option would be a model that reserves voting rights to government representatives, but affords non-state stakeholders participant status, which would provide them with more opportunity to contribute expertise, knowledge, and perspectives that inform the plenary's discussions and decisions (more inclusive but less efficient).

To have maximum credibility and mitigate the negative impact on independence while preserving state-led accountability, IPEA could erect a 'firewall' to protect its scientific review processes from external political and commercial interference. Such protection from commercial

and political influence can foster broad acceptance –legitimacy– of the panel's findings and promote widespread adoption of evidence-informed policies on AMR. A first step in this direction would be creating a clear institutional separation between the panel's scientific machinery in charge of evidence review processes and the political functions of the plenary or intergovernmental board, which would be responsible for requesting but not influencing the panel's scientific deliverables (See Figure 2).

Figure 2. Elements of IPEA's Organizational Structure



Considerations for Designing the Secretariat and Working Groups

Effective SPIs require a well-funded, central coordinating body, or Secretariat, that can coordinate their activities, providing continuity, administrative efficiency, and adherence to scientific and procedural standards. The secretariat then manages Working Groups of subject-matter experts that contribute to the scientific synthesis process. The process of expert selection must balance considerations for credibility linked to enhancing the contestability and independence of evidence with promoting policy relevant interventions by engaging relevant community members and other non-state stakeholders. It is possible to promote diverse state and non-state actor engagement in the selection of experts in the scientific process **by allowing non-state stakeholders to nominate a limited number of experts (up to 1/3).** Dominance by high-income countries or specific scientific disciplines in the selection process can be prevented by using regional and disciplinary quotas.

Options for Designing External Engagement

Trust is built when stakeholders perceive SPI processes as open, accountable, and free from undue influence. How SPIs interact with external stakeholders impacts their relevance and legitimacy, with trade-offs linked to the degree of inclusiveness by external stakeholders. Less engagement with external stakeholders may lead to more efficient and less conflictual interactions but may limit the relevance and applicability of IPEA's knowledge synthesis products. To balance this trade-off, IPEA can establish public feedback loops that allow policymakers, researchers, and civil society actors to comment on draft reports and contribute to deliberations in a transparent manner, targeting the most relevant sectors and disciplines. To achieve a higher degree of inclusiveness, IPEA could co-produce research and policy priorities with policymakers and other relevant AMR stakeholders to ensure IPEA's knowledge products feed into AMR National Action Plans (NAPs) and regional strategies. It could also include formal channels for integrating IPEA's evidence into international governance processes, such as WHO AMR policy frameworks, FAO and WOAH guidelines, and UNEP's environmental health policies.

Options for Designing the Type of Knowledge Products IPEA Will Produce

Effective communication is critical to ensure that SPI-generated knowledge is not only produced but also understood, trusted, and utilized in policymaking. The way scientific findings are framed affects their relevance and usability, and when research is presented in an excessively technical, unclear, or disconnected manner from policy needs, it risks being overlooked or misinterpreted. IPEA **should develop a dedicated knowledge mobilization unit to translate complex scientific findings into clear, actionable, and policy-relevant insights using structured formats such as policy briefs, infographics, interactive dashboards, and narrative-driven communication strategies to connect evidence to real-world policy challenges.** Opening direct channels of communication with policymakers can enhance the effectiveness of SPIs as it makes policy products more targeted towards policymaking needs.

Options for Embedding Equity

Equity focuses on how the distribution of power, influence, and access shape SPI decision-making processes and outcomes and actively work to amend historical harms and the economic, and political disparities that have excluded certain groups, including Indigenous communities, experts from LMICs, women, and early-career researchers from SPI deliberations. Equity is directly linked to legitimacy; **when SPI processes are perceived as exclusionary or structurally biased, stakeholders are less likely to trust and accept scientific knowledge products.** Establishing regional, gender, and disciplinary balance quotas across IPEA governing bodies, working groups, and advisory bodies to ensure diverse perspectives in agenda-setting and decision-making is a step IPEA can take to embed equity in its institutional processes. For maximum impact, equity considerations must go beyond representation and focus on how resources (both technical and financial) and logistical constraints may prevent the participation of underrepresented SPI stakeholders. IPEA can develop targeted capacity-strengthening programs that provide technical, financial and logistical support (e.g., IPEA fellowship program; travel grants, mentorship program, and language-access services) to facilitate meaningful engagement from underrepresented stakeholders.

INTRODUCTION

Antimicrobial resistance (AMR) is among today's most significant global health threats, leading to ineffective medical treatments, increased morbidity and mortality, and rising healthcare costs worldwide (1). Although there is a growing understanding of the policy interventions needed to address AMR, challenges persist in systematically synthesizing this knowledge and tailoring equitable strategies for varied contexts amidst a rapidly increasing AMR knowledge base (2). At the 2024 United Nations General Assembly, the international community called for the establishment of an Independent Panel on Evidence for Action against AMR (IPEA) which presents a **unique opportunity to design an effective and equitable Science Policy Interface (SPI) for AMR that can function as a global public good in the space of AMR**. This panel is meant to equip members states with reliable evidence to guide informed policy and funding decisions, and to promote high-impact interventions against AMR across diverse contexts (3).

This report **summarizes the findings from a scoping review of academic (n=41) and grey literature (n=19) on SPIs in the realm of global environmental governance to inform the design, governance structure, and scientific processes of IPEA** (see Appendix 1 for research protocol). In addition, it provides reflections on policy options and trade-offs that will have to be navigated in the establishment of IPEA, predominantly drawing from the experiences of the two most influential and widely discussed SPIs in global environmental governance; the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). We first establish the foundations for the effective operation of SPIs with regard to the credibility, relevance, and legitimacy of environmental science panels, and describe how various governance principles represent the normative building blocks of SPI effectiveness (see Figure 1). We then reflect on designing the organizational structure of SPIs and present policy trade-offs that emerge from that process. Finally, we apply those reflections to the design of the scientific scope and governance structure of IPEA.

Translating evidence for policymaking in multidisciplinary fields like AMR is inherently political and requires balancing diverse and often competing interests, values, and epistemologies. To navigate these complexities, **SPIs must uphold values that underpin the good governance of evidence such as inclusivity, transparency, and accountability** to promote their legitimacy, fairness, and trust (4).

DETERMINANTS OF SPIS EFFECTIVENESS

The Foundations of Science-Policy Interface Effectiveness

SPIs function effectively when their outputs, including the various knowledge products that SPIs produce, exhibit legitimacy, credibility, and relevance (5,6). Without these qualities, SPI-generated knowledge risks being dismissed, mistrusted, or disconnected from real-world policy needs (7). **Achieving these SPI qualities requires understanding how process-related governance principles (i.e. inclusiveness, accountability, transparency, communication, sustainability, and**

equity) shape SPI outputs and create impact pathways for their legitimacy, credibility, and relevance.

