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Chapter **1.**

ASSESSING A PLANET IN TRANSFORMATION: RATIONALE AND APPROACH OF THE IPBES GLOBAL ASSESSMENT ON BIODIVERSITY AND ECOSYSTEM SERVICES

IPBES GLOBAL ASSESSMENT REPORT ON BIODIVERSITY AND ECOSYSTEM SERVICES CHAPTER 1. ASSESSING A PLANET IN TRANSFORMATION: RATIONALE AND APPROACH OF THE IPBES GLOBAL ASSESSMENT ON BIODIVERSITY AND ECOSYSTEM SERVICES

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CHAPTER 1

ASSESSING A PLANET IN TRANSFORMATION: RATIONALE AND APPROACH OF THE IPBES GLOBAL ASSESSMENT ON BIODIVERSITY AND ECOSYSTEM SERVICES

1.1 SETTING THE STAGE

1.1.1 The scope of the IPBES Global Assessment on Biodiversity and Ecosystem Services

The challenges of mitigating and adapting to climate change, achieving inclusive food, water, energy and health security, addressing urban vulnerabilities, and the unequal burdens of nature deterioration, are not only predicaments on their own right. Because they interact, often exacerbating each other, they create new risks and uncertainties for people and nature. It is now evident that the rapid deterioration of nature, including that of the global environmental commons on land, ocean, atmosphere and biosphere, upon which humanity as a whole depends, are interconnected and their cascading effects compromise societal goals and aspirations from local to global levels. Growing efforts to respond to these challenges and awareness of our dependence on nature have opened new opportunities for action and collaboration towards fairer and more sustainable futures.

The global assessment on biodiversity and ecosystem services (GA) has been designed to be a comprehensive and ambitious intergovernmental integrated assessment of recent anthropogenic transformations of Earth's living systems, the roots of such transformations, and their implications to society. In the chapters that follow, our mandate is to critically assess the state of knowledge on recent past (from the 1970s), present and possible future trends in multi-scale interactions between people and nature, taking into consideration different worldviews and knowledge systems, including those representing mainstream natural and social sciences and the humanities, and indigenous and local knowledge systems. In doing so, the GA also assesses where the world stands in relation to several international agreements related to biodiversity and sustainable development.

This challenging task, mandated by the 123 member-countries (2016) of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), reflects the evolution of international collective thinking and action and fulfils several goals. It reflects an increasingly shared understanding that the human imprint at a global scale has made our social worlds intertwined with the larger Earth biophysical systems and fabric of life. It represents a shared understanding that internationally agreed goals for sustainable development, biodiversity conservation and climate change are interdependent in their pathways to success. As such, the GA examines our past trajectories, our actions today and the opportunities going forward as part of an interdependent global social-ecological system, with its own emergent properties, undergoing fast changes and modes of functioning. Earth history has become intertwined with human history. At the same time, it is increasingly obvious that the planet is highly heterogeneous and yet highly interconnected, physically and virtually, socially as well as ecologically. Global connectivity and unity do not mean uniformity; shared goals do not mean a single pathway.

To accomplish its goals, the GA examines the current status, past and future trends in nature, development pathways across world regions, interactions between and among direct and indirect drivers of change within and across them, human values towards the environment and response options regarding nature both on land and under water and nature's contributions to people's quality of life in landscapes and seascapes under different degrees of human intervention. A hallmark component of the GA is its systematic cross-chapter and cross-scale attention to indigenous and local knowledge (ILK) and issues concerning Indigenous Peoples and Local Communities (IPLCs), scaling-up and providing syntheses, where appropriate, at regional and global levels.

The timeframe examined in the assessment includes going back as far as 50 years (or longer) so that current status and trends up to 2020 can be seen in context. Scenarios

and plausible future projections are examined with a focus on various periods between 2020 and 2050, covering key target dates related to the Strategic Plan for Biodiversity 2011–2020 and the 2030 Agenda for Sustainable Development and its Sustainable Development Goals, as well as overall trends across the next 50 years. An important aspect of the GA is to examine the synergies and trade-offs associated with meeting multiple goals and the interactions among the social, economic and environmental dimensions underlying possible pathways to the future. Another major goal is to examine policy options and solutions in an integrated way, so that specific goals such as feeding the world, sustaining the world's fisheries, mitigating climate change, or providing water security to all do not undermine, but rather leverage on each other.

