PBL Netherlands Environmental
Assessment Agency

KEEPING GLOBAL ENVIRONMENTAL ASSESSMENTS FIT FOR PURPOSE

CHALLENGES AND OPPORTUNITIES FOR A CHANGING CONTEXT

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Content

MAIN FINDINGS

Keeping global environmental assessments fit for purpose

Global Environmental Assessments (GEAs), such as those produced by the Intergovernmental Panel on Climate Change (IPCC), Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the United Nations Environment Programme (UNEP), play a prominent role in global environmental governance. They aim to improve the quality of environmental decision-making by synthesising the state of scientific knowledge in a manner that is relevant to policy-making. However, in light of changing dynamics in science, policy and society, regular maintenance is required to retain their value. At the request of the Dutch Ministry of Infrastructure and Water Management and the Ministry of Foreign Affairs, PBL Netherlands Environmental Assessment Agency analysed the logics underlying the role and design of GEAs, and if and how these may need revision. The study is based on a literature review, interviews with scientists, practitioners and policymakers closely involved in such assessments, and a workshop with scientists and policymakers.

This report discusses the purposes GEAs serve and how their production processes are organised, as well as the implications of changing dynamics in science, policy, and society for their performance and usefulness. It creates insight into choices and options influencing the effectiveness of future assessment processes, while acknowledging that there is no one-size-fits-all model and that individual assessments are part of a wider assessment landscape. In this way, it aims to inform decision-makers on how to keep global environmental assessments fit for purpose.

Many GEAs are complex processes that are highly institutionalised. This means they tend to become path-dependent: procedures followed in the past are likely to be followed again in the future. Although these processes are designed to ensure the effectiveness of GEAs as science-policy interfaces, this path-dependence reduces their ability to readjust to changing dynamics in science, policy, and society. In the first place, the growing number of GEAs raises the question about the degree to which GEAs address possible overlap and interrelationships. Second, environmental governance is increasingly characterised by the involvement of non-state actors, whose perspective for action is only slightly reflected in GEAs that traditionally focus on national governments acting in multilateral settings.
Third, GEAs operate in a politically charged context, in which science is not self-evidently authoritative, while environmental issues are increasingly at the centre of political debate.

Table 1

Options to keep global environmental assessments fit for purpose

Key message	Description
Target and involve non-state actors	The relative importance of multilateral and national environmental governance is decreasing, with local and regional government authorities, businesses, and civil society taking a more proactive role. GEAs could reflect this shift by more actively involving these actors.
Improve coordination between niches in the assessment landscape	Different assessments should address individual niches. This should be matched with improved coordination between assessments to address interrelationships and make use of complementary features.
Align the assessment format with its purpose	Under the adage 'form follows function', the assessment design should be tailored to the niche they are to serve.
Deal explicitly with different worldviews and values	GEAs play both a political and a scientific role. In order to effectively inform decision-making in a politically sensitive context, GEAs could integrate different worldviews to an increased degree.
Back the activities that support assessment production and use	Various activities are undertaken to stimulate effective production and use of assessments. To fully capitalise on the potential of GEAs requires appropriate appreciation, attention and financial support for these activities.
Make use of strategic moments	Many GEAs have windows of opportunity for discussing the purpose and audience that a future assessment is expected to serve. Mandating parties should make active use of these moments for strategic reorientation.

Consequently, GEAs – and decision-makers in GEAs – should regularly reflect on whether the role, function, and design of GEAs remain fit for purpose in relation to these changing dynamics. There should be room for reflection and corresponding adjustments when necessary.

A Global Environmental Assessment is a process, as well as a report

GEAs are best known for the large reports they produce, generally accompanied by a Summary for Policymakers (SPM) containing the most policy-relevant messages. However, they also produce benefits from the wider assessment process. In their production process, GEAs often convene meetings of experts and policymakers, which enables them to exchange perspectives on complexities and uncertainties related to the issues assessed. Although these types of outcomes are often less visible, they are nonetheless a crucial part of how GEAs serve their purpose. GEAs are thus as much about the *process* that produces the report as the report itself.

Table 2

Enabling functions of global environmental assessments

Category	Enabling functions
Enabling functions for policy-making	**Demarcate the issue**: Define the terms in which a problem can be understood. **Agenda-shaping**: Demonstrate the urgency of a problem. **Contribute to potential policy goals and targets**: Provide guidance for setting goals or targets to achieve specific policy objectives. **Suggest potential policy interventions and instruments**: Discuss possible pathways and policies to pursue. While assessments rarely include new interventions, they may lend credibility to existing options; for instance, through ex-ante policy evaluations. **Monitor progress**: Analyse whether existing goals and targets are being achieved, primarily those of multilateral environmental agreements.
Enabling functions to support policy processes	**Capacity-building**: Support government authorities and other actors to process the results from GEA reports, to initiate assessment processes at other levels, or to build capacity for monitoring and data collection. **Social learning**. Provide forums for scientists, policymakers, and other stakeholders to interact and exchange views; thus, contributing to mutual learning and coproduced knowledge. **Standardisation**. Develop methodological or metrological standardisation.
Enabling functions for science	**Agenda-shaping for scientific research**. Identify knowledge gaps and areas for further research. **Capacity-building for science**. Support the creation of scientific networks and increase international scientific experience, especially for early-career researchers and those from developing countries.

Assessments serve a variety of enabling functions

By synthesising the current state of science, GEAs provide a knowledge base that may help a range of actors to take action. Ten *enabling functions* can be identified (Table 2). These functions are categorised into those that directly support the policy-making cycle, without being prescriptive (*enabling functions for policy-making*), those that facilitate more effective policy implementation (*enabling functions supporting policy processes*), and those that serve the organisation of science itself (*enabling functions for science*). The functions in the first category mostly result from an assessment report, whereas those in the second and third categories mostly result from the broader assessment process.

Assessment procedures are a compromise between multiple criteria for success

For GEAs to successfully perform their enabling functions, their production processes are often organised to achieve three commonly cited criteria: relevance (the relevance of an assessment to the needs of decision-makers), credibility (the scientific adequacy of the assessment), and legitimacy (the fair treatment of different values, interests and beliefs in

the assessment). However, while these criteria are often used in a straightforward manner, their practical operationalisation is more challenging. Different stakeholders have different interpretations of what meeting these criteria entails, and strategies to meet one interpretation can be at odds with meeting another. It is therefore important to see assessment procedures not as something for which a single optimal form exists but as a compromise resulting from the balance of power between various stakeholders and their interpretations of the criteria.

Attention for interrelationships requires matching international environmental governance

Over the past decades, a large number of assessment reports have been produced, each targeting specific thematic and policy niches. Figure 1 provides a graphical overview of the assessment landscape since 2015, indicating the themes and enabling fuctions covered in recent assessment reports. The degree to which various enabling functions are covered for a specific theme reflects the related progress made, in terms of international political attention and action. This is evidenced by, for instance, the larger number of reports from a wider range of assessment bodies that discuss policy interventions and instruments for climate than is the case for biodiversity. More generally, the assessment landscape can be taken to reflect international governance of environmental issues.

With the SDGs, the interest in relationships between environmental themes has increased significantly. Yet, a large part of the assessment landscape consists of thematic reports that mostly focus on a single environmental theme, while only a handful of assessment reports can be considered broad, i.e. covering multiple thematic areas. Where thematic assessments tend to provide more in-depth analysis of their core theme, broad assessments provide more insight into the relationships between themes. At the same time, thematic assessments increasingly also pay explicit attention to interrelationships, with land in particular emerging as a thematic area that links multiple environmental themes. Still, to increase their use in decision-making, the increasing interest in interrelationships needs to be matched by interlinked governance processes.

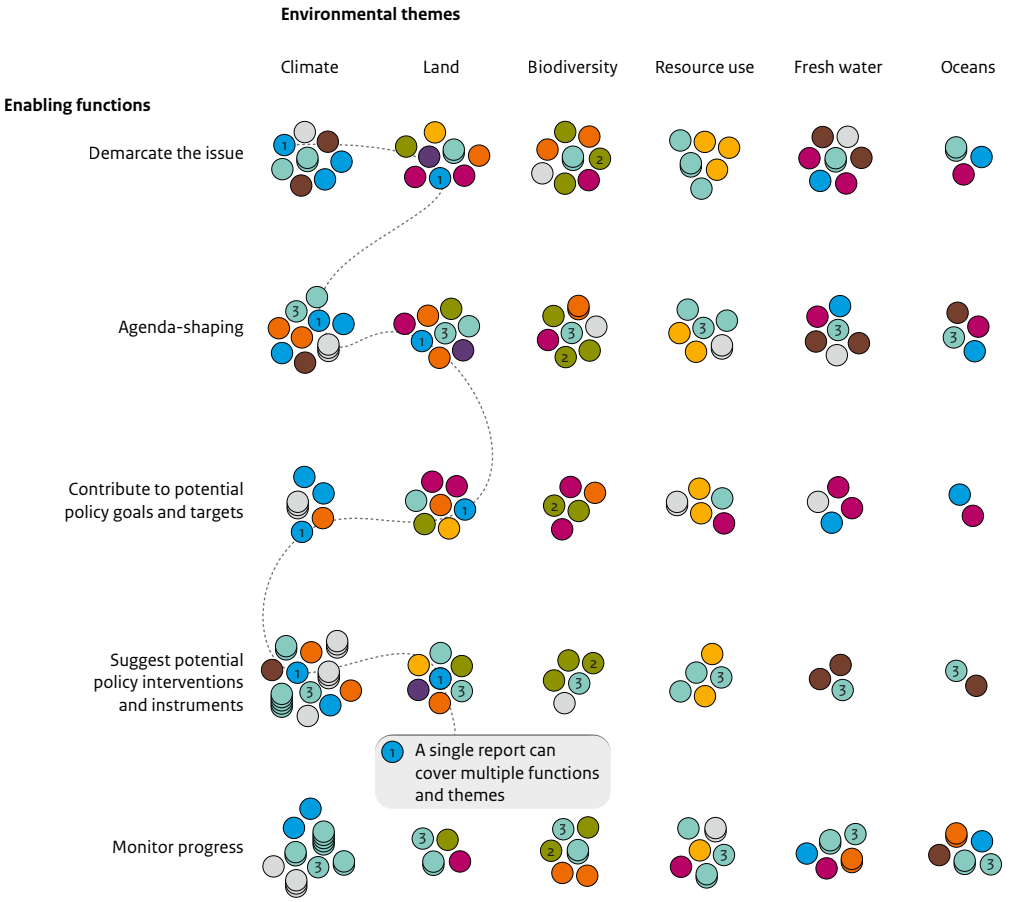
Options to keep global environmental assessments fit for purpose

Target and involve non-state actors

Many GEAs have focused on governance through international conventions (e.g. UNFCCC or CBD) implemented through national policy processes. Additional work is often required for national governments to digest the globalised knowledge GEAs provide. Furthermore, such multilateral governance has decreased in importance relative to 'polycentric' governance, in which environmental decision-making involves a wide variety of actors (including sub-national government authorities and municipalities, civil society and private corporations) at all levels (e.g. international, national and local). This requires GEAs to adjust their scope and participants to reflect the growing importance of these other actors.

Figure 1

Themes and functions covered by global environmental assessment reports, 2015 – 2019



Source: PBL

Annex III contains an overview of the assessments included.

Involving them in the mandating and scoping phases can be a way of including questions and knowledge from new target audiences, but new assessments may also be developed that specifically target or are even instigated by these actors. In particular, for GEAs organised as intergovernmental processes (e.g. the IPCC and IPBES), it is likely to be challenging to align the positions of countries necessary to change procedures. Nonetheless, in their considerations, government representatives could weigh the potential role of GEAs for others than themselves, preferably in consultation with these other actors.