Legitimacy: Building Trust and Acceptance for SPI Outputs

Legitimacy is a crucial determinant of whether SPI findings are accepted, trusted, and acted upon by policymakers, civil society, and the wider public (5,6). Legitimacy refers to the perceived fairness, inclusiveness, and transparency of SPI processes, so that diverse actors see the interface as representative and unbiased (7,8). **One of the strongest drivers of legitimacy is inclusiveness—when diverse stakeholders actively participate in knowledge synthesis and policymaking, it fosters a sense of ownership and trust in SPI outcomes** (9,10). This is of particular importance in the case of AMR where successful policy implementation requires community involvement. Inclusive processes lead to more equitable outcomes, which further enhance legitimacy so that decision-making power and policy benefits are distributed fairly, preventing exclusionary governance structures (11). Transparency is another key driver of legitimacy, as open decision-making processes help counteract skepticism regarding potential biases or hidden agendas (12). Similarly, accountability mechanisms — such as structured stakeholder consultations, independent evaluations, and participatory governance models— reinforce legitimacy by promoting outputs that are well-aligned with both scientific integrity and policy needs (5,13).

Credibility: Promoting Scientific Integrity and Independence

Credibility is the backbone of SPI effectiveness, and **pertains to the scientific rigor, reliability, and validity of the knowledge produced, which ensures that SPI outputs are methodologically sound and evidence-based (14).** Policymakers and the public trust SPI findings when they perceive the research as being free from bias, based on solid evidence, and subject to rigorous validation by experts from across disciplines (13). Accountability mechanisms such as independent peer review, expert validation panels, and public reporting play a crucial role in reinforcing credibility (5). Transparency further strengthens credibility by making data sources, methodologies, and scientific uncertainties fully accessible and traceable (12). Credibility also depends on sustainability—when SPIs have long-term, stable funding sources, they are less vulnerable to political or financial pressures that might compromise scientific independence (11) (see *also Table 1. Mechanisms and Tools to Achieve SPI Effectiveness).*

Relevance: Aligning SPI Outputs with Policy Needs

Relevance in the context of SPIs refers to the extent to which scientific outputs align with policy needs, societal demands, and governance contexts (5). This alignment makes scientific knowledge not only methodologically sound but also timely, actionable, and applicable to real-world decision-making, directly addressing pressing policy challenges (7,15,16). A lack of relevance can result in scientific assessments that fail to influence policy, either because they do not address pressing policy challenges or because they are delivered too late to inform key decision points (8). This is of particular concern in the realm of AMR policymaking where resistance levels can change rapidly. Relevance is shaped by the degree to which SPIs embody inclusiveness, transparency, and sustainability. Producing relevant outputs for SPIs requires

structured and inclusive engagements from scientists across the disciplinary spectrum and policymakers throughout the knowledge synthesis process, so that research questions, methodologies, and outputs align with governance priorities and practical implementation needs (7). Sustainability also plays a role in engendering relevance, as long-term engagement between SPIs and decision-makers enables continuous adaptation to evolving policy needs (17). **The literature notes that to enhance relevance, SPIs should invest in science-policy dialogues, real-time knowledge translation mechanisms, and establish structured policy engagement frameworks 4/21/25 7:15:00 PM.**

It is important to highlight that credibility, relevance, and legitimacy cannot be conceptually understood in isolation from each other (as indicated by the arrows between these elements in Figure 1) but should be seen as **mutually constitutive in creating effective SPIs** because each reinforces the other. When legitimacy is strong, stakeholders are more likely to trust and implement SPI recommendations, as they view the processes as fair and participatory (15). Credibility, on the other hand, reinforces scientific authority, as policymakers rely on SPIs that adhere to high methodological standards and rigorous review processes (13). Without legitimacy, even scientifically credible findings may be disregarded, while without credibility, legitimate participatory processes may fail to produce reliable, actionable advice (18). Finally, without policy relevance, credible and legitimate knowledge may fail to drive policy action. **SPIs must therefore balance all three output dimensions and manage potential policy trade-offs.**

Table 1. SPI Mechanisms and Normative Principles to Achieve SPI Effectiveness

Output	Domain	Principle	Mechanism	Effect
Legitimacy	Structured and inclusive participation	Inclusiveness	IPBES stakeholder participation (6)	Builds procedural legitimacy and fosters trust amongst diverse actors
	Capacity building for underrepresented groups	Equity	IPBES fellow program and regional workshops (15)	Expands representation and improves equity of contribution and outcomes
	Complete transparency across process and outputs	Transparency	IPCC publishes comments and review responses (14)	Increases institutional credibility by addressing potential bias
	Recognition of multiple knowledge systems	Equity	IPBES includes Indigenous knowledge in	Improves perceived fairness and

			assessments (15)	context sensitivity
Credibility	Transparent methods and uncertainty reporting	Inclusiveness/ Transparency	IPCC methodological appendices and traceability (14)	Improves traceability and public confidence in the knowledge base
	Independent quality assurance and peer review	Accountability	IPCC peer-review process (16)	Promotes methodological rigor and scientific reliability through structured review
	Clear separation between science and politics	Accountability	IPCC structure separating authorship from reviews of Policy Summaries (19)	Protects scientific integrity by limiting political influence over evidence production
Relevance	Structured co-design and co-production	Inclusiveness	IPBES scoping processes with policymakers (13)	Aligns research priorities with stakeholder needs, increasing relevance and legitimacy
	Timeliness and responsiveness to policy cycles	Inclusiveness	IPCC reports scheduled before UNFCCC COPs (8)	Delivers timely input and evidence, enhancing usability of outputs
	Multi-scale responsiveness	Sustainability	Global and regional assessments with national focal points (15)	Adapts global knowledge to local contexts, improving practical relevance and political buy-in
	Iterative science-policy dialogue	Inclusiveness	Ongoing dialogue in IPBES and climate services (16)	Supports ongoing collaboration and knowledge refinement over time

Designing IPEA's Institutional Elements to Promote SPI Effectiveness

After reviewing the determinants of SPI effectiveness, we will now reflect on organizational design choices related to establishing IPEA, as well as outline policy options and trade-offs inherent to specific design choices. This reflection includes discussion of IPEA's mandate, internal and external governance structure, and expected knowledge products. The key elements we will be considering and initial considerations for their design are presented in Table 2.