This task is structured according to five overarching questions defined in the global assessment scoping report[1]:

(a) What is the status of and trends in nature, nature's contributions to people and indirect and direct drivers of change?
(b) How do nature and its contributions to people influence the implementation of the Sustainable Development Goals? What is the evidence base that can be used for assessing progress towards the achievement of the Aichi Biodiversity Targets?
(c) What are the plausible futures for nature, nature's contributions to people and their impacts on quality of life between now and 2050?
(d) What pathways and policy intervention scenarios relating to nature, nature's contributions to people and their impacts on quality of life can lead to sustainable futures?
(e) What are the opportunities and challenges, as well as options available to decision makers, at all levels relating to nature, its contributions to people and their impacts on quality of life?

The assessment of evidence regarding these five questions is guided by the IPBES conceptual framework and a series of analytical frameworks described in this chapter. The GA builds upon a series of preceding IPBES assessments, which include an assessment on pollination (IPBES, 2016a), a methodological assessment of scenarios and models (IPBES, 2016b), four regional assessments (IPBES, 2018b, 2018c, 2018d, 2018e) and the land degradation and restoration assessment (IPBES, 2018a). Besides its specific mandate, the GA addresses issues of a global nature not fully covered in those assessments, paying particular attention to inter-regional interactions and their emergent global outcomes.

1. Annex I to decision IPBES-4/1, 2016.

The goal of the GA is to provide relevant, credible, legitimate, authoritative, evidence-based, and comprehensive analyses of the state of knowledge these questions, informing a range of stakeholders in the public and private sectors and civil society. These include governments, multilateral organizations, the private sector and civil society, including IPLCs and non-governmental organizations. The assessment is organized to contribute directly – although by no means exclusively – to the evaluation of the UN Convention on Biological Diversity's (CBD) Strategic Plan for Biodiversity 2011–2020 (including the Aichi Biodiversity Targets) and its 2050 Vision for Biodiversity. It informs the upcoming fifth edition of the Global Biodiversity Outlook (GBO) of the Convention on Biological Diversity, which in 2020 will report on the implementation and the achievements of the Strategic Plan for Biodiversity 2011–2020 and consider ways forward.

The GA also contributes to the evaluation of progress towards achieving the 2030 United Nations Sustainable Development Goals (SDGs), particularly goals related to the natural environment and biodiversity. The GA also assesses progress towards ten other environment-related international agreements (see description of chapter 3 below), and intends to contribute, among others, to national and regional assessments and strategies. Evaluations of these agreements and the guiding questions presented above consider current and projected climate change scenarios and proposed pathways to achieve the goals of the Paris Agreement on Climate.

A road map to the chapters of the Global Assessment

As other IPBES assessments, the GA is a critical evaluation of the state of knowledge carried out under the principles of relevancy, legitimacy and credibility. The GA has not undertaken new primary research, but analysed, synthetized and critically evaluated available information and data previously published or otherwise made available in the public domain in a traceable way. The questions presented above provide a framework for evaluating and integrating evidence from local to global levels, spanning past and future.

The GA chapters are organized to accomplish a two-fold goal: to provide in-depth knowledge on specific issues and domains (using diverse expertise and perspectives, evidence and indicators), and to build upon each other in the spirit of cumulative understanding of cross-cutting issues. For instance, chapter 1 provides a common framework, language, and set of analytical tools that supports all chapters; the three subchapters of chapter 2 provide detailed evidence on status and trends to date, providing support for chapter 3 to examine progress towards the 2011–2020 Aichi Biodiversity Targets, the 2030 SDGs, and other environmental agreements; both chapters provide the

