

Chapter

2

The Conceptual Framework of the Global Environment Outlook Reporting System

2.1 Introduction: Conceptual framework—a foundation for global environmental assessments

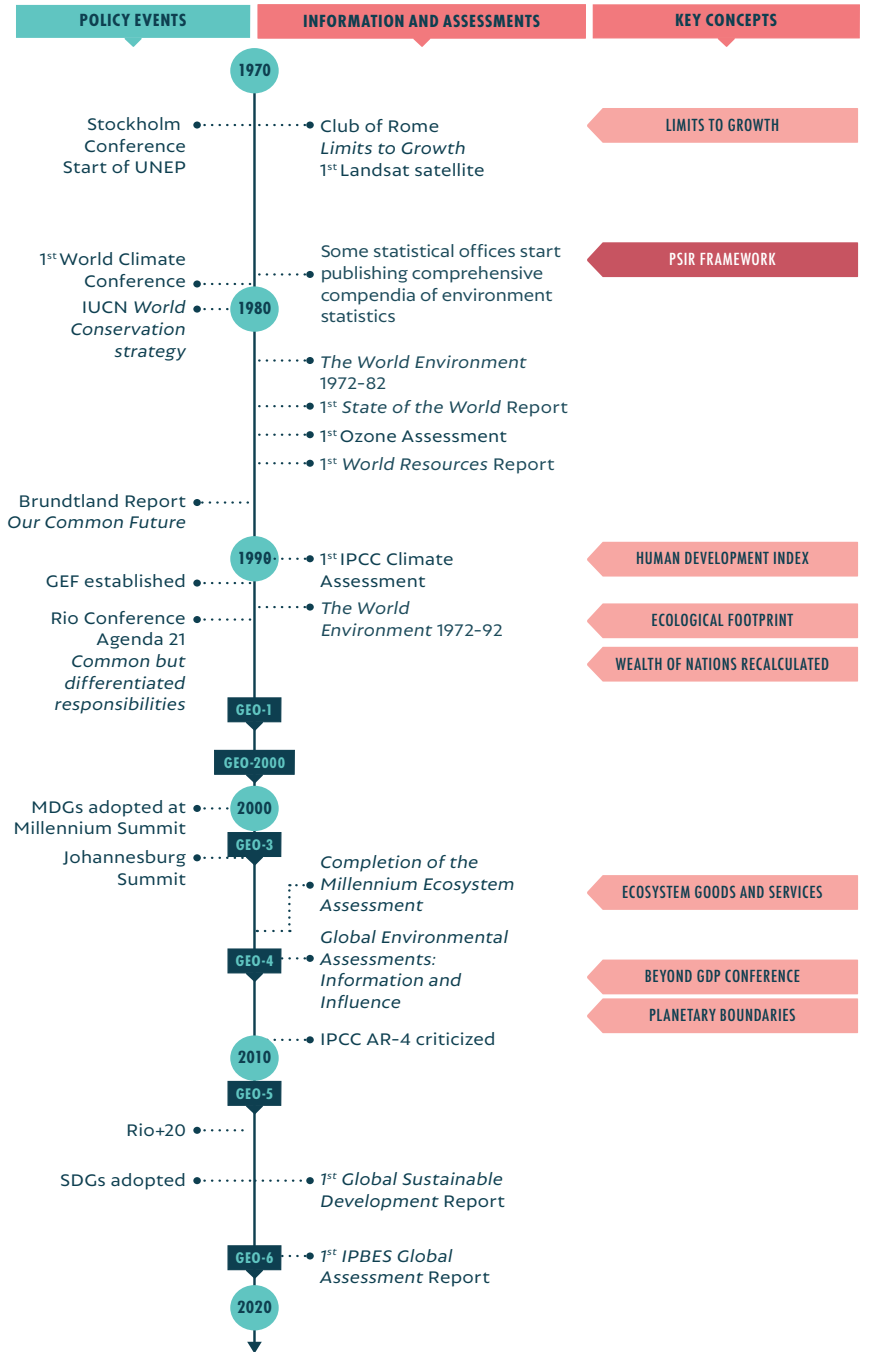
For the purposes of integrated environmental assessment (IEA), conceptual frameworks are analytical tools and symbolic, high-level, easy-to-remember representations of how the world is structured and works. Framing has been identified as a critical component for studying science-policy controversies that are often at the heart of IEAs (Rein and Schön, 1996). Formal conceptual frameworks for analysing environment-society interactions have been in place for several decades and used in various contexts – organizational, such as place-based with ecosystem or administrative boundaries;

functional, such as supply-chain related; thematic and problem-oriented such as climate change, biodiversity; or sectoral, such as agriculture or industry. (Figure 2.1.1) They may also embrace and integrate different theoretical and policy perspectives, such as sustainability, resilience or transitions.