Improve coordination between niches in the assessment landscape

The variety of environmental governance arrangements means that no single assessment can fulfil all enabling functions, for all relevant actors, on every theme. Instead, a variety of assessments each addressing a carefully considered 'niche' is required, making clear which themes and enabling functions are covered in the assessment, and for which audience it is intended. Meanwhile, coordination and/or collaboration between the various assessments could be improved, to allow them to address their niche more effectively, while creating opportunities to address the relationships between themes and to make use of complementary features.

Align the assessment format with its purpose

Currently, few assessments venture beyond the traditional format in which a large report serves as the assessment's main output. However, under the adage 'form follows function', assessments could tailor the presentation of results to the niche they are supposed to fill. Alternative options include greater use of possibilities afforded by current digital technology (e.g. interactive resources) or producing reports with a narrower focus in a shorter time frame (e.g. IPCC special reports and IPBES thematic assessments). Assessments could also produce a range of specific summaries for various stakeholders, preferably in collaboration with these stakeholders, to enable them to act in their own contexts. For instance, the Global Environment Outlook (GEO) has specific editions for Business and Youth. While it is increasingly standard, though not uncontested, practice to have government-negotiated summaries for policymakers (e.g. IPCC, IPBES, GEO), stakeholder involvement in a wider range of summaries could be operationalised without such formal consensus-based negotiations. Of course, any alternative to a large report as main output will come with its own challenges, for example with respect to keeping a common thread visible across various assessment outputs. Nonetheless, a broader variety of outputs could better suit the needs of various decision-makers.

Deal explicitly with different worldviews and values

The aspiration for policy to be based on science tends to lead to this science becoming the subject of political discussion. As such, GEAs' position at the science–policy interface gives them both a political and a scientific character. This dynamic is further strengthened by the fact that assessments increasingly focus on solutions to achieve environmental objectives. Recent assessments calling for 'transformative change' increase the visibility of their political dimension, because of the profound and far-reaching consequences of such change for the way societies and economies are organised. In order to keep informing the

decision-making process in a politically sensitive context, assessment processes could increase the degree to which they integrate different worldviews and values into their procedures. Examples of options include a broad selection of contributing experts (with IPBES having specific procedures to this end), collaborations with stakeholders and/or the general public to map different worldviews in relation to possible solutions, or by explicating the choices underpinning different possible future worlds.

Back the activities that support assessment production and use

Various activities are undertaken either during GEA processes, or preceding or following such processes, to stimulate effective production and use of assessments. To capitalise fully on an assessment's niche, these activities require appropriate appreciation, attention and financial support.

On the production side, GEAs could stimulate the 'craft' of GEA authorship. GEA processes are distinct from those that dominate academia (e.g. peer-reviewed journal articles). Assessments could thus support the ability of authors to work in these processes, including by navigating possibly contradicting demands placed upon their work by various stakeholder groups and increasing their awareness of value-laden remarks and problems that arise when aggregating knowledge.

To improve their usefulness, GEAs could place greater emphasis on dissemination activities, by encouraging the creation of a variety of communication outputs to reach all intended audiences of the niche the assessment is meant to fill. Because GEAs provide a *global* assessment of knowledge, such communication outputs could include support for activities in which actors, including at regional and/or national levels, are supported to directly translate the assessment's results to their own context. Several methods for such contextualisation exist, from subsidiary bodies on science and technology as part of an international convention to citizen dialogues aimed at discussing locally relevant policy options. Global assessment bodies could also support the production of regional or national environmental assessments.

Make use of strategic moments to align an assessment's niche and process with the needs of environmental governance

Many GEAs have recurring assessment cycles and/or multi-annual work programmes. The drawing up of such a long-term planning provides a window of opportunity for strategic reorientation of the GEA. This moment, before a full assessment process is started, might allow for a discussion to be held not just on the substance to discuss in a future report (the scoping), but also on the purpose and audience it is expected to serve – who is helped by what? These reflections could also cover the most suitable presentation of the assessment and which actors to involve. Such a process of reconsideration takes time. This means it is important that mandating parties avoid trying to reach immediate agreement on an approach for possible follow-up, but, instead, actively create opportunities for strategic reorientation. The option to substantially alter or even terminate a GEA could be presented as a reference point for the added value of a subsequent assessment cycle.

FULL RESULTS

1 Introduction

Global Environmental Assessments (GEAs) such as those produced by the Intergovernmental Panel on Climate Change (IPCC), the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the United Nations Environment Programme (UNEP) play a prominent role in global environmental governance (Biermann, 2002; Cash et al., 2003; Rothman et al., 2009; van der Hel and Biermann, 2017). They synthesise the state of the art of fragmented scientific knowledge and provide insight into scientific agreement and disagreement on answers to policy-relevant questions, with the aim to improve the quality of decision-making. Rather than attempts to move the 'frontier' of scientific knowledge on an environmental issue, they serve to *re*-present the current state of the science (including uncertainty and confidence limits) in a manner that is relevant to policy-making. In this sense they operate at the 'interface' of science and policy-making.

Due to their influence, it is important to maintain critical scrutiny of how GEAs fulfil their role, including in relation to wider societal developments. This report aims to do just that. It discusses the purposes GEAs can serve and how their assessment processes are organised, as well as the implications of changing dynamics in science, policy, and society for their effectiveness. Accordingly, it creates insight into choices and options influencing the effectiveness of future assessment processes, while acknowledging that there is no one-size-fits-all model and that individual assessments are part of a wider assessment landscape. In this way, we aim to inform decision-makers in GEAs on how to keep global environmental assessments fit for purpose.

We do not aim to provide a comprehensive evaluation of the 'success' of past GEAs. They are widely considered to have significantly contributed to environmental decision-making (Carraro et al., 2015; Kowarsch and Jabbour, 2017; Oppenheimer et al., 2019). However, this does not necessarily guarantee that GEAs retain this value into the future. Contemporary assessments are generally produced in highly institutionalised processes, organised along strict rules (Oppenheimer et al., 2019). As a consequence, their production processes are to a substantial degree path-dependent: procedures followed in the past are usually followed again in the future. Although these processes are designed to ensure the effectiveness of GEAs as science–policy interfaces, this path-dependence reduces their ability to readjust to changing dynamics in science, policy and society.

It is increasingly clear that these dynamics are changing. There is a large and growing number of GEAs, while latent discontent exists among policymakers regarding lack of interrelationships, as well as possible overlap. With respect to governance, many GEAs have been produced assuming governance of the issue at hand (e.g. climate change, biodiversity loss) takes place through single-issue multilateral environmental agreements and governmental process. However, recent agreements take a more integrated approach

(e.g. Agenda 2030 and the New Urban Agenda). Furthermore, the importance of multilateral governance seems to be waning relative to an emergence of other forms of environmental governance, in which actors including local government authorities, the private sector and civil society have gained increasing prominence. Finally, GEAs operate in a politically charged context in which science is not self-evidently authoritative and environmental issues in particular are increasingly at the centre of political debate. All this raises the question if current GEAs are fit for purpose in the present world, and able to respond to societal developments?

This study was instigated by requests from the Dutch Ministry of Infrastructure and Water Management and the Ministry of Foreign Affairs. The study is based on a combination of literature review, 21 semi-structured interviews with scientists, practitioners and policymakers closely involved in GEAs (see Appendix I for a list of interviewees), and a 1.5-day workshop on the future of GEAs with researchers and policymakers (see Appendix II for a list of attendees). Furthermore, the study has benefited from our personal experiences as coordinating and lead authors in UNEP's Global Environment Outlooks and the IPBES Global Assessment.

Chapter 2 discusses what GEAs do. It discusses their purpose, the 'enabling' functions they fulfil and how these functions are part of longer chains of actions by different actors, and how their procedures are organised in line with different interpretations of what makes them successful. By seeing GEAs as a process rather than only a report, it is possible to gain a better understanding of their possible outcomes as well as the challenges they face in their production.

Chapter 3 presents an analysis of the current 'assessment landscape'. It discusses how various themes and enabling functions are covered by different GEAs published between 2015 and 2020. This analysis helps to understand the relative position of different GEAs to each other, potential overlap between GEAs as well as blind spots in the coverage of themes and functions.

Chapter 4 describes how the governance context GEAs operate in is changing, with the traditional focus on multilateral policy-making losing prominence relative to an emerging importance of non-state actors in environmental governance. Furthermore, the chapter discusses how contested scientific authority presents new challenges for GEAs' effectiveness.

Finally, building on the analysis in the preceding chapters, Chapter 5 provides possible actions and considerations to keep future GEAs fit for purpose.

2 What GEAs do and how they do it

What GEAs are can best be understood by considering what they *do* and *how* they do it. There are several possible purposes for which GEAs can be undertaken, facilitating various aspects of environmental decision-making. The degree to which they do so successfully depends in part on their ability to balance different demands placed on their procedures. At the same time, fundamental to understanding the role of GEAs is that they can enable actions by different actors. This Chapter discusses ten enabling functions GEAs can have through their report as well as the process in which they are produced, and how GEAs organise their procedures to fulfil these enabling functions successfully.

2.1 GEAs as a process

Science plays an important role in much of environmental policy-making. Scientific research may identify current and future environmental problems, evaluate their impacts, analyse the effectiveness of policy intervention and propose certain policy mixes. However, science is not a single coherent body of work. There are myriad scientific communities, all analysing different elements of an environmental problem from various perspectives, or working on interdisciplinary, integrated analyses. Addressing environmental issues comprehensively requires the combination of knowledge from many different scientific communities. As a result, processes of assessing the state of scientific knowledge and presenting this knowledge have become widespread. In GEAs, experts compile and organise existing scientific information on environmental issues in a format that is useful in the decision-making process (Jabbour and Flachsland, 2017; Mitchell et al., 2006), aiming to be 'policy-relevant, not prescriptive' (Rothman et al., 2009; Turnhout et al., 2016).

In public and policy coverage, GEAs are best known for the large reports they produce, generally accompanied by a Summary for Policymakers (SPM) containing the most policy-relevant messages of the study. However, GEAs encompass more than a written report. Importantly, in their production, they often convene meetings of experts and policymakers to discuss the mandate, scope and results of the study. Although there are a few single edition GEAs, many are conducted more often, meaning new editions are regularly published under the same flag as previous ones. In this way, communities of regular contributors are created. GEAs are thus both a *report* and a *process* (e.g. Bakkes et al., 2019; Jabbour and Flachsland, 2017). This process ranges from scoping (what questions to answer) to writing (answering the questions) and summarising (main messages, sometimes including SPM negotiations), and finally to disseminating and reaching out.

Box 1. History of assessments

This report focuses on global *environmental* assessments, but scientific assessments more generally have a history that goes back at least two centuries. For example, between 1889 and 1896, a UK Royal Commission weighed evidence for and against vaccination. Based on 136 meetings and testimonies from 187 witnesses, they delivered a 500-page final report recommending the use of vaccines against smallpox and theremoval of penalties for non-compliance (at the time, a punishable offence) (Oppenheimer et al., 2019). As was normal in those days, this concerned an ad-hoc commission with relatively few members (commissions of more than a dozen were uncommon). In the 20th century, these types of assessments changed to the highly institutionalised and large-scale form of today (Oppenheimer et al., 2019).

2.2 Enabling functions

By presenting the current state of the science, GEAs can fulfil multiple *enabling functions*. We use the term *enabling* to emphasise that GEAs do not directly result in environmental action, but rather enable activities by other actors. This means that the impact of assessments also includes the chains of subsequent actions they facilitate. For instance, the enabling function of demonstrating the urgency of an environmental issue is commonly established by news media reporting the key messages, which in turn might lead to political debate and eventually to new or different policies being implemented. Another example of how such a chain may work is the Dutch High Court's use of IPCC's Fourth Assessment Report to set a legally binding CO_2 emission reduction target for the Dutch Government (see e.g. van Zeben, 2015). The enabling functions of GEAs are thus part of a wider logic through which GEAs (and knowledge more generally) contribute to decision-making processes for achieving societal goals (cf. van Drooge and Spaapen, 2017).