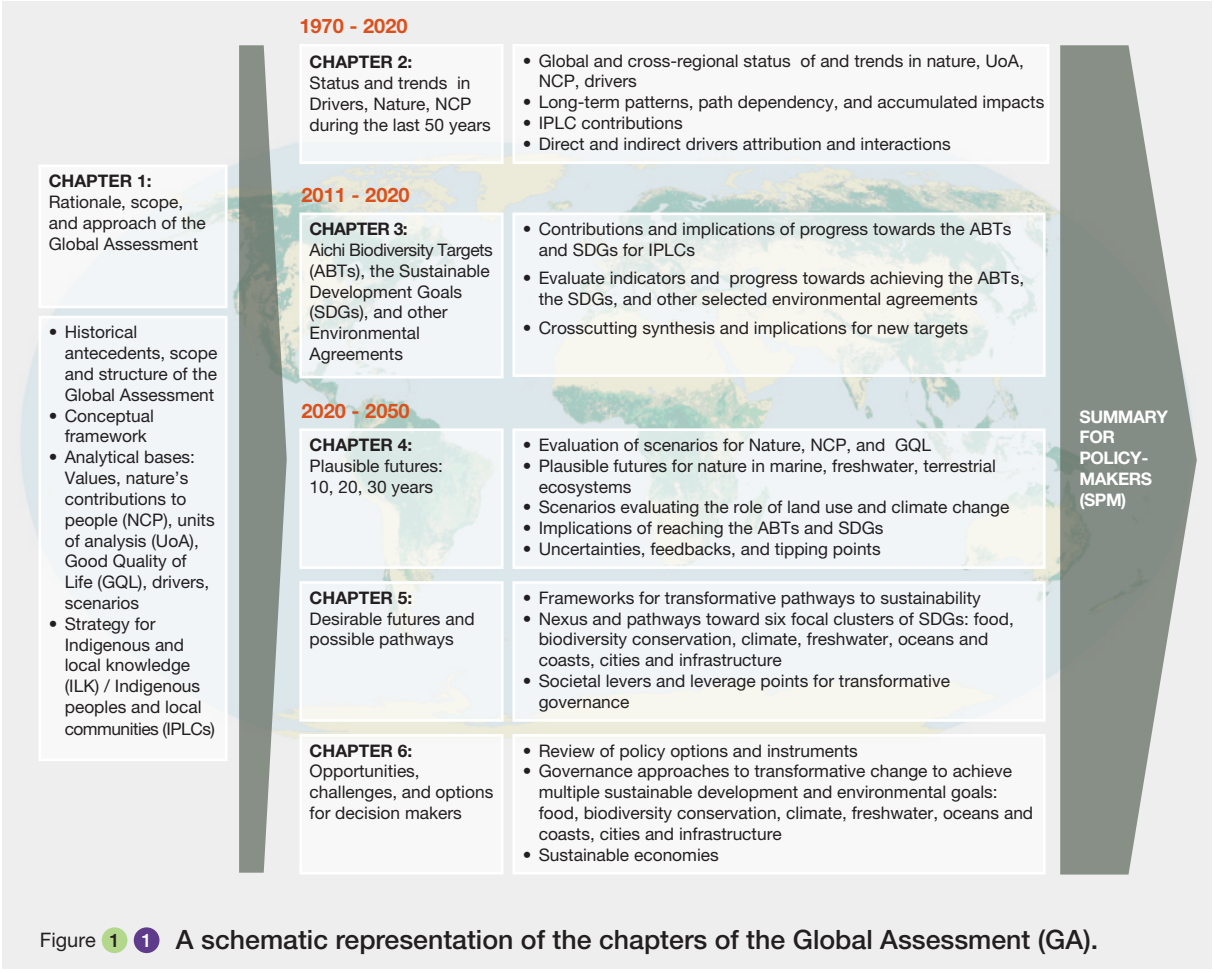


Figure 1 1 **A schematic representation of the chapters of the Global Assessment (GA).**

elements for the analyses presented in chapters 4, 5, and 6. Together, the chapters develop a storyline starting with the social-ecological transformation of the Earth particularly during the past 50 years, examining current progress in confronting the challenges posed by such transformation, evaluating the outlook of the near and more distant futures, and reflecting the potential pathways and policy options to fairer, more resilient and sustainable futures.