Having a common conceptual framework is important for global assessments in general, and the Global Environment Outlook (GEO) in particular, for several reasons. As noted by long-standing contributors to GEO, a framework helps people involved have a common axiomatic understanding of things (Ruben Mnatsakanian interview), pose robust questions, organize ideas, provide a common language and facilitate communication at the science-policy interface (Rosario Gómez interview). Of all the institutionalized global assessments initiated to date, GEO probably has one of the broadest scopes in terms of the range of environment and development issues covered; the past, present and future timescales considered; the geographic regions surveyed; the stakeholder perspectives noted; and the integration among these attempted. A common framework provides a high-level entry point into the assessment topics by considering the world as an interconnected whole. This common framework approach can identify key domains of environment and society while highlighting and visualizing interlinkages among different components as parts of the same coupled socio-ecological system. This contrasts with the compartmentalized worldview still dominating assessments that are mandated to focus on a specific economic sector such as mining, agriculture and energy or a specific environmental element such as air, water, land or biodiversity.

As a global but regionally differentiated assessment, GEO needs to report not only on different economic sectors and environmental elements but also at different scales. From this point of view, it needs a framework that can be consistently applied at and across different spatial and temporal scales (Pintér et al., 2012). This includes global problems originating in planetary-level processes such as the atmospheric circulation of synthetic chemicals or climate change. In contrast, GEO's regional and subregional assessments need to cover problems that appear in many places, such as groundwater depletion, but have strong context-specific features and require responses tailored to that local context (Levien, 1997).

Figure 2.1.1. Relevant key concepts, information technologies and policy events emerging before and alongside GEO



2.2 The role of science

In contrast with representations developed in other domains for religious, political or other purposes, conceptual frameworks for IEA are typically grounded in a scientific and positivist worldview. While the environment can be absent or under-emphasized in traditional economics-focused frameworks and models, the conceptual framework for global IEAs makes the environmental context explicit and outlines the interconnections with non-environmental domains.

GEO was conceptualized from its start as an assessment grounded in data and scientific evidence. Data are the facts or statistics collected through monitoring and can be quantitative or qualitative, while indicators are succinct representations of data that facilitate data's use in analysis – for example, a Gini coefficient of household incomes, distance-to-target in projected national emissions of greenhouse gases, or gross domestic product. The importance of data and indicators has been repeatedly highlighted in GEO-related decisions by the governing bodies of the United Nations Environment Programme (UNEP) and emphasized by many of GEO's government sponsors, who pointed out that governments as the primary clients of GEO required findings directly backed up by data and indicators (Nicolas Perritaz interview). During the lifetime of GEO, these expectations were met by two countervailing forces of change. Due to the improvements of monitoring and data-collection systems, the evidence base has significantly improved, even though many problems persist. At the same time, researchers presented new ways to integrate many of these accelerating changes. Prominent among these advances are post-normal science, defined as issue-driven knowledge produced in a context of hard political pressure, disputed values, high-stake decisions and highly uncertain epistemological and ethical systems (Funtowicz and Ravetz, 1993). They also include sustainability science, which seeks to understand the fundamental character of interactions between nature and society and encourage those interactions to follow more sustainable trajectories (Kates et al., 2001). These innovative analytical perspectives allowed for an increasing realization of the value of – and the need for taking into account – non-standard and qualitative data in the assessment, for instance, those generated by crowdsourcing or qualitative research, and acknowledgement of the validity of alternative sources of information such as traditional knowledge.

Embedded in, but from the start aspiring to go beyond, state of the environment (SoE) reporting, GEO required an assessment framework with an integrated character. The framework needed to account for different types

of data and systems of knowledge and the integration of local and global perspectives. It also had to combine the perspectives that cut across sectors and multiple environmental themes with cause-effect linkages that are consequential for environmental change and human well-being. Ultimately, underlying these perspectives is a worldview, emerging from a philosophical tradition and interdisciplinary science, that considers the Earth as an integrated whole and a socio-ecological system (Berkas and Folke, 1998; Gallopin et al., 1989; Young et al., 2006). The unified perspective applies at all scales, from communities to regions and to the planetary level, with complex cross-scale interlinkages.