From interviews and literature review we identify ten enabling functions that are both sought after and ascribed to GEAs (National Research Council, 2007; Oppenheimer et al., 2019; Riousset et al., 2017; Rothman et al., 2009; Turnhout et al., 2016; Wyborn et al., 2018). We categorise these functions into (a) enabling functions for policy-making, (b) enabling functions supporting policy processes, (c) enabling functions for science.

A. **Enabling functions for policy-making.** Through these functions GEAs support elements of the policy-making cycle[1].

1. *Demarcate the issue*. GEAs can define the terms through which a problem is understood (cf. Hoppe, 2016). For instance, the IPCC has been described as instrumental in the currently dominant framing of climate change as a global issue (Miller, 2004). In this reading, the IPCC facilitated a shift from an understanding of climate as a local phenomenon – the long-term average of the weather – to a global one, which is largely understood through the help of computer models (see also Demeritt, 2001; Edwards, 2010). Currently, the IPBES conceptual framework is broadening the concept of 'ecosystem services' to 'nature's contributions to people' (Díaz et al., 2015).

2. *Agenda-shaping*. GEAs can demonstrate the urgency of a problem, thereby 'reducing the political risk of acting' (van Bers et al., 2007). While the term assessment is rarely used for work that does not demonstrate that there actually is a reason to think of an issue as problematic, it is important to acknowledge that assessments often play an important role in emphasising and substantiating this. This function can be very visible in popular coverage of assessments, as was for instance the case with the launch of the IPBES Global Assessment. Its media release contained the statement that one million species are threatened with extinction, which was widely picked up by multiple media outlets.

3. *Contribute to potential policy goals and targets*. GEAs may suggest types of goals and targets to be set, in order to achieve a certain policy objective. For instance, the IPCC's 'reasons for concern' diagrams function as a tool to explore the meaning of 'dangerous interference', in the context of UNFCCC's stated goal of avoiding 'dangerous anthropogenic interference with the climate system' (see also Mahony and Hulme, 2012).

4. *Suggest potential policy interventions and instruments*. GEAs can assess the knowledge on policies that could be pursued, ranging from individual measures to combined strategies and possible pathways. For instance, the IPBES Global Assessment discusses five 'levers' and eight 'leverage points' through which policy can contribute to addressing biodiversity loss (IPBES, 2019a). While assessments rarely include 'new' policy instruments, they may lend credibility to existing options without prescribing certain policies. They can also contain ex-ante evaluations of policy measures to assess their efficacy, conditions, and coherencies and incoherencies. Further, many contemporary GEAs use integrative solution-oriented pathways to analyse internally coherent scenarios to achieve globally agreed goals and targets (Kowarsch et al., 2017b; van Vuuren et al., 2012).

[1] While noting the policy-making cycle is a simplifying heuristic, this does not capture the full complexity of policy-making processes.

5. *Monitor progress*. GEAs may contain an analysis on whether globally agreed environmental goals of multilateral environmental agreements are expected to be met given current trends and policies. This is mostly done in generic terms, rather than as part of a formal framework for accountability and policy evaluation. For instance, the IPBES Global Assessment assesses progress on the 20 Aichi Targets as well as several SDGs and the goals and targets of six other global agreements (IPBES, 2019a). Furthermore, the sixth Global Environment Outlook assesses if the world is on track to achieve the environmental dimension of the Sustainable Development Goals, focusing on a selection of targets (UNEP, 2019).

B. **Enabling functions supporting policy processes.** Through these functions, GEAs contribute to conditions facilitating more effective implementation of policies.

6. *Capacity-building for policy*. GEAs and their assessment bodies can contribute to various types of capacity-building. Government authorities can be aided in processing results of assessment reports, for instance through technical support, or in enhancing the capacity of national/regional statistics bureaus, e.g. for improved monitoring of environmental quality. IPBES has a specific mandate to not just produce assessments, but also contribute to capacity-building, provide policy support, and undertake outreach activities. GEAs can also spur the development of other assessments. For instance, the Global Environment Outlook has spurred various assessments at the regional and national level (Bakkes et al., 2019).

7. *Social learning.* Production processes of GEAs can provide forums at which scientists, policymakers and other stakeholders can interact and exchange views, thereby contributing to mutual learning of different perspectives on the complexities and uncertainties related to the problem at hand (Kowarsch et al., 2016). This also includes researchers being able to learn about what kind of information stakeholders desire, the forms and channels to communicate by, as well as what the 'right time' to communicate by is (Hudson et al., 2016). Moreover, social learning processes are seen to generate a kind of co-produced knowledge that increases participants' ability to take joint action (Schneider et al., 2019).

8. *Standardisation.* GEAs may be a way for methodological or metrological standardisation. For instance, IPBES developed a methodological assessment report on scenarios and models (IPBES, 2016) and the IPCC has developed guidelines for national greenhouse gas inventories (IPCC, 2019).

C. **Enabling functions for science.** Besides the policy-oriented functions, GEAs also serve the organisation of science itself, as well as its funding.

9. *Agenda-shaping for scientific research.* Because GEAs provide an overview of the state of the art of research, they also provide opportunities for researchers to develop and formulate new research questions (cf. Vasileiadou et al., 2011). Many reports contain sections identifying further research questions. This includes knowledge and data gaps. In the production of GEAs scenario databases can be created to facilitate scenario cross-comparisons. At the same time, using research resources for the requirements of GEAs may go at the expense of other possible research topics (Mastrángelo et al., 2019; Oppenheimer et al., 2019).

10. *Capacity-building for science.* GEAs can play a role in developing capacity among authors and reviewers to conduct research according to international standards and participate in assessment processes. Within GEA bodies, these take shape as scholarships for PhD students from developing countries (e.g. IPCC) or programmes aimed at getting junior scientists involved with assessment processes (e.g. IPCC and IPBES) (see also Schulte-Uebbing et al., 2015). But similar initiatives also exist outside of existing GEA bodies, for instance, in the form of a short online course on 'how to review IPCC reports'.[2] Furthermore, GEAs contribute to developing networks between researchers, leading to new collaborations and new research communities.

Individual GEAs generally do not fulfil all these functions. Some also have broader mandates than others. Funding allocations across parts of a mandate also influence the extent to which certain activities can be undertaken in practice. But it is also not necessarily possible that all these enabling functions can co-exist in a single assessment process, in the first place; for instance, due to strongly different types of work or amounts of time required to fulfil certain functions compared to others. For instance, capacity-building requires a different kind and duration of engagement with audiences than monitoring progress does.

Aside from an assessment's formal mandate, they can also implicitly enable actions by other actors. For example, physical meetings between GEA authors as part of the writing process can also create opportunities for them to network with other researchers. While networking may not have been part of why the meeting was called, it is nonetheless a positive side effect. Of course, it is possible for these kinds of side effects to become integrated in more formal goals over time.

Because many assessments are recurring processes, the functions a GEA fulfils can also shift over time in relation to the dominant phase of policy-making (see also e.g. UNEP, 2017; van Vuuren et al., 2012). Important examples of recurring assessments are the IPCC reports

[2] https://futureclimateafrica.org/news/mini-e-course-how-to-review-ipcc-assessment-reports-webinars-and-guidance-for-climate-experts/

(now in their sixth assessment cycle) and the Global Environment Outlook (which recently published its 6th edition and is scoping a possible next phase). And although the work programme does not include it yet, it seems likely a new IPBES Global Assessment will at some point be scheduled. In part, these recurrences can be seen as an update to the state of the knowledge relative to their previous version, but in that update may also shift their emphasis to different enabling functions.

2.3 Criteria for success

The degree to which GEAs perform their enabling functions successfully may of course vary (UNEP, 2017). While success is often interpreted in terms of direct 'impact', preferably in quantitative terms, the fact that assessments are *enablers* of actions by various actors means that such an approach is infeasible. No widely accepted standards for evaluating the effectiveness of GEAs exist (Alcamo, 2017). Instead, GEAs define and operationalise a set of criteria that, when met, are seen to indicate an effective assessment by many people, including several of our interviewees. These criteria can be defined as follows (Cash et al., 2003; Pintér et al., 2012; van der Hel and Biermann, 2017):

- **Relevance (also termed salience)**: the relevance of the assessment to decision-makers' needs. For this, assessments aim to comprehensively integrate the 'best available knowledge' (Wyborn et al., 2018). Furthermore, many are formally or informally affiliated with forums of international environmental diplomacy, and align their procedures with generally accepted procedures of multilateral negotiations (Díaz-Reviriego et al., 2019), for instance by ensuring governments have a say in what questions are answered (the mandate and scope of an assessment) and having specific rounds of government review, as well as in many assessments containing a Summary for Policymakers (SPM) that is formally negotiated and approved by participating governments.
- **Credibility**: the scientific adequacy of the assessment. For this, assessments emphasise peer-review procedures and the scientific credentials of those producing the assessment. This involves a strong focus on scientific peer-reviewed literature, taken to certify scientific merit (Biagioli, 2002), while using specific quality criteria for allowing 'grey' literature. Furthermore, assessment procedures generally organise open peer-review rounds, in addition to governmental review, and many assessment bodies have specific scientific oversight panels.
- **Legitimacy**: treating different values, interests and beliefs fairly. This criterion is often primarily addressed by balancing scientific disciplines, geographical representation and gender of scientists involved in the assessment (Montana, 2017). In some cases, specific steering groups largely composed of government representatives exist to ensure that relevant stakeholders and knowledge sources are represented. Underlying the emphasis on these balances is the perceived importance for the acceptance of the report by different states, as well as that a diverse author team is seen to ensure a 'balance of bias' that is considered to result in an objective assessment (Oppenheimer et al., 2019).

Meeting criteria for success is challenging

The usual way of defining and operationalising the above described criteria for success may make them seem more straightforward than they are in practice. The following examples illustrate that meeting the criteria according to their usual definition can be challenging, and that the criteria are at most 'ideal states':

- Many assessments struggle to achieve an even geographical representation. European authors are usually over-represented, whereas the participation of African and Latin-American authors is scarce (see also Ho-Lem et al., 2011; Mahony and Hulme, 2018; Montana and Borie, 2016; Timpte et al., 2018).
- The way GEAs are currently produced is faced by an increase in the complexity of the process and the growing body of literature to assess (Jabbour and Flachsland, 2017; Minx et al., 2017). Recent assessments cite thousands of sources and receive tens of thousands of review comments, while their procedures generally prescribe that each and every one of these is replied to. This means that the mere logistical task of doing an assessment according to current procedures has increased drastically, while supporting staff has not grown in parallel (Jabbour and Flachsland, 2017).
- By operating from a principle of scientific consensus, assessments risk omitting information that is policy-relevant precisely because of its uncertainty, such as tipping points in the climate system (Oppenheimer et al., 2019; Scoones, 2009; van der Sluijs et al., 2010). While many assessments include sections or chapters listing knowledge gaps, these are generally not included in their SPMs, meaning they are not seen by most policymakers.

Interpretations of criteria differ and can be contradictory

At the same time, a more fundamental challenge underlies these criteria. Different stakeholders may have different interpretations of what meeting the criteria entails, including by applying different hierarchies in the relative importance of each criterion. These interpretations do not always align and strategies to meet one interpretation may directly contradict efforts to meet another. Furthermore, different criteria may also be deemed important, such as feasibility (how do expectations relate to available time/resources), understandability (what is the target audience's level of envisioned background knowledge and of the language) or independence (to what degree are the assessments' producers autonomous in the process) (Kowarsch et al., 2016; see also e.g. Kunseler and Verwoerd, 2019). Of course, interpretations exist in which these are part of the above-mentioned criteria, but they can equally be considered separate and possibly contradicting.