Table 2. Key Design Considerations for IPEA

Design Elements	Organizational Aspect	Key Considerations
Setting a Mandate		This foundational choice should enhance legitimacy and credibility by clearly defining IPEA's mission and its alignment with existing global initiatives in AMR; and engaging high-level policymakers to promote political buy-in and legitimacy.
SPI Governance	Funding and in-kind support	Secure sustainable and long-term funding and in-kind support from diverse sources (*e.g.*, voluntary contributions from governments, philanthropic foundations, international donors, private partnerships). Develop transparent procedures for accepting funding and in-kind contributions with the understanding that contributions from sources such as foundations or private sector bodies cannot orient the scientific work of the platform or come with conditionalities.
	Plenary	Establish an intergovernmental decision-making body with state representatives as voting members and non-state stakeholders (civil society, scientific and academic institutions, UN bodies and intergovernmental organizations, and relevant private sector bodies) as non-voting observers or non-voting participants.
	Executive Committee (Optional)	Establish an Executive Committee (EC) to serve as a IPEA's high-level governance and coordination body responsible for ensuring operational continuity, addressing urgent administrative matters, and facilitating coordination between working groups and the plenary. The EC must not influence or interfere with the panel's

		multidisciplinary expert panel's independent scientific review processes. of the
	Bureau (Optional, MEP could absorb these functions for more streamlined IPEA)	Establish a Bureau which would serve as the panel's scientific and technical oversight body, providing leadership and ensuring consistency, quality, and integrity across the panel's evidence review processes. It would be composed of the IPEA Chair, Vice-Chairs, and the Chairs or Co-Chairs of the panel's thematic working groups, and should reflect balanced representation across disciplines, regions, and One Health sectors.
	Multidisciplinary Expert Panel (MEP)	The Multidisciplinary Expert Panel (MEP) for IPEA would be the panel's core scientific body, composed of independent experts across One Health disciplines relevant to AMR. The MEP would be responsible for conducting evidence assessments, producing technical reports, and formulating recommendations based on scientific consensus — insulated from political or commercial pressures.
	Working Groups and Technical Support Units (TSUs)	Form interdisciplinary thematic working groups based on initial scoping exercise, to conduct knowledge syntheses and address specific AMR knowledge gaps. Working groups are made up of volunteer experts drawn from scientific and other relevant organizations. Each working group is supported by a Technical Support Unit and Working Groups present findings from review processes to the MEP for consolidation and validation.
	Secretariat	Create a dedicated Secretariat to manage daily operations, provide administrative and operational support, coordinate activities, and ensure continuity.
External Engagement	Stakeholder Engagement Mechanisms	Develop platforms for multi-stakeholder dialogues, including workshops, community consultations, and public awareness campaigns, promoting transparency and inclusivity, and engagement on an iterative basis. Consider designating the use of Multistakeholder Partnership Platform (MSPP) for AMR as a launching off starting point.

Knowledge products	Policy Summaries	Develop actionable, context-specific policy guidance for AMR interventions in human, animal, and environmental health to mitigate AMR.
	Research Priorities	Identify critical research gaps and prioritize highly targeted areas for investment and focused research, ensuring a well-defined scope to enable concentrated, actionable efforts.
	Communication Materials	Produce accessible policy briefs, assessment reports, and stakeholder updates to promote science-policy dialogue; as well as media-friendly products such as shot narrative summaries, op-eds, and digital content to promote science-policy dialogue and public engagement.

Setting a Mandate

One of the most important factors determining IPEA's effectiveness will be the **foundational choice about the creation and governance of this new scientific panel, including its mandate**. There are historically three pathways towards the creation of SPIs in the realm of environmental governance: 1. an international treaty; 2. a UNGA resolution or UN-agency (e.g. World Health Assembly) resolution; or 3. an international or intergovernmental agreement based on a coalition of national governments and/or international organizations (20). The first and second options are unlikely to succeed in the current political climate, as evidenced by difficulty completing the negotiations surrounding an international pandemic treaty.

The third option was used in the development of the IPCC which was established in 1988 through an intergovernmental agreement by two United Nations organizations, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), with the approval of the UN General Assembly. **As an intergovernmental body, IPEA can be expected to be more successful in compelling policy actions than a non-governmental SPI**, given that states would be active participants in all aspects of the SPI process, and multilateral bodies could formally receive and welcome reports (4). Evidence from SPIs such as the IPCC and IPBES shows that when governments are formally involved in SPIs, as both participants and endorsers, scientific assessments are more likely to shape policy agendas and decisions (16). These platforms benefit from structured processes where reports are officially reviewed and welcomed by states, increasing their policy uptake. However, maintaining scientific independence is crucial, as excessive political influence, such as in the case of the International Whaling Commission, can compromise credibility and reduce impact (16). This intergovernmental approach could also help promoting adequate representation from LMICs. To avoid a situation where some countries or powerful actors would stall its inception, IPEA could initially be

established by a coalition of national governments with limited input from non-state actors but closely integrated with the most relevant international organizations.

Policy Option #1:

- *Formalize IPEA as an intergovernmental body through a coalition of national governments and under the leadership of the Quadripartite (WHO, FAO, UNEP, and WOAH), facilitating One Health alignment and sustained political buy-in from national governments*

This approach is often described as an **open membership model where any UN member state can join without any prerequisite commitments and aims for inclusivity by promoting widespread participation** and integration of a diverse range of perspectives into the panel (21). It can enhance efficiency and rapid establishment of IPEA but the focus on states as the sole founding agents could potentially limit the legitimacy of its operations. Alternatively, **to maximize legitimacy, IPEA could integrate non-state stakeholders into the deliberations about foundational choices** related to its establishment and operation. As an example for this model, IPBES emerged from a broader coalition of actors advocating for a more inclusive science-policy platform for biodiversity, reflecting both state and non-state input at the foundational stage (22).

Policy Option #2:

- *Form IPEA as an intergovernmental panel through a coalition of willing national governments but explicitly include non-state actors and One Health stakeholders (e.g., academic institutions, civil society organizations, and private sector representatives) in its foundational design and governance structure.*

This option would allow IPEA to benefit from a **broader coalition of expertise and perspectives during the initial conception of the panel, positioning it as an inclusive and legitimate global body** capable of addressing the cross-sectoral challenges of AMR while maintaining strong intergovernmental support. Policy options #1 and #2 are mutually exclusive, and the choice between these two options has important implications for policy options #5 and #6.

IPEA's inception process must include establishing a **One Health mandate for its operation so it can facilitate the generation, synthesis, and use of credible, relevant, and legitimate multisectoral scientific evidence to support Member States and other global stakeholders in their efforts to prevent and mitigate AMR**.

Internal Governance Structure

Funding

The source of funding for IPEA's daily operations has important implications for its sustainability, and in turn effectiveness, and entails important policy trade-offs. **Sustainability refers to**

creating financial stability, institutional resilience, and political continuity in SPI operations, and is an essential feature for maintaining the long-term independence and relevance of scientific outputs (23,24). Sustainable, multi-source funding for SPIs can be an important element to ensure the independent operation of SPIs (6), as it allows SPIs to reduce their dependence on individual funders that may attempt to politically influence its operation or topical focus. In addition, sustainability supports the relevance of SPIs by maintaining long-term engagement between scientists and policymakers, and preventing knowledge gaps that emerge from short-term, project-based research cycles (23). Without stable funding and governance, SPI outputs risk becoming short-term, project-based deliverables that fail to sustain policy engagement over time (11). Crucially, funding sustainability of SPIs also depends on making a clear, compelling case to funders for why specific types of SPI funding are needed — distinguishing it from other research or health investments in the AMR space and demonstrating its added value for long-term, evidence-informed policy action.