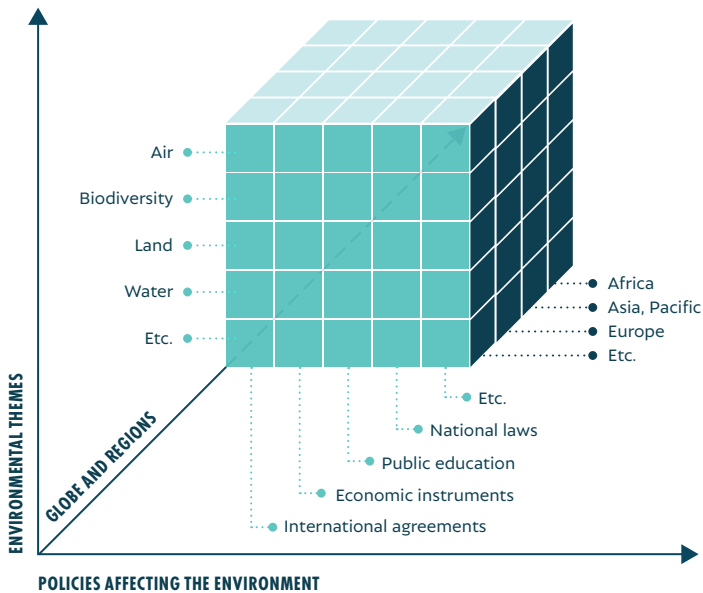
An additional element of integration is related to the emphasis on participation and consultation during the assessment process, including during the preparation of summaries for policymakers. Driven by both policymakers' needs and scientific interest in using transdisciplinary methods, reconciling different perspectives represents an increasingly important element of integration, as the impacts of environmental change in the present, and even more so in the future, continue to mount. Participation is also important for building ownership of the assessment process, outputs and findings and strengthening legitimacy as one of the criteria of making use of the assessment (Cash et al., 2003). This is increasingly important due to growing risks, costs and the urgency associated with many issues covered by GEO.

2.3 From GEO's mandate to its assessment framework

The choice of GEO's integrated assessment framework is ultimately rooted in the way its mandate has been defined, first by the UNEP Governing Council and then continued by the United Nations Environment Assembly after 2014. The original mandate characterized GEO as a report on the state and trends of the global environment. However, over time the mandate and the conceptual framework put increasing emphasis on understanding the effectiveness of policy responses and transition pathways to agreed-upon environmental goals. As an outlook, by definition GEO's framework requires that the assessment includes projections, which in policy terms was often interpreted as reporting on progress towards commitments made in environmental conventions or, more recently, the environmental components of the Sustainable Development Goals.

The mandate is directly reflected in the structure of most GEO reports. This structure was captured by ‘the GEO juggernaut’ in GEO parlance (Figure 2.3.1). While it did not appear in actual GEO reports, the diagram helped communicate the level of ambition and the underlying complexity of the assessment. It laid the foundation for working with the assessment’s more elaborate and formal conceptual framework that goes beyond a simple structural identification of the issues and levels covered. It also aims to help identify functional cause-effect type interlinkages where possible.

Figure 2.3.1. Components of the GEO Juggernaut



The dimensions of GEO directly reflect its mandate

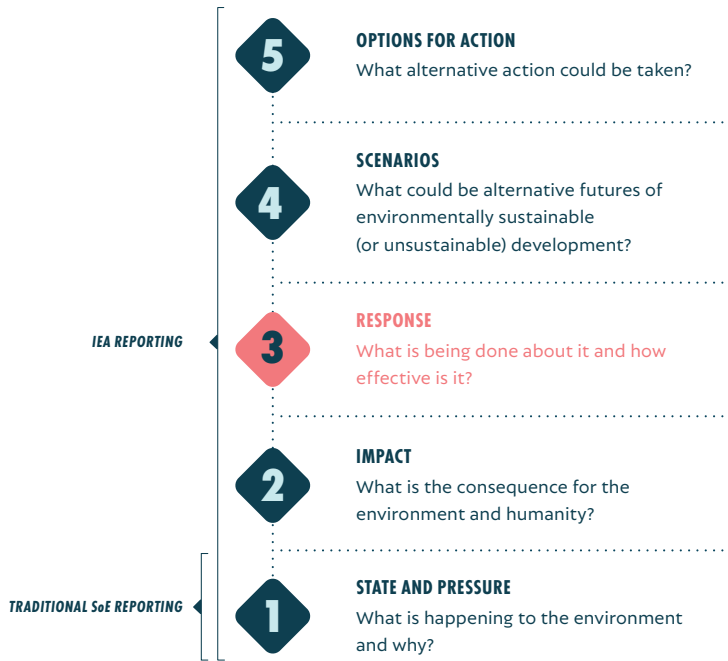
Source: (UNEP and AIT, 2000)