A prominent way in which such contestation is visible is in the practice of having a government-negotiated SPM. Some analysts and interviewees reject this practice arguing that 'the science is not negotiable' (cf. Hulme et al., 2010; Victor et al., 2014), while others support this process arguing it increases government buy-in with the assessments' results (cf. Riousset et al., 2017). Neither the literature nor our interviewees give an unambiguous view on the degree to which this procedure's alleged, but also observed, 'watering down' is balanced by the opportunity to make clarifications, communicate the results, and increase governmental ownership of the content.

The operationalisation of credibility in GEAs is primarily in terms of accountability to scientific communities. It makes intuitive sense that GEAs are accountable to the communities whose work they represent, but sometimes scientific accountability is wrongly equated with public accountability (Beck, 2012). However, an assessment that is considered perfectly credible to the scientific community, does not have to be so to the wider public (Jasanoff, 2010). For instance, when emails from the University of East Anglia were hacked and errors in the melting of glaciers in the Himalayas and sea level rise in the Netherlands were found in IPCC's AR4, PBL Netherlands Environmental Assessment Agency was asked to investigate the report for any additional issues (PBL, 2010). While this exercise made many researchers in PBL and the climate research community uncomfortable, seeing it as harmful to the IPCC and PBL, the then General-Director Maarten Hajer argued it allowed PBL to engage in dialogues with groups otherwise rarely reached, helping to build credibility more broadly than just among scientific peers (Hajer, 2012). While this exercise was perhaps not deemed necessary for scientific accountability, it did help to build or rebuild public accountability (Tuinstra and Hajer, 2014). This is important because public accountability can be relevant for the use of assessment outcomes in the activities of other actors, such as politicians.

Interpretations differ of what science can and should contribute

Many assessments are structured around the assumption that their relevance is dependent on their ability to provide information directly related to questions of policymakers. This assumes that policymakers are both willing and able to ask questions – for instance assessing the effectiveness of past policies has been a notoriously difficult question for policymakers to accept. But it can also be seen as being at odds with an independent assessment process, making assessments forego other possible purposes, such as more fundamentally questioning the narratives and framings underpinning the policy questions so as to contribute to envisioning alternatives to the status quo (Castree et al., 2014; Machen, 2019; Turnhout, 2018).

The expertise required for solution-oriented assessments may differ

Another challenge for assessments stems from the fact that they increasingly assess (and are increasingly asked to assess) possible solutions to the environmental problems they cover (Kok et al., 2008; Kowarsch and Jabbour, 2017). This means they not only address changes in the states of natural systems, but also in socio-economic and political ones. As a result, there is a need for additional expertise from the social sciences, which have historically been underrepresented in GEAs (Heffernan, 2016; Stenseke and Larigauderie, 2018; Timpte et al., 2018).

Currently, assessments' emphasis on providing a single, coherently integrated message sits uneasily with the kinds of knowledge these sciences could be particularly complementary for. Namely, their ability to open up space for a political discussion on what solutions could be seen as desirable from both an environmental and socio-economic point of view, by discussing aspects such as how measures might impact different groups of people unequally (Castree et al., 2014; Lövbrand et al., 2015). In that sense here also, different stakeholder groups' interpretations of what contributes to a successful assessment clash.

Science 'on top' or 'on tap'?

An assumption underpinning many assessment procedures is that good governance is a matter of 'getting the facts' right (van der Sluijs et al., 2010). As a large body of work has discussed, this is a problematically simplistic view of the role of science in policy-making that ignores the political work performed by scientific facts (see e.g. Beck et al., 2017; Jasanoff, 2004; Owens, 2015; Turnhout et al., 2016). Nonetheless, the view remains in vogue with many involved in assessments, although policymakers may be more attuned to its problematics than the scientists involved themselves.

An example brought up in one of the interviews illustrates this point (see also Wible, 2014). A draft version of the SPM of the Working Group 3 part of the IPCC's fifth Assessment Report contained a country grouping based on income. This grouping had been used in order to be able to explain variance in emissions, for which the UNFCCC's distinction in Annex I and non-Annex I countries was considered unsuitable by the IPCC chapter authors (Victor et al., 2014). However, in the SPM negotiations, this and other groupings used in the report were declared unacceptable by governments, fearing that it would be a disadvantage in the UNFCCC negotiations (Edenhofer and Minx, 2014). This example suggests that these policymakers were well-aware that the country grouping used by the IPCC is not merely a 'neutral' method to answer a purely scientific question but could serve to affect what actions would be expected from which countries in future UNFCCC agreements. Moreover, this example also suggests there is something like 'GEA craftsmanship', indicating the ability/skill of an author to relate to this operating environment and understand how their audiences use their work (e.g. Bijker et al., 2009; Owens, 2015; Palmer et al., 2018).

Consequently, GEA processes reflect a compromise between interpretations of criteria

The challenges, as outlined in this section, in meeting the various interpretations of criteria can be like multiple horses tugging a rope into different directions. As a result, compromises between interpretations and the way they are operationalised in assessment procedures are inevitable. This means that, despite the fact that these criteria are frequently cited for their significance, it is important to be careful and avoid their application without prior critical reflection on their definition and operationalisation within a GEA process. Different choices in the compromises in assessment procedures are possible, meaning there is no single best way to organise them so that they are optimally in line with the criteria for success. Current strategies followed by GEAs should therefore be seen as a result of the balance of power between the stakeholders in the assessments.

Of course, the needs and preferences of these stakeholders may change. It is possible for a regularly occurring GEA to change its procedures, over time. However, these changes take time and are often incremental because of the highly institutionalised degree of assessment processes (see also Box 2). Consequently, it is not self-evident that current compromises can be can nimbly readjusted to continue to live up to the expectations and requirements of the various stakeholders in GEAs. So, for GEAs to remain fit for purpose, it is important to monitor changes in the environmental governance context they are meant to inform.
To that end, the next chapter considers the themes and enabling functions covered in recent GEAs, with the subsequent chapter discussing the governance processes GEAs operate in.

Box 2. Repositioning the IPCC

The IPCC is often considered a flagship example of a successful GEA (Hulme and Mahony, 2010), which has caused many recurring assessments to have become more 'IPCC-like'. At the same time, the IPCC itself has also had moments in which procedures were re-established. Two of these moments stand out: the InterAcademy Council Review (IAC, 2010), which was organised in the wake of the 'Climategate' affair, and the Task Group on the Future Work of the IPCC (2013–2015), which was set up following IPCC's fifth assessment cycle.

The IAC Review was conducted at the request of the UN Secretary-General, to independently evaluate the IPCC's functioning. The report made a number of recommendations related to IPCC management processes, communication, quality control and procedures related to the peer review of reports (IAC, 2010). These recommendations were largely adopted by the IPCC through several subsequent reforms of its procedures (Bregman, 2013; Gustafsson, 2019).

These reforms focused on transparency with regards to science and governments (Beck, 2012), as necessary changes to ensure the IPCC's procedures met the requirements of IPCC's stakeholders in an appropriate way. However, these requirements, and who to count among these stakeholders, were not in themselves part of the discussion. Arguably, the Task Group (TG) on future work of the IPCC provided a more explicit window of opportunity for considering these questions. The TG was installed following a call for governments to submit their considerations regarding the future of the IPCC (IPCC, 2013a; see also e.g. Thoni and Livingston, 2019), which, together with submissions from IPCC authors and several international organisations, were used by the TG to create a document outlining possible options (IPCC, 2014).

However, in this process, the scope of options open for consideration seemed to decrease progressively. For instance, initial country submissions included relatively fundamental suggestions, including for example concerns from non-state actors in scoping and including them as intended audience, whereas a synthesis of these comments already summarised the IPCC as having to respond to 'informational needs of governments and the UNFCCC' (IPCC, 2013b). The mandate for the TG itself was also limited to reviewing future products and their appropriate structure, and how the participation of developing countries could be improved. Consequently, the final decision as adopted by the IPCC contained few substantive changes in the IPCC's structure, mandate and processes (IPCC, 2015; Petersen et al., 2015). This illustrates that, even if GEAs attempt to periodically re-think their processes, it can be difficult to achieve more than incremental changes.

3 The assessment landscape

Over the past decades, there has been a large increase in the number of assessments (Jabbour and Flachsland, 2017). Most of these have sought to target a specific thematic or policy niche. However, there is little overview of the full 'assessment landscape', i.e. a description of what global environmental assessments there are and what they do. This chapter provides an overview of the distribution of GEAs published across enabling functions and environmental themes they cover.

3.1 Methodology: compiling the assessment landscape

The analysis of the assessment landscape focuses on global environmental assessment reports published since 2015, the year Agenda 2030 was adopted. Assessments were identified building on the organisations and reports identified by Jabbour and Flachsland (2017) in their analysis of 40 years of GEA-making. Subsequently, assessments were categorised based on the enabling functions and environmental themes covered, making use of press releases, website texts, introductory chapters and tables of contents of the respective reports. The availability of these sources varied per assessment report.

By focusing on reports, we delimited the analysis to the five enabling functions for policy (Category A in Chapter 2). The other enabling functions are generally outcomes of the process, on which official documentation on expected contributions is sparse. For instance, the IPBES mandate includes capacity-building, policy support and outreach activities, in addition to, rather than part of, the production of assessment reports. Considering IPBES is among the 'youngest' assessment bodies, this broader mandate can be seen as resulting from a changing view of what makes a GEA body effective (Beck et al., 2014; Brooks et al., 2014; Hulme et al., 2011; Turnhout et al., 2012).

The selection of environmental themes roughly follows the five thematic areas included in the sixth Global Environment Outlook – climate, biodiversity, land, fresh water and oceans – which we expanded with resource use as an environmental theme attracting increasing attention. Assessment reports can be assigned to multiple environmental themes. This thematic criterion means assessments focusing on a specific sector (e.g. energy or

agriculture) rather than an environmental theme are excluded. Some possible environmental themes are not included, such as air pollution, or may be shared under another theme (e.g. reports addressing chemicals or waste are classified as resource use). In order to be assigned to a theme a report has to explicitly address the issue along one or more of the enabling functions. For instance, although the IPBES reports discuss climate change, they do so in the context of its impacts on biodiversity. They are therefore not classified as addressing the climate theme. Conversely, thematic reports such as the IPCC Special Report on Climate Change and Land explicitly addresses the interlinkages between the two themes and is therefore categorised in both.

Of course, a categorisation like this is not without ambiguity. To keep this ambiguity to a minimum, the categorisation was reviewed both within PBL and by the UNEP Science Division. Furthermore, it should be stressed that this analysis provides an impression of the degree to which recent assessments cover the various enabling functions and environmental themes. Large differences also exist between reports in terms of their prominence in public and policy debate, and the degree to which their enabling functions have been effective. This means that the quantitative dimension of this analysis (how many assessments do X, what percentage addresses theme Y) should not be over-emphasised.