1.1.2 The chapters: Unfolding the story of global changes and what to do about them

What follows in chapter 1 starts with contextualizing the GA within a longer lineage of efforts to understand global changes and possible pathways to sustainability. It then provides a detailed discussion of the IPBES conceptual framework supporting the assessment, explaining its main elements and interactions. The nature's contribution to people approach is presented as a product of evolving ideas since the popularization of ecosystem services concepts and approaches. Next, this approach and its derived analytical categories are explained, followed by a presentation of other key analytical tools used in the assessment, including values towards nature, institutions and governance, good quality of life, direct and indirect drivers, and units of analysis. This is followed by a detailed discussion of the operational strategy to integrate and scale-up from local to global levels, and systematically across chapters, issues concerning IPLCs and evidences from ILK. Finally, other supporting tools used in the assessment are presented, including scenarios, indicators, literature review, units of analysis, typology of drivers and confidence framework.

Chapter 2 addresses the question *What are the current status as well as the trends for nature, nature's contributions to people, and their indirect and direct drivers?* Given its enormous scope, the chapter is broken into three subchapters.

The first of chapter 2 subchapters (2.1), *Drivers*, examines the status and trends for drivers that affect nature directly (arrow 3 of the IPBES conceptual framework, **Figure 1.2**), and indirectly (arrow 2), including across regions. It emphasizes anthropogenic drivers and examines the development

trajectories for different groups of countries, during the past 30–50 years, given their economic and environmental interactions. It considers how values and their expressions in decisions affect demands for contributions from nature, given related socioeconomic processes including evolving governance institutions (arrow 1), and how these indirect drivers in turn affect direct drivers acting directly on nature and their aggregated consequences (arrow 2).

The second subchapter (2.2), *Nature*, unpacks the nature box of the IPBES conceptual framework. After setting the stage by discussing different perspectives and worldviews about nature, it outlines nature's many different aspects, such as biodiversity and ecosystem structure and function, and the contributions of IPLCs to wild and domesticated biodiversity and to their management and conservation. The subchapter assesses status and trends of nature, using both a wide array of globally relevant indicators from marine, terrestrial and freshwater ecosystems and the first global synthesis of IPLCs indicators of local-scale change. It assesses the relative impacts of the main direct drivers on nature globally (arrow 3) as well as reports on each unit of analysis. This subchapter also describes how the many facets of nature underpin its contributions to people (arrow 4).

The third of Chapter 2 subchapters (2.3), *Nature's Contributions to People (NCP)*, describes status and trends of nature's contributions, both positive and negative, to human quality of life. This section presents a summary of status and trends globally, and highlights differences across ecosystem types and regions, for 18 NCP that span regulating, material, and non-material contributions. This section discusses the co-production of NCP by people and nature, as well as the impact that NCP has on different user groups. This section also examines multiple dimensions of value that describe impacts on human quality of life.

Chapter 3 addresses the questions of *How much progress has been made towards the Aichi Biodiversity Targets and the objectives of other biodiversity-related agreements, and how do nature and its contributions to people contribute to the implementation of the Sustainable Development Goals?* Building upon findings from chapter 2 and additional evidence from analyses of indicators and literature reviews, the chapter assesses progress towards meeting major international objectives related to biodiversity and sustainable development, with special attention given to the Aichi Biodiversity Targets and to relevant (i.e., directly biodiversity-related) Sustainable Development Goals. The chapter also examines the objectives of other biodiversity-related agreements: Convention on Migratory Species (CMS), Convention on International Trade in Endangered Species (CITES), Ramsar Convention on Wetlands (Ramsar), Convention to Combat Desertification (UNCCD), World Heritage Convention (WHC), International Plant Protection Convention (IPPC), Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR), the Arctic Council's Conservation of Arctic Flora and Fauna (CAFF), the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), and the Convention on the Law of the Sea (UNCLOS). The chapter assesses the contributions of Indigenous Peoples and Local Communities (IPLCs) to achieve biodiversity goals and targets, and how progress towards them (or lack of it) affects IPLCs. Chapter 3 also discusses the reasons for variation in progress towards international objectives, and the implications for the development of a new generation of targets towards the CBD 2050 Vision for Biodiversity.

One of the innovations of the GA is to explore target-seeking scenarios related to desirable futures, possible pathways, and their trade-offs in Chapters 4 and 5. They build upon previous chapters to assess the evidence of plausible future trends (4) in nature, nature's contributions, and quality of life; and possible pathways (5) to sustainable futures.