2.4 The evolution of GEO's conceptual framework

The conceptual frameworks of GEO went through several iterations during the history of the assessment, but essentially all versions are rooted in a set of common questions. As shown in Figure 2.4.1, IEA grew out of an SoE practice that evolved since the early 1970s in response to legislative requirements and mounting concerns about environmental change. As the first question indicates, these practices mainly focused on documenting changes in traditionally recognized environmental conditions such as air, water, biodiversity and others. The assessments were science-based and,

to the extent possible, built on monitoring data and indicators. Going beyond the question of what is happening to the environment, SoE reports from an early stage also started to look into the underlying causes of environmental change, mainly direct causes rather than broad societal patterns that underpin direct causes.

Figure 2.4.1. Key questions to be answered by GEO assessments



Integrated Environment Assessments address a wider range of questions than traditional state of the environment reporting

Source: (UNEP and IISD, 2007)

Another important part of the IEA conceptual tradition was the organization of information in terms of a Pressure-State-Response model. Since the late 1970s, this was commonly used in official statistics to organize comprehensive data collecting and reporting mainly on the environment and the forces contributing to environmental change.

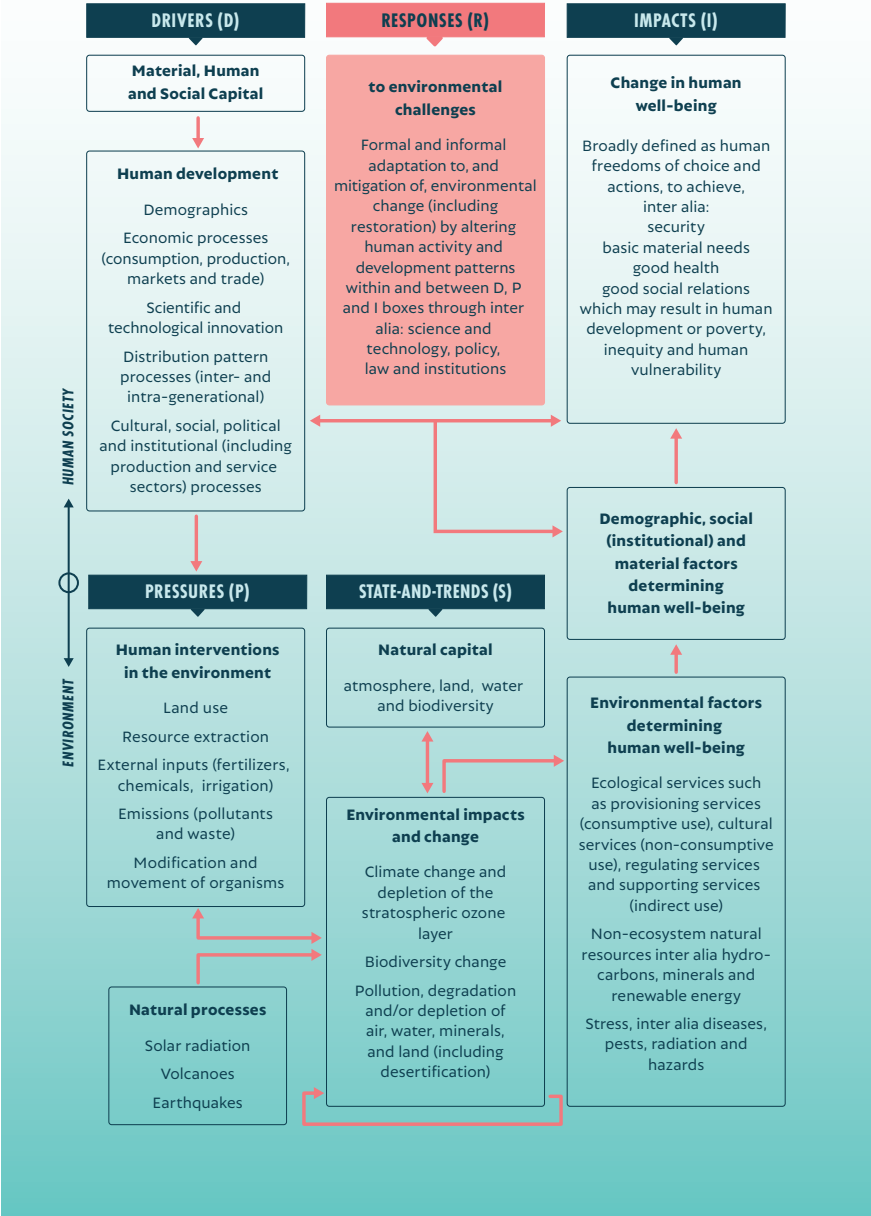
Statistics Canada explicitly connected these traditions, and they were also adopted by the United Nations (Rapport and Friend, 1979; UNDESA, 1984). The Pressure-State-Response model differentiates between pressures as human activities that – in combination with natural forces – result in