3.2 The assessment landscape

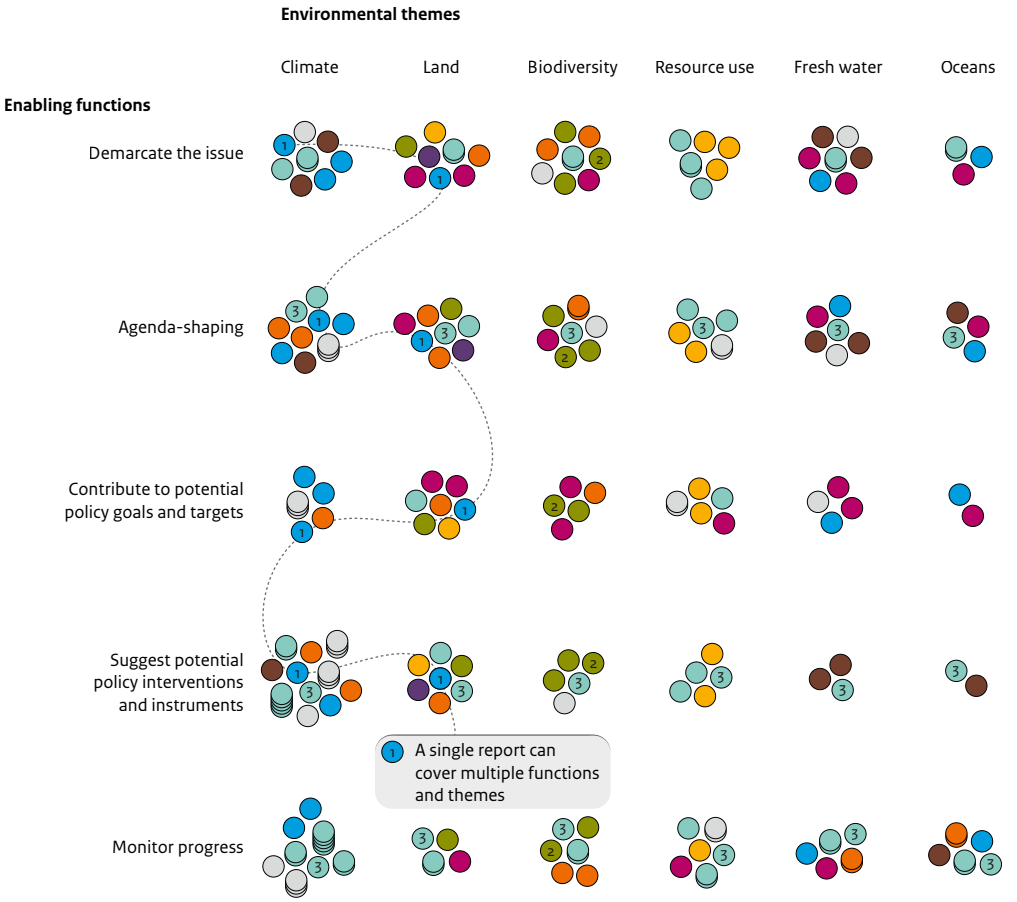
From the identified assessments, a total of 53 were selected that were published between 2015 and 2019 and took at least one environmental theme as its core focus (see Appendix III for a list of assessments included). As some assessment reports are published on a regular basis (e.g. the UNEP Emissions Gap Reports), 41 unique reports are included in the analysis. Regular reports were assumed to have the same functions and environmental themes each iteration. Figure 1 presents a graphical overview of the assessment landscape. Each circle represents an instance of a report covering a certain function for a certain theme, so that the same report can be represented by multiple circles in different combinations. Together, the assessments cover 116 functions and 61 themes. While most reports cover multiple functions (generally 2 or 3), only a few reports cover multiple themes.

Most assessments are thematic, only some are broad

Reports by assessment bodies, such as the IPCC, IPBES, and UNEP-IRP, focus largely on their thematic area, i.e. climate, biodiversity and resource use, respectively. Of these three, the IPCC can be considered the most well-established thematic GEA body, having provided regular assessment reports since the early 1990s. While IPBES is a relatively new assessment body, other reports specifically targeting biodiversity and ecosystem services have been produced including the Millennium Ecosystem Assessment (Millenium Ecosystem Assessment, 2005), Global Biodiversity Assessment (Heywood, 1995) as well as several Global Biodiversity Outlooks (CBD, 2014). UNEP-IRP is another relatively new thematic assessment body.

Figure 3.1

Themes and functions covered by global environmental assessment reports, 2015 – 2019



Source: PBL

Annex III contains an overview of the assessments included.

Thematic assessment reports tend to provide in-depth analysis of the theme at hand. At the same time, a possible consequence can be that it leads to pillarisation, in which relevant relationships between different environmental themes are addressed only to a limited degree. Especially when it comes to policy responses this could be seen as problematic, when trade-offs exist that could have been avoided, synergies that could have been used, or if multiple negative effects concentrate within a small group of people and/or ecosystems. While it is impossible to address all interrelationships, the comprehensive approach many assessments pride themselves on may suggest they provide an all-encompassing synthesis. This could lead to reports providing different answers to similar questions, especially when considering policy options that go beyond the immediate environmental theme, limiting their ability to inform decision-making. Furthermore, unnecessary 'double work' may occur when different assessments synthesise virtually identical bodies of literature, which is already an increasingly complex task due to its large volume (Jabbour and Flachsland, 2017).

In contrast to thematic assessments, several reports, most notably from UNEP and OECD, can be considered broad, covering multiple thematic areas. However, what these assessments gain in breadth, they may lose in depth. For a single report to synthesise both detailed expert knowledge on a range of themes as well as on their interrelationships, *and* still be able to present this in an accessible format, can be too much to ask. This does not have to be a problem, as long as the added value sought is in synthesising knowledge on interrelationships. Attempts to avert losing depth can go at the expense of insight into interrelationships. For example, because GEO-6 includes in-depth discussion on five individual environmental themes, attention is to some extent deflected from their interrelationships and the shared issues faced by environmental governance on these different themes.

Land as framework for integration of other themes

While assessment bodies tend to focus on their core environmental theme, several have also produced reports focusing on land, e.g. the IPCC Special Report on Climate Change and Land and the IPBES Assessment Report on Land Degradation and Restoration. These reports explicitly deal with the link between land and the core environmental theme of the assessment body, i.e. climate change and biodiversity loss, respectively. As a consequence, land is less of a pillarised theme than other environmental themes. This can be explained by the fact that many environmental challenges centre on land, and that land can thereby act as a framework for integration (UNCCD, 2017). Through changes in the condition and use of land (or land degradation), land features as cause of climate change and biodiversity loss. However, land is also where potential opportunities lie – it provides possible routes to climate mitigation (e.g. biofuels, reforestation) and plays an important role in climate adaptation, ecosystem restoration and solutions to cope with water stress or flood risks. The second edition of the Global Land Outlook, expected by late 2021, will provide a synthesis of land-related solutions, building on the knowledge base of GLO-1 (UNCCD, 2017).

Few assessment reports on fresh water and oceans

Only a few thematic reports on fresh water or oceans have been published, while several broad reports include fresh water and oceans, mostly in terms of their interaction with other environmental themes, e.g. GEO-6, the IPCC Ocean and Cryosphere report and the OECD Land-Water-Energy Nexus report.

For fresh water, a possible explanation is that governance of freshwater bodies is commonly performed through arrangements specific to a river basin or lake, with only the countries with a direct geographic interest represented. General statements addressing the urgency of an issue such as water stress are made in broad reports, mostly in relation to other themes (e.g. climate change, food production). However, there may be relatively little demand for scientific information on possible responses at the global abstraction level in such freshwater governance arrangements, while they may instead provide local scientific assessments. For instance, the Mekong River Commission publishes a five-yearly State of the Basin report to inform joint management and sustainable development of the Mekong River (Mekong River Commission, 2018).

For oceans, there is currently little specific environmental governance in place, partially because much of the ocean is beyond national jurisdiction. Nevertheless, interest is growing. A fourth and final round of negotiations was planned for an intergovernmental agreement on marine biodiversity in April 2020, and a UN Oceans Conference was been planned for June 2020.[3] Furthermore, a first World Oceans Assessment was launched under the auspices of the United Nations in 2017 and a second is to be published in 2021.

Occupancy of functions reflects phase in policy cycle

There are clear differences in how the various assessment bodies cover the different enabling functions. Whereas the conventions on climate, land and biodiversity all originate from the Rio Earth Summit in 1992, they have progressed differently in terms of political attention and action, which is also visible in their GEAs. As one would expect, on climate the IPCC reports are important on all functions. This is especially the case for operationalising goals and targets, while suggested solutions are also provided by a relatively large number of reports from other bodies. Conversely, for biodiversity there is no such proliferation of solution-oriented assessments from different bodies (more than half are IPBES reports), and GEAs focus more on functions in the early phases of policy-making, i.e. demarcating the issue and agenda-shaping. For land, the functions covered by assessments are more evenly spread out; only monitoring progress is not that well covered. In line with above statements that many assessment bodies produce land-related reports, many other bodies than the UNCCD also cover the enabling function to suggest potential policy interventions and instruments for land-related issues. The number of land-related reports indicate that land seems to be increasingly high on the international agenda, as also evidenced by, for instance, the Bonn Challenge to restore deforested and degraded land and by increased attention for nature-based solutions linked to

[3] At the time of writing, both have been or are expected to be postponed due to the Covid-19 pandemic.

land restoration practices in climate governance. At the same time governance uptake of land at other levels (e.g. national policy-making) remains limited, compared to climate and biodiversity.

Assessment landscape mirrors thematic environmental governance approach

In their analysis of the 40-year history of GEA-making, Jabbour and Flachsland (2017) conclude that the way assessments are conducted is related to the way they are embedded in political and institutional processes. Extending their argument to the wider set of assessments analysed here, we can take the assessment landscape to reflect the dominant approach to environmental governance. From the relatively large number of thematic assessments, this would suggest a predominance of thematic environmental governance approaches in which there is limited, but increasing, attention for other themes.

For broad assessments, this implies they may find it challenging to address a suitable audience. The foremost example of this is GEO. While one of the longest running regular GEAs, it lacks a clear governance forum as target audience. GEO-6 was linked to the United Nations Environment Assembly (UNEA), but by being launched during UNEA itself the assessment could not directly contribute to the resolutions discussed there. With its broad scope, GEO could be positioned to contribute to a more integrated environmental governance approach. Another core contribution of the various GEOs seems to be the spin-off they have generated through informing the production of domestic and regional reports for local environmental governance (Bakkes et al., 2019).

At the same time, interest in cross-cutting GEAs seems to be on the rise, in part related to the adoption of Agenda 2030. Several cross-cutting reports have recently been produced, and the work plans of assessment bodies contain several more for the near future. For instance, the upcoming IPBES Work Programme contains a technical paper on biodiversity and climate change to be jointly produced by IPBES and IPCC, as well as a thematic assessment on interlinkages between biodiversity and other themes (IPBES, 2019b).[4] However, the effectiveness of such cross-cutting reports may require more than different GEA secretariats and scientific communities collaborating, but is also dependent on the degree to which they are matched by policy processes attending to similar interlinkages. It may not be necessary for these processes to be fully integrated, but without mechanisms in thematic policy processes that create space for interlinkages to be considered, cross-cutting reports may end up facing similar challenges as broad reports.

[4] The 'Nexus' assessment: biodiversity, water, food and health, in the context of climate change.

4 Governance context of GEAs

GEAs operate in the governance context of environmental issues. As the previous chapter discussed, this governance context is reflected in GEAs in terms of which enabling functions they emphasise and how they organise their processes accordingly. However, because GEAs are highly institutionalised they are also path-dependent, and this might limit their ability to readjust to a changing governance dynamic. This chapter discusses the governance context of GEAs, in which a shift from multilateral to polycentric governance is taking place and in which the politics embedded in assessments are becoming increasingly visible.

4.1 Traditional governance context of GEAs

Many GEAs have focused on governance as orchestrated through multilateral negotiations (cf. Díaz-Reviriego et al., 2019). Their influence is generally uncontested in this arena, and many interviewees see a close link with a Multilateral Environmental Agreement (MEA) as crucial for a GEA's effectiveness. The unofficial but widely recognised link between the IPCC and the UNFCCC is probably the most prominent example of this, while the Global Biodiversity Outlook[5] and the Global Land Outlook are formally linked to the CBD and UNCCD, respectively. In this respect, assessments have been suggested to lay the shared knowledge foundations of international negotiations, with a government-negotiated Summary for Policymakers having a 'perceived binding force' in these negotiations (Riousset et al., 2017).