Recognizing IPEA as a public good calls **for sustainable funding mechanisms to ensure its independent operation** and longer-term survival. Sustainable SPI operation requires multi-source funding models that draw on both public and private sources of funding (IISD 2022), but the inclusion of private sector funds can undermine credibility, and in turn, the legitimacy of SPI operations (21). **To protect its legitimacy and credibility, IPEA should create a 'firewall' to promote institutional separation and insulate its scientific review processes from political and commercial interference** (see Figure 2). Concerns about the role of the private sector in influencing global scientific panels in environmental governance have been regularly raised, including in recent discussions surrounding the establishment of the Science Policy Panel on Waste, Toxins, and Pollution Prevention (25).

To address this trade-off, IPEA could be initially established as an intergovernmental panel through an international agreement that enshrines sustained funding commitments by governments. Securing ongoing funding will be one of the most pronounced challenges of IPEA, and establishing IPEA as a predominantly publicly funded panel with direct governmental support will be important. The inception of IPEA could be led by a coalition of governments and **include significant public sector funding commitments to ensure a basic funding package for independent knowledge synthesis**. A significant public funding package will set IPEA up on a path of success, with public underfunding or lack of equitable cost-sharing by governments weakening SPI effectiveness and threatening their independence (26). The goal should be to maximize fully flexible funding arrangements while avoiding, as much as possible, the creation of funding silos.

Policy Option #3:

- *Establish a multi-source public funding mechanism that blends government contributions (based on voluntary commitments), international grants, and philanthropic supports, promoting financial independence and resilience. This should include exploring setting up*

an IPEA trust fund or similar long-term financing framework to buffer against political shifts and guarantee continuity in research and policy engagement.

However, if IPEA were to solely rely on public resources, this could limit concerns about how private funding may undermine its independent operation but could present sustainability challenges (5). One way to **balance the need for scientific independence with the need for private sector funding to establish sustainable IPEA operations could be to rely on funds and in-kind contributions from private sector bodies for knowledge translation and dissemination-related collaborations** once IPEA and its core mandate and scope have been established. Contributions from private sector bodies could also include logistical support for travel for authors, especially those from LMICs, as well as contributions for activities such as policy implementation. This would be similar to the funding models adopted by the IPCC and IPBES (27).

Policy Option #4:

- *Seek project-specific funding commitments from the private sector to support knowledge mobilization and dissemination and policy implementation or other areas of work where conflicts of interest may be less pronounced.*

Policy options #3 and #4 are not mutually exclusive and can be combined. While multi-stakeholder funding models allow for the diversification of resources, they raise potential concerns about conflicts of interest, particularly when accepting funds from private companies (e.g. pharmaceutical companies) with vested interests in how IPEA may operate and what evidence it may produce (21). **To mitigate these risks, IPEA could implement a conflict-of-interest policy for private donations** that develops: transparency requirements for disclosing all funding sources publicly to maintain accountability; funding caps to intentionally limit the proportion of total funding that can come from a single private entity or sector; an ethical review process to regularly review and approve funding sources (21). IPBES and IPCC adopt some of these methods to ensure that procedures for sources of funds and in-kind contributions are laid out in an open and transparent manner (27). For example, IPBES accepts funding from stakeholders such as private sector bodies and philanthropic foundations with the understanding that this funding cannot orient the scientific work of the platform and cannot come with conditionalities. IPBES' procedures for financial and in-kind contributions are laid out clearly under its policies for financial and budgetary arrangements (28,29). Such policies establish a framework for contributions that support the Panel's objectives without undue influence on its scientific priorities and assessments.

Plenaries

The most important governing bodies of SPIs are their plenaries, which are decision-making bodies that initiate, review, and approve the scoping process. At the Plenaries of most SPIs, decisions are either taken by consensus or by vote. At the IPCC Plenary, decisions are taken by consensus. In contrast, other SPIs such as IPBES, and the Montreal Protocol on Substances that

Deplete the Ozone layer aim for consensus-based decision-making but allow majority voting as a secondary mechanism to resolve disagreements, when needed (30,31). **Plenary sessions could be organized alongside the AMR Ministerial Meetings to be held every two years**. This would ensure scientific advice is immediately available to policymakers, build visibility and perceived relevance of IPEA, and create a natural reporting channel and cycle between independent science and high-level political deliberations.

Plenaries are typically composed of representatives from member states and non-state actors (such as scientific experts, and representatives from UN agencies, NGOs, INGOs, industry, etc.). **The membership of SPIs and the roles of state and non-state actors varies based on the SPI's mandate.** At both the IPCC and IBPES Plenaries, the final approval of documents occurs through intergovernmental consensus (20). Representatives of member states have voting rights, while non-state actors are classified as observers without voting rights. At the IPCC Plenary, influence on decision making is restricted primarily to governments; however, non-state actors can contribute indirectly through expert participation in scientific assessments, representing a more state-centric approach. At the IPBES plenary, there is more direct engagement from, and access granted to non-state actors in discussions. Non-state actors have a non-voting participant status and can contribute expertise, knowledge, and perspectives that inform the plenary's discussions and decisions (16). IPBES also has two official structured stakeholder networks of non-state actors that organise contributions (22). The extent to which non-state stakeholders are included in SPI deliberations speaks to a policy trade-off between legitimacy and efficiency. IPEA needs to facilitate stakeholder engagement across all levels, from global (international organizations), to national (member states), all the way to local levels (community engagement), to promote legitimacy and relevance via integration of diverse perspectives into IPEA. However, **inclusiveness must be balanced with considerations for efficiency in the decision-making and knowledge synthesis process**. Potential solutions entail having a more state-centric decision-making process where a panel would integrate civil society and relevant private sector One Health stakeholders as observers without voting rights (less inclusive but more efficient, see Policy Option #5); or alternatively adopting a tiered decision-making process where non-state stakeholders have a non-voting participant status (more inclusive but potentially less efficient, see Policy Option #6). Please note that these policy options are mutually exclusive and policy option #5 builds on policy option #1, and policy option #6 builds on policy option #2.

***Policy Option #5**:*

- *IPEA could adopt a two-tier plenary model: the primary decision-making tier would consist of member states delegates with voting rights to ensure efficiency, while a secondary advisory tier would engage civil society, community groups, and relevant private sector One Health stakeholders solely as observers without voting rights.*

The level of political control over policy summaries afforded to governments in this model can improve clarity and policy relevance but may be a source of political conflict and raise questions about scientific independence and credibility (32). One way **to address this trade-off would be**

to incorporate non-state actors more centrally into the decision-making process via a model similar to that of the IPBES, where non-state stakeholders have a non-voting participant status at the level of the Plenary, and where they can also contribute expertise, knowledge, and perspectives that inform the plenary's discussions and decisions through structured stakeholder networks. This level of inclusiveness would enhance legitimacy and increase policy engagement from non-state stakeholders.