stress on the state of the environment, and that, in turn, elicits human responses in the form of policies and actions. Understanding interlinkages in the form of feedback loops and emergent dynamics is important for the model, as environmental outcomes often result from the complex interplay of multiple factors and cannot simply result from the total of their causes. Limitations of the framework arising from such potential over-simplifications and the role of power relationships have been part of the criticism of the framework (Carr et al., 2007).

When elaborating a framework for UNEP's new assessment series, the Dutch National Institute for Public Health and the Environment (RIVM) built on this tradition, modifying it to the Drivers-Pressures-State-Impacts-Responses (DPSIR) framework (Swart and Bakkes, 1995). The framework differentiated between drivers or driving forces as deep underlying macro trends, such as demographic change or economic growth, and more specific human practices or pressures contributing to environmental change. It also identified impacts of environmental change on socio-economic conditions and compounding environmental consequences as a separate analytic category. Responses were conceptualized as policy measures or direct action addressing drivers, pressures, states or impacts. Linkages between the different elements of the framework – Drivers, Pressures, State, Impacts and Responses – were important to support the proposed forward-looking component of the new assessment series via scenarios and modelling. Chapter 4 explores the evolution of the five DPSIR elements through the six global GEOs.

While *GEO-1* referenced the Pressure-State-Response framework with some mention of driving forces (UNEP, 1997c), the DPSIR framework was fully adopted by GEO from *GEO-3* (UNEP, 2002e). However, the framework had to be expanded according to GEO's overall design and mandate over time. Figure 2.4.2 shows the framework diagram from *GEO-4*. In terms of its overall structure, the framework differentiates between human society and the environment. Cross-scale dimensions and the applicability of the DPSIR logic across scale are noted by the local-regional-global labels for three overlapping sheets. The axis below the diagram shows the temporal dimension, a continuum from retrospective analysis to foresight. DPSIR components are placed either entirely in the human society domain (Drivers and Responses), the environment (State) or on the interface (Pressures and Impact). The connection between responses and other domains is not shown but implied. Figure 2.4.3 shows the DPSIR approach used in *GEO-6*, where the links from responses to pressures, state and impacts are shown.

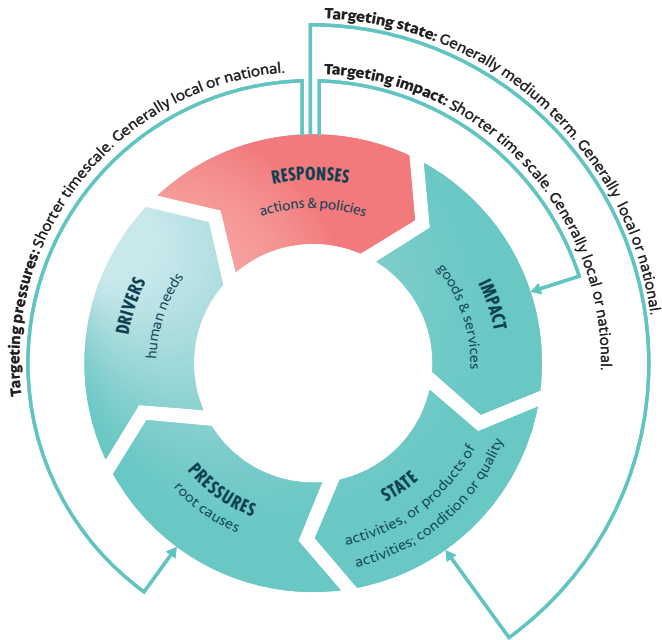
Figure 2.4.2. GEO-4 conceptual framework



GEO is about understanding interactions between human society and the environment across scales and over time.