Use of a GEA at sub-global levels requires contextualisation

Because of their role in international policy-making, it is often expected that assessments contain the knowledge national governments require in order to act in line with the goals they agreed to internationally (Soberón and Peterson, 2015). However, as many interviewees acknowledge, the assumption of global reports being useful in national contexts is problematic because it is nigh impossible for a single document to satisfy the diverse contexts of close to two hundred different countries. In part, this is because different countries and cultures are known to have different 'rules' through which the public and policy-making expects knowledge to be produced and used in decision-making (Beck, 2012; Halffman, 2005; Jasanoff, 2005). Additionally, issues may be framed differently in different countries. Also more fundamentally, it is difficult to make a highly globalised type of

[5] The Global Biodiversity Outlook's importance can be expected to decrease with the advent of IPBES and its first Global Assessment.

knowledge meaningful in local contexts (Heymann, 2018; Hulme, 2010; Sarewitz, 2010; Turnhout et al., 2016), be they governmental or non-governmental. So, while the various enabling functions mean GEAs create an impetus for global and regional environmental governance and may suggest analogous policy interventions, in effectuating these suggestions more localised types of knowledge and experience are required (Jasanoff and Martello, 2004).

A number of activities are undertaken through which assessments are contextualised to a specific governance context. The subsidiary bodies on scientific and technical matters (SBST(T)A) to the CBD and UNFCCC are highly institutionalised examples through which GEAs are contextualised to these MEAs. The Structured Expert Dialogues organised by the UNFCCC, between 2013 and 2015, also functioned as a platform through which the IPCC's 5th Assessment Report and other recent scientific knowledge was discussed. At a more local level, examples include syntheses of multiple GEAs by PBL Netherlands Environmental Assessment Agency in 2008 and 2020 (Kok et al., 2008; Lucas et al., 2020) as well as a contextualisation of the 6th Global Environment Outlook by the German Environment Agency (Jacob and Wolff, 2019). However, resources available for this kind of contextualisation vary greatly between countries and actor types. As such, multilateral forums and wealthy countries are more readily served by such contextualisation processes, whereas developing countries or some civil society groups may be more directly reliant on the GEA outputs themselves.

4.2 Changing governance dynamics and consequences for GEAs

Over the past decades, a shift has taken place in which non-state actors have gained importance in environmental governance.[6] This change is commonly denoted as a shift from 'government to governance', in which environmental decision-making has become more polycentric to involve all kinds of actors (including sub-national governments and municipalities, civil society and private corporations) at all kinds of levels (e.g. international, national and local) (Bevir, 2010; Burch et al., 2019; Chan et al., 2015; Hajer et al., 2015; Ludwig and Kok, 2018; Ostrom, 2010; Patterson et al., 2017).[7] This means that aside from the challenge of enabling action by national governments through global knowledge, various other actors may place additional demands on GEAs. Consequently, GEA processes that inform polycentric decision-making may be different to the multilateral settings their current processes are tailored to (Beck and Mahony, 2018; Livingston et al., 2018; van der Hel and Biermann, 2017; Yamineva, 2017).

[6] For brevity, we use the term non-state actors to include sub-national governments as well.

[7] We use the term governance descriptively here, i.e. as a perceived change in the way governing takes place, rather than normatively, an idea of how governing *should* take place (Renn et al., 2011). We also note that this descriptive change does not mean the state has become irrelevant, as many modes of governance rely on some form of state involvement for their functioning (Swyngedouw, 2005).

So far, assessments have primarily responded the shift to polycentric governance by more actively targeting other groups as intended audiences (Kowarsch et al., 2017b; Soma et al., 2016). Currently, this mostly manifests itself in specific summaries for various types of actors. For example, for UNEP-IRP's Global Resource Outlook a specific summary was created targeting business, while GEO-6 has processes to produce different spin-off reports for Youth, Cities, and Business. Still, many assessments remain limited to discussing the possible influence of policy on non-state actors, rather than explicitly paying attention for action not directly resulting from public policy.

This limited response is at least partially explained by the fact that non-state actors are at most modestly involved in many assessment bodies (see also Box 2). IPBES is widely cited as front runner in this context, prescribing that 20% of its experts are to nominated by stakeholders (rather than governments) (Montana, 2017). Nonetheless, selected experts are commonly still based at universities or other knowledge institutes, rather than affiliated with business organisations, local communities or civil society (Timpte et al., 2018). Moreover, formal decision-making in the Panel is still mostly held by governments, limiting the degree to which non-state actors can influence the processes in which mandates and questions for particular assessment reports are decided (Díaz-Reviriego et al., 2019; Esguerra et al., 2017). The IPCC has a comparable decision-making process (van der Hel, 2016), and only admits non-state actors with a non-profit status as observers to Panel discussions, although individuals may contribute as author or reviewer. Governments have further responded cautiously to suggestions to include stakeholders in scoping for the IPCC's Sixth Assessment Report (AR6) (Yamineva, 2017), at least in part due to concerns over the compatibility of stakeholders and the desire to have an independent assessment process (Thoni and Livingston, 2019). The Sixth Global Environment Outlook was guided by a group of government and stakeholder representatives, although also here the stakeholders were not part of the formal approval process of the SPM negotiations.

Changing scope of enabling functions for polycentric governance

For GEAs to more explicitly attune to a shift to governance implies a shift in problem demarcation (enabling function 1 in Section 2.2), related policy goals and targets (enabling function 3) and possible policy interventions and instruments (enabling function 4). More specifically, while a framing of environmental problems in terms of governing a global commons (climate, forests, biodiversity) aligns with orthodox principles of multilateral governing, a framing more in line with a changed approach to environmental governance is emerging in parallel in which problems are seen as embedded in the workings of the economy or society. Such a reframing opens up other forms of political action (Beck et al., 2014). This has to some degree been the case in the IPBES Global Assessment, which has broadened its problem-framing to include aspects such as governing in global supply chains, inequality and rights, and changing consumer preferences.

Furthermore, for monitoring progress (enabling function 5) it is important that assessments go beyond the contributions of states. Omitting contributions by non-state actors to the realisation of the Paris Agreement will miss an important part of the picture (Chan et al.,

2016; Widerberg and Pattberg, 2015). The same holds for monitoring progress of the post-2020 framework for the biodiversity convention (currently being developed) in which non-state actors are also expected to play an important role (Pattberg et al., 2019). The 2018 edition of the Emissions Gap Report (UNEP, 2018) and the fourth Global Biodiversity Outlook (CBD, 2014) already incorporated non-state actor contributions.

Changing involvement in assessment processes as a result of polycentric governance
Effectively addressing polycentric governance and a shift in framing of problems and solutions foregrounds the need for GEA processes to reflect the perspectives of other agents of change on aforementioned criteria, such as relevance, credibility, and legitimacy, in their production processes. This goes beyond attempts to target other groups as new audiences, but also means that it is important for GEAs to include questions and knowledge from their new target audiences (Kowarsch et al., 2017b; Petersen et al., 2015). The planned IPBES methodological assessment on business and biodiversity will be an interesting test case. Will this assessment answer questions from the business community, or remain focused only on those from a government perspective? And to what extent will IPBES' procedures for including other knowledge sources be used to include knowledge from the business community itself?

Aside from changes in the way GEAs are produced, new assessment outputs may be instigated on behalf of different groups of actors. Such new outputs can be requested by government authorities hoping to engage other agents of change, such as the IPBES business and biodiversity assessment, which was requested by states and multilateral organisations (IPBES, 2019c). But it is also possible that groups of other actors may request 'traditional' GEA producers to address their topic. For instance, the IPCC will be including a Special Report on Climate Change and Cities in its 7th Assessment Cycle, and organised a conference to stimulate scientific research and publications on this topic in 2018 (IPCC, 2016). This decision was lobbied for by various city networks, expecting that an IPCC report will provide a 'comprehensive, global and authoritative resource' clarifying the possible contribution of urban areas to climate mitigation and adaptation (ISOCARP, 2016). Noteworthy is that the global characteristic of the IPCC is herein mobilised as a factor contributing positively to highly local and contextualised action.

In addition to new assessments being produced within the confines of 'old' GEA bodies, new assessments may also be issued by new actors. An illustrative example is the report 'Toward Sustainability: The Roles and Limitations of Certification' (Steering Committee of the State-of-Knowledge Assessment of Standards and Certification, 2012), produced by a 12-member Steering Committee composed of international business and civil society leaders and academic experts. This self-described consensus report aims to synthesise knowledge on the performance and potential of voluntary standards and certification as an emerging instrument of governance. The report was funded by foundations and businesses with stakes in the legitimacy of this new way of governing production and consumption. It targets both groups involved in certification, mostly businesses and NGOs, as well as government authorities. Reports such as this show how assessments may serve to reframe

an issue and the types of measures that are required to address it. Whether or not all such new assessments qualify as GEAs may in some cases be debated, but their intended purposes share clear commonalities with GEAs aiming to *re*present scientific information in a way useful to decision-making.

4.3 Contested knowledge and GEAs

The much-discussed position of knowledge in society also affects GEAs. In brief, this discussion focuses on an apparent loss of authority of science in society over the past decades (Bijker et al., 2009; Lave, 2015). The extent to which this is indeed the case, and whether it is a problem, can be debated (see also e.g. Jasanoff and Simmet, 2017; Sismondo, 2017), but the discussion is nonetheless relevant to GEAs in and of itself.

Section 2.3 already briefly discussed the political role of science. This can be further elaborated on through the notion of a paradoxical 'scientisation' of politics accompanied with a 'politicisation' of science (Weingart, 1999). This paradox describes that the tendency to require policy to be based on science leads to the science itself becoming object of political discussion (Turnhout, 2018).

The case of the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) exemplifies this point (Scoones, 2009). This assessment, which ran between 2003–2008 meant to give a consensus on innovations in sustainable agriculture practices. The process was designed to have a wide inclusion of stakeholders, including from NGOs and industry. Throughout the process, contention developed on the topic of genetically modified crops. Many NGOs considered the IAASTD to 'use' them to legitimise GMOs, whereas industry saw NGOs' position as unscientific. The process' aim to provide a single consensus message likely only increased the importance attached to this controversy. These processes thus are not merely 'rational scientific', but inevitably involve value judgements (Scoones, 2009). GEAs' position at the science-policy interface thus makes them political objects as much as scientific ones.

Arguably, this point increases in significance because of the shift to solution-oriented assessments (Haas, 2017; Kowarsch and Jabbour, 2017). Many assessments now argue 'transformative changes' are necessary in the way societies and economies are organised to achieve environmental goals (Lucas et al., 2020). This means they directly touch upon societal values and visions of what a good life entails, on which many different views exist. Consequently, the political dimension of assessments is increasingly visible, because the effects science is expected to have on policy is much more profound and far-reaching. This means it is important to be aware of the role GEAs play in politics and society, and how they may perform this role responsibly (Beck and Mahony, 2018; Owen et al., 2012).

5 Keeping GEAs fit for purpose

The preceding chapters have described GEAs through the purposes they serve. We have discussed the enabling functions of GEAs and how assessments have operationalised their processes to balance different criteria for serving these purposes successfully. We analysed the assessment landscape to provide an overview of the extent to which different themes and enabling functions are covered. Furthermore, we discussed how the governance context of environmental issues has changed, with the central position of multilateral negotiations shrinking relative to other forms of global environmental governance, including increasing contributions by non-state actors. Finally, we discussed how GEAs, like society in general, are being confronted with issues of contested knowledge, partially due to the increasing visibility of the politics they embed.

While we do not doubt GEAs have been valuable to environmental decision-making in the past, we do contend that this analysis provides signals of changing dynamics in science, society, and policy to which GEAs should respond. In this chapter, we discuss opportunities for decision-makers in GEAs on how to keep global environmental assessments fit for purpose.