Policy Option #6

- *To promote inclusiveness in IPEA's decision-making processes, a tiered model could be adopted where non-state stakeholders have a non-voting participant status but can contribute expertise, knowledge, and perspectives that inform the plenary's discussions and decisions through structured stakeholder networks.*

This model would promote a deeper integration of the perspectives of non-state One Health stakeholders into IPEA's decision-making body than Policy Option #5, enhancing legitimacy and relevance, while preserving the state-led accountability necessary for effective global governance. Structured criteria for non-state stakeholder selection and representation should be established to ensure transparency and avoid conflicts of interest (COI), with organizations applying to the Secretariat for observer status, and the Plenary making final decisions about approval, based on recommendations from the Bureau. This COI policy could follow the principles recommended for the Science Policy Panel on Chemicals, Waste, and Pollution Prevention (25), which include: (i) provide clear and strict COI provisions; (ii) do not confuse conflicts of financial or political competing interests with legitimate interests or biases; (iii) install regular audits of the SPI's work; (iv) secure as many elements of transparency as possible.

The Executive Committee

In the case of most SPIs, an Executive Committee supports the plenary to ensure operational coordination of activities. Such an Executive Committee would ensure high-level operational coordination between Working Groups, Technical Support Units and the Secretariat. It could guide the implementation of decisions from the Plenary and support the Panel Chair and Co/Vice Chair(s) in addressing urgent matters related to IPEA products between sessions of the Plenary (such as corrections), or in response to government queries. It may also coordinate communications in response to public or political scrutiny. While the Executive Committee does not set policy, it is a responsive body that provides advice and supports smooth coordination.

Working Groups

Working Groups of SPIs are usually made up of large teams working across multiple years. They are typically composed of experts with different roles (including authors and reviewers) and led by chairs or co-chairs. Working groups contribute to the scientific synthesis process and are responsible for thematic or long-term assessments (e.g., climate or biodiversity impacts in the case of the IPCC) and produce comprehensive reports or deliverables (20). The Working Group approach has been employed successfully by many SPIs, including the Intergovernmental Panel

on Climate Change (IPCC), which organizes its work into three thematic groups (e.g., the physical science of climate change, impacts, adaptation and vulnerability and mitigation of climate change) (33), as well as UNEP's International Resource Panel (IRP) and the Montreal Protocol on Substances that Deplete the Ozone layer (Ozone) (34).

IPEA could establish a set of thematic working groups aligned with key challenges along the AMR response pathway. This could include Working Groups focused on Prevention (WG1), Transmission and Environmental Containment (WG2), Treatment, Access, and Stewardship Interventions (WG3), and Implementation, Governance, and Systems Strengthening (WG4). Cross-cutting Working Groups could also be considered.

Table 3. Comparison of Selection of Experts

	IPCC	IPBES
Roles for experts	Coordinating lead authors Lead authors Contributing authors Review editors Fellows (35)	Co-chairs; coordinating lead authors, Lead authors, Contributing authors Review editors Fellows (35)
Nomination	Governments Observer organizations 'Other relevant stakeholders' Limited self-nomination through website (35)	Governments Expert institutions Self-nomination through website (35)
Selection process	Selected by the relevant Working Group/Task Force Bureau, under general guidance and review provided by the Session of the Working Group (35) Coordinating Lead Authors and Lead Authors selected by working group may enlist other experts as contributing authors (36)4/21/25 7:15:00 PM	Selected by the Multidisciplinary Expert Panel, in consultation with the Bureau (35)
Selection criteria	Scientific, technical, and socio-economic expertise, geographical representation (with a focus on developing countries), gender balance, and a mix of experienced and new IPCC members (35).	Scientific, technical, and socio-economic expertise, geographical representation (with a focus on developing and developed countries), diversity of knowledge systems, and gender balance (35).

Most SPIs in global environmental governance are tasked with evidence synthesis, but not evidence production; although Carlson et al (20) note that some of the work conducted by Working Groups may blur this distinction, and the assessment processes and products of SPIs act as priority-setting mechanisms for the broader AMR research community. Authors and reviewer selection is generally unique to each SPIs (see Table 3 for IPC and IPBES comparison), but in most cases represents a mix of nomination and selection by government representatives, observer organizations, and limited self-nomination. In the case of the IPCC, working group experts are nominated predominantly by governments and accredited observer organizations, through national focal points (37). The process of **expert selection must balance considerations for credibility linked to enhancing the contestability and independence of evidence with promoting policy-relevant interventions** by engaging relevant community members and other non-state stakeholders (Policy Option #7).

Policy Option #7:

- *Promote diverse state and non-state actor engagement in the selection of the scientific process by allowing non-state stakeholders to nominate a limited number of experts (up to 1/3), as well as prevent dominance by high-income countries or specific scientific disciplines in the selection process by using regional and disciplinary quotas.*

Trust is built when stakeholders perceive SPI processes as open, accountable, and free from undue influence, making transparency a hallmark of effective SPIs (6). By making decision-making processes, scientific methodologies, and dissenting views publicly accessible, transparency strengthens credibility and, in turn, legitimacy (13). For example, **the IPCC peer review system ensures contestability by documenting contested perspectives and providing open access to review comments, alternative interpretations of evidence, and allowing scrutiny from a broad range of actors** (14,19). This openness prevents scientific outputs from being perceived as one-sided or politically driven, reinforcing their credibility and policy relevance (5). Similarly, the IPBES conceptual framework integrates multiple knowledge systems, enabling broader contestation and deliberation over scientific claims (10). Without transparency, SPI outputs may be met with skepticism or rejected outright, as seen in cases such as the Climategate controversy in 2009. Climategate refers to a series of events in which confidential files, including data and emails between high profile climate scientists, were leaked. The leaked documents suggested that climate scientists may have suppressed or manipulated data. Although the IPCC was not directly involved in the scandal, critics pointed to perceived errors in IPCC Assessment reports, giving fuel to climate skeptics and undermining the reputation of the IPCC in the process. Following the fallout from the scandal, the IPCC implemented a series of reforms to bolster public trust in its assessment process, including developing stronger guidelines for their peer review process (38).

Transparency in how Working Groups adjudicate evidence will be crucial for the success of IPEA, and **this should include publication of contested perspectives and dissenting views during the evidence synthesis processes**. But legitimacy will also rely on how external stakeholders are engaged in the knowledge synthesis process.

The Bureau /Multidisciplinary Expert Committee

The majority of SPIs that represent an intergovernmental model have a Bureau. The function of a Bureau is typically to fulfill a set of administrative, management, and policy functions (such as overseeing the implementation of Plenary decisions), as well as to provide guidance on the scientific and technical aspects of the work of the SPI, including overseeing the selection of authors and reviewers for working groups. The role of the Bureaus of existing SPIs in environmental governance may differ in practice. The IPCC model uses a singly subsidiary body to address both administrative/management/policy and scientific/technical issues separately. However, the IPBES model separates the oversight of these issues. For example, in the IPBES model, the 'Bureau' addresses administrative issues, while a separate body, the Multidisciplinary Expert Panel (MEP), is responsible for overseeing scientific/technical issues. The composition of existing Bureaus also differs. The IPCC Bureau has 34 members, composed of working group and task force chairs and vice chairs; the IPBES Bureau has only 10 members (2 per UN region). While the IPCC Bureau members represent their region, IPBES MEP members are independent and do not represent their region. In both the IPCC and IPBES, the Bureau/MEP members are selected by the Plenary (34).