Chapter 4 addresses the question *What are the plausible futures for nature, nature's contributions to people and their implications for a good quality of life?* It does so by considering a wide range of scenarios of direct and indirect drivers, from business-as-usual to transformative sustainability. In line with the 2030 SDGs and the CBD 2050 Vision for Biodiversity, the chapter focuses on the 2030 and 2050 timeframes, but also includes projections to the end of the 21st century. Using statistical extrapolations, exploratory scenarios of direct and indirect drivers, and inferences from patterns in case studies derived from an extensive systematic literature review, the chapter examines these trends for terrestrial, marine, and freshwater systems, including the projected impacts of climate change on them, and the relative roles of direct drivers such as climate change, atmospheric CO_2 concentration and land use in terrestrial systems. These trends are then linked to their potential impact on the Aichi Targets and the SDGs. It also addresses potential interactions and feedbacks among nature, nature's contributions, and quality of life, including possible implications for regime shift and tipping points, and adaptive capacity. The systematic review of the literature evidenced a paucity of global scale scenarios accounting for important drivers such as pollution or invasive alien species, and concerns about Indigenous Peoples and Local Communities.

Chapter 5 addresses the question *What pathways and policy intervention scenarios relating to nature, its contributions to people, and their impacts on quality of life can lead to sustainable futures?* In doing so, the chapter focuses in particular on the means of achieving internationally agreed upon goals and targets broadly related to biodiversity and ecosystem functions and their societal benefits. Building upon and expanding the literature review carried out in Chapter 4, the chapter includes a

nexus analysis of pathways toward six focal clusters of SDGs, including potential synergies and trade-offs. These six foci include *feeding the world without degrading nature on land* (SDGs 15, 2, 12), *meeting climate goals while maintaining nature and its contributions to people* (SDGs 7, 2, 13, 15), *conserving and restoring nature on land while contributing positively to human well-being* (SDGs 15, 3), *maintaining freshwater for nature and humanity* (SDGs 6, 2, 12), *securing food provisioning and nature protection in oceans and coasts* (SDGs 14, 2, 12), and *resourcing growing cities while maintaining the nature that underpins them* (SDGs 11, 15). The chapter then synthesizes cross-cutting findings from the nexus analysis and integrates other broad and diverse scholarship on social transformation to derive common constituents of sustainable pathways, using the metaphor of 'levers' and 'leverage points' of societal change. These interventions and points of intervention together lay out bold but achievable pathways to deep and lasting change that would sustain and improve the state of nature and human quality of life in the coming century.

Finally, Chapter 6 addresses the question *What are the opportunities and challenges, as well as options available to decision makers, at all levels relating to nature, its contributions to people, and their impacts on quality of life?* Building upon previous chapters, and closely aligned with the nexuses and pathways discussed in Chapter 5, this chapter focuses on assessing opportunities and challenges for decision makers at all levels to engender transformative change by integrating governance approaches that are integrative (addressing policy incoherence), inclusive (advancing mechanisms that enable participation), informed (based on legitimate and credible knowledge), and adaptive (governance that enables learning). This analysis provides a framework to examine transformative governance of five overarching issues following the discussion of pathways and levers in Chapter 5. These include integrated approaches applied to sustainable management and conservation of landscapes, coastal and marine areas, freshwater systems, cities and urban areas, and energy and infrastructure. In each case, the chapter examines the advances and setbacks of existing policy instruments, their implications for different stakeholder groups, and further advances needed to address current and emerging governance challenges. Finally, the chapter pays attention to factors affecting transformations towards sustainable economies, including the role of societal values behind economic development models, distortions and disparities in trade, tackling inequalities, developing more inclusive economic accounting, and improving financing for biodiversity and the environment.

In addition to the main body of each chapter, an extensive set of Supplementary Material is available, providing further information and preserving relevant supporting evidence and documentation.

1.2 THE IPBES GLOBAL ASSESSMENT IN THE CONTEXT OF OTHER ASSESSMENTS

The GA is part of a lineage of environmental assessments, and as such it builds upon the experiences and rules of practice of previous assessments of the global environment, biodiversity and ecosystem services, oceans and climate change, including four notable assessment reports completed on a global scale with strong focus on environmental change, biodiversity and ecosystem services, namely the Global Environmental Outlook Series (GEO), the Global Biodiversity Assessment (Heywood & Watson, 1995), the Millennium Ecosystem Assessment[2] (MA 2005), and the Global Biodiversity Outlook (GBO) and the Local Biodiversity Outlook (LBO) series. Benefiting from this rich heritage, the GA is also innovative on several fronts (**Box 1.1**: The global assessment innovative approach).