Source: (UNEP, 2007b, p. xxii)

Figure 2.4.3. Representation of the DPSIR framework in GEO-6



Response options have become more prominent in GEO-5 and GEO-6

Source: (UNEP, 2019e, p. 13)

In terms of methodological steps and assessment structure, the analysis of the state is the common starting point, meaning an evidence-based retrospective assessment of environmental conditions until the present time, based on environmental elements. This is followed by the analysis of drivers as macro trends, including demographic change or economic growth, for example. Drivers underpin pressures, which are more specific processes that lead to changes in the state of the environment. While drivers are considered predominantly the result of human activities, pressures can also result from natural processes, such as earthquakes. Also to be noted is the bidirectional arrow between environmental state and pressures, indicating that changes in environmental conditions can positively or negatively affect human activities that lead to pressures. Examples include how the decline in soil productivity resulting from intensive farming on marginal land may in the short term lead to even further attempts of the same or different types of intensification or increased fishing pressure resulting from the decline of fish density resulting from overfishing. Put together, the analysis of environmental state, drivers and pressures addresses the first step in Figure 2.4.1 by describing what is happening to the environment and why.

The following assessment step considers the consequences of environmental change. Starting with *GEO-4*, the framework adopted the concept of ecosystem goods and services¹ as mediating factors between environmental conditions and human well-being, shown as the component of impacts in the environment domain. In Figure 2.4.2, the top part of impacts in the human society domain includes the impact related to broader drivers and the combined impact on human well-being. Some of the GEO reports, particularly *GEO-3*, frame the impact on humanity through the lens of vulnerability (Chapter 5), which takes into account not only environment-related stress but also exposure, sensitivity and adaptive capacity. By analysing the impacts, the assessment addresses the second step by describing the consequences for the environment and humanity.

To look at responses and their effectiveness, GEO reports experimented with separate policy response chapters and policy report cards, as well as their integration with the assessment of state and trends, in a single chapter. As explicitly shown in Figure 2.4.3, responses can be directed at driving forces, pressures, states and impacts. The framework in *GEO-6* excluded the link between responses and drivers, understood as non-negotiable human needs. Policy assessment was always seen as crucially important, but also as one of the more challenging aspects of GEO, given the complex interlinkages within and among policies, environmental states and impacts themselves. In some cases, a distinction was made between policy effects, as outcomes, and policy effectiveness, where progress towards established targets in multilateral environmental agreements or the Millennium Development Goals and Sustainable Development Goals, for instance, could be assessed. Some later GEO reports featured chapters on linkages to emphasize systemic connections, while *GEO-6* had a chapter covering 12 cross-cutting issues.

The fact that many environmental trends have continued to deteriorate – and significant new problems such as microplastics or the decline of pollinators have emerged – during the lifetime of GEO made understanding how human policies and actions forestall or compound the deterioration a critically important objective of the report. However, it is also one of the most challenging objectives. First, even though policymakers request information on policy outcomes and effectiveness, policies often fail, and reporting on that may be politically or diplomatically difficult. *GEO-6* made major strides in this respect by systematically discussing experiences with

¹ The concept of environmental goods and services was pioneered by the Millennium Ecosystem Assessment, and then adopted by *GEO-4*; the two processes were essentially being carried out at the same time and had some of the same participants.

various environmental policies in their regional contexts. Second, as all changes in the environment and their repercussions result from many factors, not all of which are known or understood, policy assessment is typically inexact. This can conflict with some GEO audiences expecting evidence-based assessment with minimal levels of uncertainty. In fact, for some issues, the uncertainty surrounding policy effectiveness and outcomes is precisely the point.

Beyond policies, other broad forces that shape human behaviour have been recognized in more recent versions of GEO. They include identifying socio-cultural patterns associated with unsustainable production, consumption and lifestyles. With or without formal policies, but often amplified through formal and informal media, these are powerful in influencing the environmentally consequential decisions of individuals and social groups. On the other hand, GEO and other related assessments also started paying more attention to ways of knowing beyond Western science, including traditional and local knowledge and citizen science (Bäckstrand, 2003; Tengö et al., 2017). While both are recognized as having value in their own contexts, their contribution and place in global assessment processes are still evolving (IPBES, 2021).