The Secretariat

Effective SPIs require a well-funded, central coordinating body, or Secretariat, that can coordinate IPEA activities, providing continuity, administrative efficiency, and adherence to scientific and procedural standards.

External Governance Structure to Promote Legitimacy and Relevance

A central element of SPI success is their engagement with external stakeholders that are not directly involved in the daily decision-making process (Plenary) or knowledge synthesis machinery (Working Groups) (16). How SPIs interact with external stakeholders impacts their relevance and legitimacy, with trade-offs linked to the degree of inclusiveness by external stakeholders. Less engagement with external stakeholders may lead to more efficient and less conflictual interactions but may limit the relevance and applicability of IPEA's knowledge synthesis products (21).

At a minimum**, SPIs must create feedback loops to facilitate an iterative engagement with policymakers and private sector and community stakeholders** (Policy Option #8) to ensure policy relevance of SPI outputs, but this engagement may be targeted to the most relevant

stakeholders. This can be seen in the approach taken by the IPCC which intentionally limits the degree of stakeholder engagement to maximize efficiency (21).

Policy Option #8

- *Establish public feedback loops that allow policymakers, researchers, and civil society actors to comment on draft reports and contribute to deliberations in a transparent manner, targeting the most relevant sectors and disciplines.*

A different approach would aim to engage stakeholders early on during the conceptualization of knowledge synthesis all the way to the development of policy summaries through a co-design approach (5). **To maximize their policy relevance and deepen legitimacy and credibility, SPIs can facilitate co-production processes for research and policy prioritization (Policy Option #9) through highly structured external stakeholder engagements**. For example, the IPBES Stakeholder Network promotes legitimacy by formally engaging non-state actors, including Indigenous knowledge holders and local communities in its scientific co-production of evidence (Borie et al., 2020). This approach ensures that SPI outputs reflect diverse perspectives and are not limited to Western scientific paradigms (9). Beyond legitimacy, the IPBES stakeholder engagement model also enhances credibility and relevance by integrating multiple knowledge systems, including Indigenous and local knowledge, with conventional scientific assessments (5). By fostering formal and well-structured deliberative, participatory processes, IPBES strengthens trust in its assessments and increases the likelihood that its recommendations will be both socially accepted and politically actionable. To achieve maximum legitimacy and relevance, IPEA could promote a knowledge synthesis model that is based on co-design principles (Policy Option #9).

Policy Option #9:

- *Co-produce research and policy priorities with policymakers and other relevant non-state AMR stakeholders to ensure IPEA's outputs feed into AMR National Action Plans (NAPs) and regional strategies; and develop formal channels for integrating IPEA's evidence into international governance processes, such as WHO AMR policy frameworks, FAO and WOAH guidelines, and UNEP's environmental health policies.*

IPEA'S KNOWLEDGE PRODUCTS: BUILDING TRUST AND DEMONSTRATING RELEVANCE

Effective communication is critical to ensuring that SPI-generated knowledge is not only produced but also understood, trusted, and utilized in policymaking (39). Within SPIs, communication operates at two key levels: internal communication, which includes interactions among scientific and advisory bodies that drive knowledge production, interdisciplinary collaboration, and consensus-building (38); and external communications, which involves

engagement with policymakers, stakeholders, media, and the public to promote knowledge uptake and integrate scientific insights into policy decisions (6).

Most SPIs in global environmental governance produce several outputs on different timelines, including major multiple-year Assessment Reports, Technical Papers, Policy Briefs, Fact Sheets, Methodology Reports and Guidelines, Online Databases, and Summaries for Policymakers. SPIs also often organize more interactive outputs including Workshops and Stakeholder Consultations, Educational and Training Resources (such as webinars and E-learning platforms), as well as short videos and animations.

SPI communication products generally aim to be "policy-relevant but not policy-prescriptive", a safeguard that frames the scientific process as independent and apolitical; and neither the IPCC nor IPBES can prescribe specific policies as this authority has been assigned to a separate subsidiary body for scientific and technical advice (20). A key challenge for SPIs is facilitating the integration of scientific knowledge into policy decisions. Research suggests that scientific findings are more likely to be utilized when they are communicated in a clear, timely, and accessible way, and are targeted to specific knowledge users (5). Policymakers are often more partial towards structured formats such as policy briefs, infographics, and targeted reports over dense academic publications, which can be difficult to interpret and apply in policymaking (8). The way scientific findings are framed also affects their relevance and usability because if research is presented in an excessively technical, unclear, or disconnected manner from policy needs, it risks being overlooked or misinterpreted (13). Narrative-driven communication and visually engaging tools can help filter complex information, making it more comprehensible and actionable for decision-makers (7). This is why IPEA **should develop a dedicated knowledge translation unit to translate complex scientific findings into clear, actionable, and policy-relevant insights using structured formats such as policy briefs, infographics, interactive dashboards, and narrative-driven communication strategies to connect evidence to real-world policy challenges.** In the case of some SPIs, this function is performed by external stakeholders, such as the United Nations Foundation which contributes to IPCC knowledge translation efforts.

Equity as a Cross-Cutting Governance Challenge for SPIs

Equity focuses on how distribution of power, influence, and access condition SPI decision-making processes and outcomes (9,40). Unlike inclusiveness, which emphasizes representation, **equity principles acknowledge and actively work to amend historical, economic, and political disparities that have excluded certain groups, including Indigenous communities, experts from LMICs, women, and early-career researchers from SPI deliberations** (11). Without equity, inclusiveness risks becoming solely representational and tokenistic, where diverse voices are present but lack genuine influence over SPI decision-making and agenda-setting (10). Equity is directly linked to legitimacy; when SPI processes are perceived as exclusionary or structurally biased, stakeholders are less likely to trust and accept scientific outputs (5). Governance structures that promote a fair distribution of power and benefits strengthen the perceived

legitimacy and credibility of SPIs, making it more likely that scientific advice will be incorporated into policy (23).

Embedding Equity into the SPI Process

Achieving equity in SPIs requires structural considerations that address imbalances in representation, decision-making authority, and resource access. Prominent concerns in the academic literature include **promoting adequate representation from LMICs in SPI decision-making and knowledge synthesis** – given that the IPCC, and other global SPIs, have faced criticisms regarding the limited participation of scholars from LMICs – as well as ensuring the inclusion of Indigenous and local knowledge, and social sciences and humanities expertise (6,20). Beyond building legitimacy, broad and inclusive representation across regions and disciplines also improves credibility of SPI outputs, as it enhances the contestability of synthesized evidence. Contestability in SPIs refers to the degree to which scientific advice is open to critical reflection, debate, and diverse perspectives (7). Inclusiveness fosters contestability by integrating diverse scientists, policymakers, Indigenous knowledge holders, and civil society actors in SPI processes (9). When SPIs integrate diverse disciplines and knowledge systems, they create a broader evidence base for scientific debate (40).