Multiple ways forward are possible, each having their respective benefits and drawbacks. Preferable forms of upkeep depend on the kinds of assessments deemed necessary in the future, all carrying implications for how these assessment processes are organised. Considerations should take into account the range of enabling functions laid out in this report, and be made against the background of the wider assessment landscape as well as assessments' relation to the environmental governance context they operate in. Moreover, different stakeholders have varying interests and subsequent demands of assessments, e.g. in their thematic focus or what they consider to be politically sensitive. The point here is not to lay out a blueprint for organising GEAs or the assessment landscape, but to provide input material for discussions on future assessments. These aspects can be summarised as in Table 1.

Table 5.1

Key messages

Key message	Description
Target and involve non-state actors	The relative importance of multilateral and national environmental governance is decreasing, with local and regional government authorities, businesses, and civil society taking a more proactive role. GEAs could reflect this shift by more actively involving these other actors.
Improve coordination between niches in the assessment landscape	Different assessments should address individual niches. This should be matched with improved coordination between assessments to address interrelationships and make use of complementary features.
Align the assessment format with its purpose	Under the adage 'form follows function', assessments should tailor the format in which they represent their outcomes to the niche they are supposed to fill.
Deal explicitly with different worldviews and values	GEAs are political objects as much as scientific ones. In order to effectively inform decision-making in a politically sensitive context, they could increase the degree to which they integrate different worldviews.
Back the activities that support assessment production and use	Various activities are undertaken to stimulate effective production and use of assessments. To fully capitalise on the potential GEAs offer requires appropriate appreciation, attention and financial support for these activities.
Make use of strategic moments	Windows of opportunity exist in many GEAs in which the purpose and audience a future assessment is expected to serve can be discussed. Mandating parties should make active use of these moments for strategic reorientation.

5.1 Actively engage with process opportunities GEAs provide

As stressed throughout this report, assessments are as much a process as a report. As the discussion of enabling functions in Chapter 2 showed, part of what GEAs do is not necessarily an outcome of the report itself but arise as benefits from the wider assessment process. These process outcomes may often be less directly visible but can nonetheless be a crucial part of achieving GEAs' range of possible purposes. For instance, SPM negotiations are also a way to actively communicate key findings to decision-makers in a two-way interaction, author meetings contribute to creating scientific networks, and the number of authors in a typical GEA can be seen to contribute to the societal urgency attributed to its messages. Moreover, there may be discrepancies between different actor groups in terms of what outcomes they value. The outcomes that arise as a result of the GEA process create opportunities for a range of stakeholder groups to mobilise the enabling functions covered in the assessment and should therefore be recognised as an inextricable part of GEAs.

5.2 Target and involve non-state actors as well

The changes in environmental governance dynamic, in which multilateral governance is decreasing in importance relative to 'polycentric' governance, asks GEAs to think fundamentally about what audiences they target and who they involve in the production process. As also highlighted by the processual character of GEAs, audiences are broader than only policymakers from national governance. However, these audiences are currently served by GEAs only to a limited degree. GEAs could therefore aim to target decision-makers in environmental governance in a broader sense, including local government authorities, the private sector and civil society. Furthermore, by including non-state actors in the mandating and/or scoping phases of an assessment process, GEAs can accommodate questions relevant to alternative audiences.

Since policymakers currently remain the main requestors and funders of GEAs, they will likely have a substantial say regarding how this broadening of audiences and their involvement in GEAs can be implemented. Especially in GEAs organised as intergovernmental process (e.g. IPCC and IPBES), it is likely to be challenging to align the positions of countries necessary to change procedures. Nonetheless, government representatives could weigh the potential role of a GEA for actors other than themselves in their considerations, preferably in consultation with these other actors. GEAs' enabling functions serve not only commissioning governments, but also a broad range of non-state actors. Furthermore, new assessments that specifically target these other actors can be instigated, both on behalf of and by these actors themselves.

5.3 Ensure the assessment landscape consists of complementary niches

In a world characterised by polycentric governance and environmental issues in different stages of the policy cycle, no single assessment process can feasibly fulfil all possible enabling functions for everyone. Accordingly, a variety of assessments is required to effectively respond to diverse information needs. Such a variety demands clarity of purposes across the different assessment processes, including what assessments focus on which themes and which address interrelationships between them. This requires careful consideration of the purpose the assessment serves. By which logic is the assessment expected to contribute to that purpose? What enabling functions should it serve and what primary audience should it target?

This means that the 'niche' of an assessment in the wider assessment landscape should be clear. How does the purpose of one assessment relate to the purposes of other assessments touching upon similar themes and/or governance actors? This may result in a conscious choice to pursue separate assessment processes, but could also result in joint outputs, such as the current request for IPBES and IPCC to develop a joint technical paper on biodiversity and climate change. Furthermore, there seems an increasing need for 'gap reporting' to

strengthen accountability frameworks in environmental governance. UNEP's mandate to keep the quality of the environment under review does not fully cover this need, which also includes the quality and results of the implementation of environmental policies. This need could thus be addressed by changes in the mandate of UNEP, or by integrating gap reporting in the scope of other assessments, such as their periodic Global Environmental Outlook.

5.4 Improve coordination in assessment landscape to reduce overlap and increase complementation between assessments

Coordination between assessments can be a way to address their specific niche while taking key interrelationships into account. Furthermore, it can help to communicate *why* different messages may arise between assessments. Since production processes for different assessments usually run in parallel to each other, coordination takes place during assessment cycles. Thus far, formal coordination has proven difficult to achieve, including because of differing mandates, a lack of budget for shared work as well as competition by assessment bodies. Informal coordination at the working level may thus be more feasible. UNEP's 'Global Assessment Dialogue', which is meant to provide an ad-hoc formalised collaboration between five assessments (GEO, IPBES, IPCC, IRP and GSDR), could be a promising middle ground approach.

Furthermore, assessments may benefit from procedures that stimulate interaction and shared work between different assessment processes, which could also help to avoid unnecessary double work being performed for different assessment processes. For instance, they could produce shared bibliographies to reduce the burden of reviewing very large bodies of scientific literature by creating key groupings of literature that multiple assessments can draw on.

Another example of formal or informal coordination across assessments is the use of shared scenarios. A limited number of key archetypical scenarios, or scenario families, have been identified, that reappear in many GEAs published between 2000 and 2010 (van Vuuren et al., 2012). The scenarios grouped under specific scenario families share a similar storyline or logic, resulting in a similar kind of quantification. More recently, the Shared Socio-economic Pathways (SSPs) were developed. The SSPs are a set of five storylines on possible trajectories for human development and global environmental change during the 21st century (Riahi et al., 2017; van Vuuren et al., 2017). Although originally developed to support climate change research they are also used extensively for other fields of environmental research, including biodiversity loss, water scarcity and resource use. While not undertaken as part of GEAs as such, they are explicitly used as a framework in various recent assessments, thereby allowing comparison and integration of scenario results across assessments. Conversely, within IPBES, an effort is currently underway to develop the 'Nature Futures Framework'. This framework is intended to be a set of scenarios setting out positive futures for biodiversity and ecosystem services (Lundquist et al., 2017). This is

meant to address the lack of explicit attention to these as policy objectives in traditional scenarios, including the SSPs (Rosa et al., 2017). The process builds on a combination of stakeholder consultations, modelling and analysis to generate a set of scenarios that can support future assessments by IPBES (PBL, 2019, 2018) and open up new options for actions.

5.5 Ensure form follows function

Having a well-defined niche for an assessment facilitates the alignment of its purpose and output formats, as well as the processes required to produce that output. For instance, this entails the choice between having hundreds of authors involved in a report or having a select group of experts perform the assessment, as well as the choice of format through which to communicate the assessment's findings (e.g. textual report or infographics).

Currently, few assessments venture beyond the traditional format of multi-annual assessments culminating in a large report that serves as the assessments' keystone. However, there are many other ways possible to organise the assessment process and represent its outcomes. To truly follow the adage that 'form follows function' may well require creative application of such different formats. Some examples of what that would entail include:

- **Digital encyclopaedia.** The problem demarcation function often intends to provide a consistent definition available as a reference. As such, this closely mirrors the purpose of an encyclopaedia. A digital encyclopaedia that is updated on a rolling basis by a preselected group of authors/staff could thus provide much of the same functionality as that of certain chapters of current assessment reports (Hulme et al., 2010), while being more swiftly responsive to changing scientific understanding than multi-annual assessment cycles.

- **Digital dashboard.** Similarly, the monitoring function of GEAs can be seen to aim to have a common reference for the 'state and trends' of an environmental problem. Here, a digital dashboard could increase accessibility of this information, for instance through the SDG indicators. UNEP is currently setting up the World Environment Situation Room along the lines of such a dashboard (Jabbour et al., 2018; UNEP, 2020).

- **Involve stakeholders in producing targeted summaries.** As mentioned, aside from Summaries for Policymakers (SPMs), various reports are now producing other stakeholder-specific summaries (e.g. national and local government authorities, business, municipalities or youth). These summaries provide translations of assessments' key messages for various different governance contexts and increase insight into locally appropriate options for action. Similar to how SPMs are government-negotiated, these other summaries can involve relevant stakeholders in their production in order to increase their relevance to these specific contexts, while noting that such stakeholder involvement can be operationalised without such formal consensus-based negotiations.

- **Rapid, focused assessments.** Assessing themes or cross-cutting issues that are newly emerging on policy agendas can take relatively long within current GEA processes. Instead, focused assessments with a short lead time could be developed in response to specific questions from policymakers and/or other actors. The IPCC Special Report on 1.5 °C and the IPBES Thematic Assessment on Pollinators, Pollination and Food Production are examples of assessments following this route. The World Economic Forum and World Business Council for Sustainable Development also produce short reports intended to inform thematic conferences. A rapid and focused assessment report could also be produced through collaboration across assessment bodies for exploring interlinkages between their core themes.

- **Regional assessments.** Attuning a discussion of possible policy measures to the socio-political context of a particular region can potentially be more relevant to certain countries (and their governments) than a highly general global assessment can be. Both UNEP's Global Environment Outlook and IPBES have a structure in which regional reports are produced, but they receive far less attention than their global counterparts, and the degree to which the regional reports feed back into their global report seems to be limited. Assessment bodies could adjust their procedures to clarify and improve the link between regional and global reports. Furthermore, global environmental assessment bodies could support initiatives for regional assessments through their networks and by codifying knowledge on organiing their processes.

5.6 Deal explicitly with different worldviews and values

Assessments increasingly focus on policy interventions and solutions that can contribute to achieving environmental objectives. The implementation of many of these possible solutions has significant effects on the organisation of societies and economies. Because these effects are often subject to value judgements, the political dimension assessments embed is becoming increasingly pronounced. In order to keep informing decision-making in a politically sensitive context assessment processes could increase the degree to which they integrate different worldviews and values in their procedures (Kowarsch et al., 2017a; Turnhout et al., 2019). A range of options is available, such as:

- **Broad selection of contributing experts.** Inclusion of, for example, a broad selection of scientific disciplines, or even other knowledge systems (as in IPBES), facilitates the input from multiple different and possibly opposing perspectives. However, effective inclusion requires assessments to forego their focus on providing a single, coherent consensus message and instead provide multiple conditional perspectives (Díaz-Reviriego et al., 2019; Stirling, 2010). This can also facilitate the participation of experts in a broad sense, as they have more leeway to dissent from parts of the assessment (cf. Oppenheimer et al., 2019; Scoones, 2009).