The outlook component of the GEO framework

The next step of a typical GEO assessment, addressing question 4 in Figure 2.4.1, requires a forward-looking perspective. It requires imagining the future, desired or undesired, as a function of the interplay between human choice and environmental dynamics. This outlook part of a GEO leads directly into the final step, dealing with the question of which alternative actions could be taken.

From the start, GEO included an outlook component as an inherent element. Like every other component, it grew more complex over time and changed, catering to more complex and varied information needs. Chapter 5 describes the evolution of the outlook component in more detail.

In line with GEO as a whole, the emphasis of the outlook chapter shifted from what could happen to what should happen. For example, *GEO-1* tabled a single baseline scenario, illustrating what would happen if we continued along the path of conventional development. The report looked at alternatives to the baseline only in the context of a few selected policies, not as a synthetic whole. In contrast, *GEO-3* featured four contrasting scenarios, each richly elaborated and jointly exploring 'what if...'. *GEO-6* sketched

pathways to sustainable development and sought to identify key changes and conditions associated with transitions. The scenarios were framed around sustainability themes reflected in global commitments such as the Sustainable Development Goals and relevant multilateral environmental agreements, emphasizing the importance of their interconnections.

The significance of the outlook component to the conceptual framework of GEO is arguably five-fold:

1. It bridges from GEO's body of factual, retrospective information to future-relevant illustrations arguing for or against certain approaches, based on which policymakers and stakeholders might develop commitments for the future.
2. It is a potential entry point for the engagement of a wide variety of stakeholders and the development of projections that are well attuned to conditions at the regional level.
3. It provides an opening to address important details that would have been easily missed in conventional SoE reports, such as near-term decision points determining long-term effects by locking societies into given development pathways.
4. It provides the reader, in principle, with a tool to recognize and label contemporary developments in a certain sector or region, or globally, as characteristic of a certain path into the future.
5. It provides an opportunity for the integration of quantitative and qualitative methods and perspectives that allows the construction and exploration of future trajectories with a richer texture and a better sense of possible implications.

In the GEO conceptual framework, scenarios are not predictions. Instead, they are exercises in storytelling, informed by the insights of GEO collaborators and the rigour of quantitative modelling. The outlook part of GEO is typically about larger-scale issues with much inertia, such as agricultural systems, urban development, poverty, education or energy systems and ocean management. Thus, the time-horizon of its outlook component typically lies decades into the future: at least one – or for some societies two – human generations. But implications for policymaking often occur much sooner than that. Identifying these implications – including physical and social impacts and costs – and how they follow from policy choices is a key function of GEO, with practical relevance for policymaking.

2.5 Beyond DPSIR

The DPSIR framework did not begin with GEO, and even though it has served GEO well over many assessment cycles, its use in future GEOs is not a given. The design of upcoming GEOs always involved discussions about the conceptual framework as a prominent element. Such discussions also took place as part of the Future of GEO process that started after *GEO-6*. Even though past considerations of the conceptual framework typically led only to adjustments in the DPSIR framework, more profound changes cannot be excluded.

Since the creation and adoption of the DPSIR framework, a number of key concepts have emerged on the interface of the scientific and policy fields directly relevant for GEO. While recognized, and to some extent even addressed, by GEO reports, these are not explicitly reflected in the DPSIR framework. Examples of such concepts include ecosystem goods and services, planetary boundaries, resilience and transition theory in the sphere of science and governance in the sphere of global policy goals.

While assessments like GEO need to learn and evolve, changes in their frameworks and methods need to be weighed against the value of maintaining consistency over time, as observed by Elizabeth Dowdeswell, a former Executive Director of UNEP (Elizabeth Dowdeswell interview). Is the methodology sound enough to ensure consistency, from early GEOs to future editions in the 2020s? Consistency also matters across the many spatial scales where GEOs have been produced and where framing an IEA around specific political and social realities may deliver ancillary benefits. At the same time, it means that interpretations of some of GEO's facts reflect changing viewpoints, which may be a concern for consistency over time. Ideally, GEO would offer both a layer of comparable measurements and a layer of interpretation, depending on political and social contexts, both of which may vary and change.