A first step towards addressing inequitable participation in SPIs is establishing balanced regional, gender, and disciplinary representation across SPI governing bodies, within Working Groups and advisory roles so that diverse perspectives contribute to SPI governance and knowledge production (9,41). In existing SPIs in environmental governance, the extent to which equity principles are reflected in selection criteria varies widely. At IPCC, the selection criteria for its governance bodies are limited to scientific, technical, and socio-economic expertise, geographical representation (with a focus on developing countries), and gender balance (33). IPBES has a wider array of criteria, including all IPCC criteria listed above, in addition to diversity of knowledge systems. To promote a greater diversity of knowledge, IPBES developed a dedicated mechanism to facilitate the participation of Indigenous Peoples and Local Communities (IPLCs) in its work (42). Indigenous and Local Knowledge Liaison Groups, which comprise the Indigenous and local knowledge experts selected for the various chapters of each individual assessment, are established for each assessment (35). IPLCs can participate in scoping assessments, participate as assessment authors, and share Indigenous and local knowledge around assessment by means of dialogue workshops. **At a minimum, SPIs must establish quotas that facilitate equitable representation** (Policy Option #10).

Policy Option #10

- *Establish regional, gender, and disciplinary balance quotas across IPEA governing bodies, working groups, and advisory bodies to ensure diverse perspectives in agenda-setting and decision-making.*

For maximum impact, **equity considerations must go beyond representation and focus on how resources (both technical and financial) and logistical constraints may prevent the participation**

of underrepresented SPI stakeholders (Policy Option #11). In this context, capacity-strengthening programs are essential for eliminating financial and logistical barriers that disproportionately hinder underrepresented groups' participation in SPIs (43). This includes targeted funding, logistical support, and training initiatives to facilitate meaningful engagement in SPI processes (13). Existing SPIs differ in the degree to which they explicitly address constraints in the technical and resource capacities of specific SPI stakeholders. For example, to address the issue of the impact of limited resources on the participation of stakeholders from LMICs in key SPI bodies (such as Plenary and Working Groups), the Secretariat of some SPIs – such as the UNEP International Resource Panel – provide funding to facilitate the participation of members from developing countries in meetings and events (33). The IPBES Fellowship Programme enables early-career researchers to be mentored and contribute to the assessment processes and covers expenses for attending selected IPBES meetings for fellows from developing countries. Similarly, IPEA must build the capacity for historically underrepresented SPI stakeholders to be able to participate in IPEA's knowledge synthesis process.

Policy Option #11

- Develop targeted capacity-strengthening programs that provide technical, financial and logistical support (e.g., IPEA fellowship program; travel grants, mentorship program, and language-access services) to facilitate meaningful engagement from underrepresented stakeholders.

In addition to the use of capacity strengthening programs and quotas, it is also important for the leadership of SPIs to embed reflexive practice into SPI governance, to ensure considerations of equity are integrated throughout their work, and are continuously monitored and adjusted (9,12,23,44,45).

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APPENDIX 1. SCOPING REVIEW PROTOCOL

SCIENCE POLICY INTERFACES (SPIS) IN GLOBAL ENVIRONMENTAL GOVERNANCE AND THEIR LESSONS FOR ANTIMICROBIAL RESISTANCE (AMR): A SCOPING REVIEW PROTOCOL

Introduction

Antimicrobial resistance (AMR) is among the most significant global health threats, leading to ineffective treatments with antimicrobials, increased morbidity and mortality, and rising healthcare costs worldwide (1). Although there is a growing understanding of knowledge about the policy interventions, options, and guidelines needed to address AMR, challenges persist in tailoring strategies for varied contexts amidst a rapidly increasing knowledge base (2). Specifically, there is a need for deeper insights on how to translate existing knowledge into effective, context-specific, equitable, and actionable policies.

Translating evidence for policymaking in multidisciplinary fields like AMR is inherently political and requires balancing diverse and often competing interests, values, and priorities. Evidence is neither generated nor applied in a vacuum as its creation, selection, interpretation, and use are shaped by the social and political context in which policy decisions are made. Such processes reflect power dynamics favoring certain groups or agendas and involve value judgments about what evidence and which outcomes matter most and for whom. To navigate these complexities, organizations bridging evidence and policy must uphold democratic values such as inclusivity, transparency, and accountability to ensure legitimacy, fairness, and public trust (3).

Organizations connecting the realms of science and policy, often referred to as science-policy interfaces (SPIs), are crucial in supporting decision-makers with relevant and timely knowledge (4). Given the rising significance and rapid rate of accumulation of knowledge for decision-making across issue areas, SPIs have received growing attention, with a sizeable body of literature assessing the operation of SPIs in global environmental governance. This knowledge can be a useful base from which to explore lessons for establishing a global science-policy interface to address AMR.

Currently, no authoritative global entity synthesizes AMR evidence, and no science-policy interface exists for this critical issue. However, the 2024 UNGA Political Declaration's call for the establishment of an Independent Panel for Evidence on AMR (IPEA) presents a timely opportunity to design an inclusive and equitable SPI for AMR. Lessons from global environmental governance, particularly the Independent Panel on Climate Change (IPCC), emphasize that democratic governance principles like fairness, transparency, and accountability are foundational

to fostering stakeholder engagement and co-producing knowledge effectively (1). Similar principles have also been highlighted as essential in research on One Health governance for AMR (5).

This scoping review evaluates how good governance principles may enhance the legitimacy and effectiveness of SPIs. By identifying institutional features and normative principles that enhance the performance of science-policy interfaces in global environmental governance, the review will contribute actionable insights for designing a normatively informed framework that balances scientific rigor with democratic accountability, inclusivity, and transparency. These insights will ultimately strengthen global health policies to address AMR more effectively.

The research questions guiding this scoping review are:

1) *What are the institutional and normative features and principles of SPIs in global environmental governance, and how do these design features influence the effectiveness of SPIs?*
2) *What lessons can be learned from SPIs in global environmental governance for establishing IPEA as a global public good?*

Methods

We will conduct a scoping review, in line with guidelines published by Arksey and O'Malley (6) and refined by Levac and colleagues (7) which emphasizes an iterative approach suited to exploratory research questions in areas where limited knowledge has been synthesized about a subject matter.

Identifying Relevant Studies

This scoping review will review studies on the design and role of SPIs within environmental governance, encompassing peer-reviewed journal articles, policy reports, and grey literature, drawing from a wide array of sources that engage with SPIs, knowledge exchange, and governance practices. Various muti-disciplinary databases, including PubMed, Scopus, and Web of Science, will be used to identify academic sources while relevant government reports and policy documents will be sourced through a targeted online hand search to capture the grey literature on SPIs, as well as dedicated grey literature search engines, such as CABI Global Health.