Efforts to develop evaluations of the global environment date back to the 1960s, benefiting from pioneer initiatives such as the International Biological Program (IBP), which set out a collaborative and international research agenda seeking to understand the 'biological underpinnings of productivity and human welfare'. IBP also influenced the creation of UNESCO's Man and Biosphere program in 1971 and its vision to bring together natural and social sciences to collaborate on understanding human-environment relationships. The 1972 Club of Rome's "The Limits to Growth" report and *World3* simulation model had a major influence on both global sustainability thinking and analytical approaches to global level human-environmental analysis; *World3* pioneered modelling interactions between scenarios of population, economic, and industrial growth, food production and resource uses, and limits to global ecological systems. During the 1980s, numerous initiatives emerged, among others, the Worldwatch Institute State of the World report series (starting in 1984), the World Conservation Strategy report developed by UNEP, IUCN, and WWF (starting 1980), and the influential Brundtland report 'Our Common Future' (1987).

Equally important to our current understanding of global environmental and climate change, and global sustainability more broadly, were the emergence of international research networks and programs since 1980. In just over a decade, under the auspices of various international organizations, four main research programs emerged, the World Climate Research Program (WCRP), the International Geosphere Biosphere Program, DIVERSITAS, and the International Human Dimensions Program (IHDP). Later, these programs

2. https://www.millenniumassessment.org/en/About.html

collaborated on cross-cutting issues through the integrated Earth Systems Science Partnership (ESSP), eventually coming together within the current Future Earth program. Under their umbrellas, research projects/programs covering virtually all aspects of human-environment interaction developed, many of which continue to flourish today. These programs and projects continue to provide scientific knowledge and conceptual underpinnings which have been key to efforts such as, among many others, the IPCC and IPBES.

The first comprehensive large-scale international biodiversity assessment was the Global Biodiversity Assessment (Heywood & Watson, 1995), which was proposed in 1992 in an effort to, for the first time, mobilize the scientific community to evaluate the global status of biodiversity. This endeavor was initiated by the Global Environment Facility (GEF)'s Scientific and Technical Advisory Panel (STAP) and overseen by UNEP. The GBA, however, was not an intergovernmental process and did not have a mechanism for involving multiple stakeholders, including decision-makers; which limited its policy reach even though the assessment included policy implications (Watson & Gitay, 2007).

At the turn of the millennium, in response to biodiversity-related conventions (e.g., Convention on Biological Diversity [CBD], Ramsar Convention on Wetlands, the Convention on Migratory Species, [CMS], Convention to Combat Desertification [UNCCD]) and a request by the United Nations Secretary-General (2000)[3], another major, one-time global assessment centered on the relationship between ecosystem services and human well-being was initiated: the Millennium Ecosystem Assessment (MA). The MA, completed in 2005, covered the status and trends in biodiversity, ecosystems and their services, plausible future scenarios, and options for action, and a series of sub-global assessments, which continued after the publication of the MA. Although its external review included governments as well as experts, and its board included representatives of end user groups such as biodiversity-related conventions, UN agencies, business, some national governments and civil society, the MA is considered a non-governmental assessment as its key findings were formally approved by their board, not by governments. The legacy of the MA has been major in mainstreaming the relationship between ecosystem services and human wellbeing and in motivating international interdisciplinary collaborations. It also spurred an array of sub-global assessments, along with many other regional and thematic assessments carried out since 2000. Equally important, the MA motivated the emergence of The Economics of Ecosystems and Biodiversity program (TEEB), bringing together in particular economics and ecological sciences to advance the understanding of values of ecosystem services, using sectoral and cross-sectoral analyses, bringing attention to their importance to national economies (Kumar, 2010). TEEB has had both important impacts in the mainstreaming of ecosystem services in public policies and in advancing approaches and conceptualization of values in ecosystem services analyses.