- **Mapping divergent viewpoints.** In collaboration with stakeholders or members of the general public, assessment processes could map divergent viewpoints in relation to possible solutions. Such a process would create a 'map' of the solution space available to decision-makers, providing insight into the expected consequences of different paths that can be taken without having to claim fact and value can be neatly separated (Edenhofer and Kowarsch, 2015). The ongoing IPBES Methodological Assessment on Values can be seen as aiming to provide a basis for such mapmaking, by assessing different conceptualisations of values of nature and its benefits, as well as assessing methodologies by which to incorporate these into governance (IPBES, 2018).

- **Starting from desired futures.** Rather than taking 'state and trends' as starting points, which is common practice these days, a different type of assessment could be conducted to structure debate on 'where do we want to go?' Such an assessment could picture what various worlds could look like. It would be based on the assumption that various desired futures are possible, all of which could achieve current goals, such as the SDGs and other longer term targets. These futures would each imply different choices, for example, in terms of economic structure and reliance on existing and expected technologies. This type of assessment would make these choices explicit, thereby offering decision-makers at all levels a way to relate their decisions to visions of desired futures. A more local example of such an approach is the PBL study 'European nature in the plural', which explores how various value perspectives on what nature is and how it should be protected lead to a variety of possible governance approaches (PBL, 2017)

5.7 Back the activities that support assessment production and use

In the various phases of assessment processes, supporting activities are undertaken to stimulate effective production and use of assessments. This includes e.g. coordinating activities by GEA secretariats, communications work to promote media publicity around the assessments' formal launch, as well as the work performed to contextualise assessments to specific governance contexts (see Section 4.1 and above).

For an assessment to capitalise fully on their enabling functions requires that appropriate appreciation, attention, and financial backing is given to these supporting activities (Jabbour and Flachsland, 2017). Concrete examples include:

- **Attention to 'GEA craftsmanship' of authors**. The majority of authors in a GEA process are academic scientists. However, a GEA process is distinct from many other scientific works, including peer-reviewed journal articles that have become the norm in many scientific disciplines, which means the degree to which an individual author has experience with the 'craft' of GEA-making can vary. Assessments may

benefit from actively supporting their authors' ability to navigate the sometimes contradicting demands placed upon their work by different stakeholder groups and relate scientific insights into the governance context they play a role in (Hulme et al., 2010), such as being aware of value-laden remarks and problems arising from aggregating knowledge.

- **Vary communication outputs**. Assessments could increase the variety of different outputs created that all have their roots in a single global assessment. Besides the already-mentioned stakeholder-specific summaries, examples of what this could entail include producing stand-alone visualisations, as some assessments already do (e.g. UNEP-IRP's Global Resource Outlook), or even active engagement with the arts community to produce output that engages audiences beyond the 'usual suspects'. Here too, producing such communication output will benefit from the involvement of relevant stakeholders.
- **Supporting the organisation of side activities** to create opportunities for social learning. The Structured Expert Dialogues organised by the UNFCCC is a good example of this at the intergovernmental level but can also be applied in other governance contexts. For instance, Leeds (UK) ran a citizen jury process in which 25 local residents co-formulated recommendations for local urban climate change policy,[8] with IPCC authors, among others, providing input to this process.

5.8 Make use of strategic moments to align an assessment's niche and process with the needs of environmental governance

Many GEAs have recurring assessment cycles and/or multi-annual work programmes. Such a long-term planning provides a window of opportunity for strategic reorientation. Before a new assessment process is started, a discussion could be held not just on the substance for a future report (the scoping), but also on its purpose, composition of the group of authors, and the audience it is expected to serve ('who is helped by what?') These discussions could also include the most suitable format for presentation of the assessment. Such a process of reconsideration takes time. This means it is important that mandating parties avoid intending to reach immediate agreement on an approach for possible follow-up but instead actively make space for strategic reorientation. The option to substantially refit or even terminate the GEA could be put on the table as reference point for the value added of a subsequent assessment cycle.

[8] https://www.leedsclimate.org.uk/leeds-climate-change-citizens-jury

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Annex I Interviewees

Name	Organisation at time of interview	Date of interview
Jan Bakkes	The Integrated Assessment Society	4 April 2019
Detlef van Vuuren	PBL Netherlands Environmental Assessment Agency	21 May 2019
Martin Kowarsch	Mercator Research Institute on Global Commons and Climate Change	22 May 2019
Klaus Jacob	Freie Universität Berlin	23 May 2019
Michel den Elzen	PBL Netherlands Environmental Assessment Agency	4 June 2019
Heleen de Coninck	Radboud University	4 June 2019
Leida Rijnhout	Leapfrog2SD	5 June 2019
Astrid Hilgers	Netherlands Ministry of Agriculture, Nature and Food Quality	7 June 2019
Arthur Eijs	Netherlands Ministry of Infrastructure and Water Management	11 June 2019
Philip Drost	Netherlands Ministry of Infrastructure and Water Management	12 June 2019
Laszlo Pinter	Central European University	14 June 2019
Pierre Boileau	UNEP	14 June 2019
Joyeeta Gupta	University of Amsterdam	21 June 2019
Pauline Riousset	IÖW - Institute for Ecological Economy Research	21 June 2019
Marcel Berk	Netherlands Ministry of Economic Affairs and Climate Policy	25 June 2019
Giulietta Duyck	WWF Switzerland	27 June 2019
Christian Hudson	GIZ - German Corporation for International Cooperation	3 July 2019
Leo Meyer	ClimateContact-Consultancy	12 July 2019
Lilian van den Aarsen	Netherlands Ministry of Infrastructure and Water Management	31 July 2019
Pieter Terpstra	Netherlands Ministry of Foreign Affairs	6 August 2019
Jason Jabbour	UNEP	20 August 2019
Edgar Gutierrez-Espeleta	fmr Minister of the Environment for Costa Rica	23 August 2019

Annex II Workshop Participants

During this study, a 1.5-day workshop was organised in early December 2019. This workshop explored what challenges GEAs are facing and what options are available for them to respond, in the form of possible elements of strategies through which GEAs can remain fit for purpose. Participants were researchers with prior experience studying GEA processes, as well as policymakers involved in mandating and use of assessments (for part of the workshop). An earlier version of this report served as discussion paper to the workshop. Aside from providing input for the present report, an academic publication is expected to result from the workshop.

Name	Organisation
Laszlo Pinter	Central European University
Willemijn Tuinstra	Independent Consultant
Martin Kowarsch	Mercator Research Institute on Global Commons and Climate Change
Astrid Hilgers	Netherlands Ministry of Agriculture, Nature and Food Quality
Marcel Berk	Netherlands Ministry of Economic Affairs and Climate Policy
Frank van der Vleuten	Netherlands Ministry of Foreign Affairs
Detlef van Vuuren	PBL Netherlands Environmental Assessment Agency
Machteld Schoolenberg	PBL Netherlands Environmental Assessment Agency
Marcel Kok	PBL Netherlands Environmental Assessment Agency
Paul Lucas	PBL Netherlands Environmental Assessment Agency
Rob Alkemade	PBL Netherlands Environmental Assessment Agency
Timo Maas	PBL Netherlands Environmental Assessment Agency
Jan Bakkes	The Integrated Assessment Society
Martin Mahony	University of East Anglia
Jasper Montana	University of Oxford
Sandra van der Hel	Utrecht University
Esther Turnhout	Wageningen University and Research

Annex III List of GEAs

The Table below includes the assessment reports selected on the basis of the search criteria as described in Chapter 3, spanning the years 2015–2019. Abbreviations used in the table: IPCC SR = IPCC special report; IPBES TA = IPBES thematic assessment. Functions: (1) demarcate the issue; (2) agenda-shaping; (3) contribute to potential policy goals and targets; (4) suggest potential policy interventions and instruments; (5) monitor progress

Global Environmental Assessment	Organisation	Recurrence	Years included	Themes	Functions
Global Landscape of Climate Finance	CPI	Periodic	2015, 2017, 2019	Climate	4, 5
Global Forest Resources Assessment	FAO	Periodic	2015	Biodiversity	1, 5
State of Food And Agriculture: Climate change, agriculture and food security	FAO	Periodic	2016	Climate	2, 4
State of the World's Biodiversity for Food & Agriculture	FAO	Periodic	2016	Biodiversity	1, 3, 5
Trees, forests, and land use in drylands	FAO		2016	Land	1, 2
State of the World's Fisheries and Aquaculture	FAO	Periodic	2016, 2018	Oceans, Fresh water	2, 5
State of Food Security and Nutrition: Building climate resilience	FAO	Periodic	2018	Climate, Land	2, 3, 4
State of the World's Forests	FAO	Periodic	2016, 2018	Biodiversity	2
New Climate Economy Report	Global Commission on Economy & Climate	Periodic	2015, 2016, 2018	Climate	2, 3, 4
Land degradation and restoration	IPBES	IPBES TA	2018	Biodiversity, Land	1, 2, 3, 4, 5
Pollinators, pollination & food production	IPBES	IPBES TA	2016	Biodiversity	1, 2, 4
IPBES Global Assessment	IPBES		2019	Biodiversity	1, 2, 3, 4, 5
IPCC Special Report on 1.5 °C	IPCC	IPCC SR	2018	Climate	1, 2, 3, 4, 5
Climate change and land	IPCC	IPCC SR	2019	Climate, Land	1, 2, 3, 4
The Ocean and Cryosphere in a Changing Climate	IPCC	IPCC SR	2019	Climate, Oceans, Fresh water	1, 2, 3, 5
Human acceleration of the nitrogen cycle	OECD		2018	Biodiversity, Land, Fresh water, Oceans	1, 2, 3

Global Environmental Assessment	Organisation	Recurrence	Years included	Themes	Functions
The Land-Water-Energy Nexus: Biophysical and economic consequences	OECD		2017	Land, Fresh water	1, 3, 5
Mainstreaming Biodiversity for Sustainable Development	OECD		2018	Biodiversity	3
Global Material Resources Outlook to 2060	OECD		2019	Resource use	3, 5
The geography of future water challenges	PBL		2018	Fresh water	1, 2, 3
Economics of Ecosystems and Biodiversity for Agriculture and Food	TEEB		2015	Biodiversity	1, 2, 4
Assessment Report on Climate Change and Cities (ARC3.2)	UCCRN	Periodic	2018	Climate	1, 4, 5
First Global Integrated Marine Assessment: World Ocean Assessment	UN		2018	Oceans	2, 4, 5
Global Land Outlook 1	UNCCD	Periodic	2017	Land	1, 2, 4
Emissions Gap Report	UNEP	Annual	2016–2019	Climate	4, 5
Measuring Progress: Towards Achieving the Environmental Dimension of the SDGS	UNEP	Annual	2018, 2019	All	1, 5
Global Environment Outlook 6	UNEP	Periodic	2019	All	2, 4, 5
Global Chemicals Outlook 2	UNEP	Periodic	2019	Resource use	1, 2, 3, 4, 5
Global Waste Management Outlook	UNEP & ISWA		2015	Resource use	1, 2, 4
United in Science	UNEP, WMO		2019	Climate	1, 2
Global Assessment of Sand and Dust Storms	UNEP, WMO, UNCCD		2016	Land	2, 3, 4
Adaptation Gap Report	UNEP-DTU	Periodic	2017, 2018	Climate	1, 2, 5
International Trade in Resources	UNEP-IRP		2015	Resource use	1, 2, 5
Unlocking the sustainable potential of land resources	UNEP-IRP		2016	Land	1, 3, 4
Food systems and Natural Resources	UNEP-IRP		2016	Resource use	1, 3, 4
Global Resource Outlook	UNEP-IRP		2019	Resource use	1, 2, 3, 4
UN World Water Development Report	UNESCO	Annual	2015, 2018	Fresh water	1, 2, 4
Circularity Gap Report	WEF	Annual	2018, 2019	Resource use	2, 3, 5
State of the Global Climate in 2018	WMO		2018	Climate	1, 2
State of Climate Services Report	WMO	Periodic	2019	Climate	1, 4

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