A comprehensive Boolean search strategy will be employed to identify relevant articles. Boolean operators (including 'AND', 'OR', and 'NOT') will be used to combine key terms and optimize search results (8). The search terms are displayed in Table 1. This search strategy will enable the review to cast a wide net while maintaining a specific focus on the research areas of SPIs, governance designs, and AMR-related environmental governance.

Table 1. *Boolean Search Chart*

Step	Details
Research Question	What are the institutional and normative design features and principles for SPIs in environmental governance, and how do these design principles influence the effectiveness of SPIs at the global level? What lessons can be learned from SPIs in global environmental governance for establishing IPEA as a global public good?
Significant Words, Concepts (Search Terms) for the Statement/Question	Environmental governance, Science-Policy Interfaces (SPIs), design principles implementation
Concept 1 Search	**Environmental Governance and SPI**: “Science Policy Interface*” OR “SPI” OR “scientific panel” AND “environmental governance” OR “environmental policy” AND Global
Concept 2 Search	**Design Principles**: “design principle*” OR "institutional design" OR "normative principle*" OR "design framework*" OR "institutional arrangement*" OR “equity” OR “design feature”
Concept 3 Search	**Effectiveness**: "implementation" OR “effectiveness” OR "application" OR "adoption" OR "impact" OR "outcome*"

Academic Literature Search String:

((“Science-Policy Interface*” OR “SPI” OR scientific panel) AND (“environmental governance” OR “environmental policy”)) AND (“design principle*” OR “institutional design” OR “normative principle*” OR “design framework*”) AND (“implementation” OR “effectiveness” OR “application” OR “adoption” OR “impact” OR “outcome*”))

The search results will be reviewed and iteratively refined to capture additional synonyms, ensuring a comprehensive approach that maximizes the review’s sensitivity and specificity (8). We will also use snowball sampling techniques in this scoping review by identifying relevant studies from the reference lists of included articles and tracking citations forward to capture additional pertinent literature. This search strategy will provide a comprehensive foundation for the subsequent stages of thematic analysis, ensuring that the lessons learned from global environmental governance can be effectively applied to the AMR context.

Grey Literature Search String:

("science-policy interface" OR "science policy interface" OR "science-policy interaction" OR "knowledge-policy interface") AND design AND ("environmental governance" OR "environmental policy" OR "ecosystem management" OR "natural resource governance") AND ("technical report" OR "policy brief" OR "white paper" OR "working paper" OR "discussion paper" OR "evaluation report") filetype:pdf (site:.int OR site:.org OR site:un.org OR site:who.int OR site:ipbes.net OR site:worldbank.org OR site:weforum.org OR site:undp.org OR site:unesco.org OR site:globalpolicy.org OR site:oecd.org)

We will conduct additional online hand-searches to identify additional documents and will include documents referred to us by members of the IPEA Lessons Learned panel.

Study Selection

The study selection process will follow a multi-step approach to ensure that only the most relevant and high-quality studies are included in the review. The titles and abstracts of the identified studies will be double screened in Covidence, to assess their relevance to the research question. In a second step, full-text screening will be performed to identify relevant content in each article for coding by two reviewers independently. The inclusion criteria will aim to prioritize studies that examine the intersection of science and policy in environmental governance, with a particular focus on those that explore knowledge exchange strategies, governance and normative design features of SPIs, and the outcomes of such exchanges and SPIs at the global level. We will focus on the global level in our analysis, as the level at which SPIs operate impacts their design, stakeholders, and decision-making, with design principles needing to align with the operational levels of the SPI. We will follow Wagner et al (4) in defining SPIs as “structured platforms that arrange co-production processes, often resulting in the production of scientific assessments” (4). The Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) represent two widely known SPIs at the global level. This also means that we will disregard national-level political factors in this study which may impact the operation and implementation of SPIs in specific political and national contexts. The aim is to keep the literature review focused on identifying lessons from environmental governance at the global level that can inform the development of a robust institutional and normative framework for an SPI in AMR.

Inclusion Criteria	Exclusion Criteria
Studies that discuss SPIs in environmental governance at the global level	Studies not directly focused on SPIs in environmental governance, and that discuss SPIs at national or local levels.
Studies that explore normative and design considerations of SPIs and their impact	Studies that do not address normative and design considerations of SPIs, and their impact
Academic articles and grey literature will be included in the study	Articles without full-text availability and commentaries will be excluded

Any article published since 2000	Any article published before 2000
Included studies will be limited to English-language publications only	Any study not published in English

Charting the Data

In this scoping review, data will be coded into an extraction sheet in the qualitative coding software MAXQDA. The data extraction process will follow a deductively derived coding structure that combines elements of the widely used CRELE framework (9) with Parkhurst's 'good governance for evidence' framework (3). The CRELE framework highlights that for SPIs to be effective, they must produce knowledge outputs that are scientifically sound (credible), responsive to user needs (relevant), and perceived as fair and inclusive (legitimate). These three dimensions are interdependent and foundational to the influence and trustworthiness of SPIs in global governance. Parkhurst's framework focuses on the governance inputs to establish SPI effectiveness in complex policy environments which makes it highly applicable to issues like AMR, where evidence spans multiple sectors (human, animal, environmental health) and where normative principles (e.g., equity, sustainability) are central to policy effectiveness (10). When coding data in MAXQDATA, we will include institutional design features (structural and procedural elements) and normative values (ethical and social principles) in our analysis. These are the foundational components through which transparency, accountability, and inclusiveness are implemented. These features also carry normative implications, as normative elements may impact the capacity of various institutional features to deliver on their functions, or their performance (10).

While our scoping review departs from a deductive coding structure, we will inductively enrich our coding categories if relevant information emerges that we are not able to capture with pre-existing first- and second-level coding nodes. This information will be collected under a miscellaneous coding node, and additional thematic analysis will be conducted to determine the need for additional, inductively developed codes.

Collating, Summarizing, and Reporting the Results

The method employed in this review will follow a narrative synthesis approach, focusing on how SPIs are institutionally and normatively structured, their success in fostering knowledge exchange, and their ability to integrate scientific research into policy. For our thematic synthesis, we will organize the findings by coding nodes. A narrative approach allows for a comprehensive descriptive summary, linking thematic analysis to the research objectives and offering practical insights into how SPIs can be adapted for AMR governance. Evaluating the role of good governance principles in enhancing the legitimacy and effectiveness of SPIs is critical to this review. By drawing on the good governance of evidence framework (3), the review will assess how principles such as transparency and appropriateness have been applied in environmental SPIs, with what impact, and how they can be adapted for use in AMR governance (11). This

evaluation is essential for understanding how SPIs can balance scientific rigor with the need for democratic accountability, independence, and inclusivity, particularly in contexts where science and politics intersect (12).

Findings from this review will be narratively synthesized with the aim to directly inform the design of future SPIs, and offer practical recommendations for policymakers and practitioners, enhancing SPIs to improve knowledge exchange. This will contribute to enhancing policy outcomes in complex governance environments like that surrounding AMR. The review will conclude with suggestions for how SPIs can be better integrated into AMR governance, addressing this global health challenge, by building on the successful models from global environmental governance (13).

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