Two other relevant global-level reports are the Global Biodiversity Outlook (GBO) series, CBD's flagship reports, and the Global Environmental Outlook (GEO) series, UNEP's flagship report. The GBO was initiated at the second meeting of the Conference of the Parties of the CBD (COP-2), which requested a periodic report on biological diversity providing a summary of the status of biological diversity and effectiveness of implementation measures for safeguarding biodiversity. The first edition of the GBO series was published in 2001 with their key end users being decision-makers involved in the implementation of the Convention (CBD). The GBO-5 report, to be released in 2020, will consider the IPBES global assessment as a major input. UNEP's GEO reports were initiated in 1995 at the request of member states in response to UN Agenda 21[4] and its reporting requirements, and as a response to the Brundtland report. Since its first volume in 1997, to date, five GEO reports have been published and the GEO sixth edition (GEO-6) delivered in March 2019.

In addition to the assessments mentioned above, the GA shares many features in terms of procedures, with the Intergovernmental Panel on Climate Change (IPCC) assessments. The IPCC was created 30 years ago under the joint auspices of the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP), and its first assessment report was delivered to Governments in 1990. IPBES assessments procedurally mirror those of IPCC, as IPBES rules of procedure for the preparation of deliverables (i.e., decision IPBES 3/3) are transposed from the Intergovernmental Panel on Climate Change (IPCC)[5]. While the structure of IPCC assessments differs slightly, in general these two intergovernmental assessment processes are very similar. These similarities stem from the fact that, like the IPCC, the assessment work of IPBES is mandated in response to governments' requests; it aims to inform decision-makers through policy-relevant, not policy-prescriptive statements and findings.

3. https://www.millenniumassessment.org/en/About.html

4. Agenda 21 is a comprehensive plan of action to be taken globally, nationally and locally by organizations of the United Nations System, Governments, and Major Groups in every area in which human impacts on the environment. Agenda 21, the Rio Declaration on Environment and Development, and the Statement of principles for the Sustainable Management of Forests were adopted by more than 178 Governments at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil, 3 to 14 June 1992. https://sustainabledevelopment.un.org/outcomedocuments/agenda21. Accessed May 2018.

5. Procedures for the preparation, review, acceptance, adoption, approval and publication of IPCC reports – Appendix A to the Principles Governing IPCC Work (https://archive.ipcc.ch/pdf/ipcc-principles/ipcc-principles-appendix-a.pdf)

The roles of experts are similar, authors are regionally represented, and each assessment undergoes two external review rounds prior to the submission of the final government draft. In both cases, the resulting Summary for Policymakers (SPM) is negotiated in their respective plenaries among member countries. IPBES' mandate includes three functions in addition to assessments: capacity building, knowledge generation catalysis and policy support (Brooks *et al.*, 2014). Distinctively, IPBES also has an explicit mandate to embrace different knowledge systems in its assessments and functions.

The GA had seven IPBES assessments to draw from (i.e., synthesize information from) and build upon which included two thematic assessments (pollination and land degradation and restoration), one methodological assessment (scenarios and models), and four regional assessments: Americas, Africa, Europe and Central Asia, and Asia and the Pacific. Because the four regional assessments and the land degradation and restoration assessment were being undertaken almost in parallel (completed in 2018) – this meant the global assessment had the unique advantage and benefit of accessing a separate and extensive up-to-date pool of evidence (albeit somewhat overlapping) and experts that could confirm, support or contribute to the evaluations and work completed in the global assessment.

Box 1 1 The global assessment innovative approach.

The IPBES global assessment is the **first independent comprehensive global assessment of biodiversity, ecosystems and their contributions to people following an intergovernmental process from start to end**, as such, this assessment is **highly policy relevant** having its mandate and scope requested and approved by governments and international conventions. In addition, the geographic, gender and disciplinary **balance** of the author team has further increased this assessment's legitimacy. The global assessment is built on the innovative and inclusive **IPBES conceptual framework** explaining connections between people and nature (see Section 1.3.1 and **Box 1.2**) with institutions, governance and other indirect drivers being central to all interactions. The global assessment also made a concerted effort to include a diversity of **worldviews and knowledge systems including systematic analyses of evidence on indigenous and local knowledge and issues**, and dialogue meetings involving experts and representatives from Indigenous Peoples and Local Communities (see Section 1.3.2 and **Box 1.3** and **1.4**). The IPBES global assessment has recognized thresholds, synergies, trade-offs and feedbacks in its assessment of nature, nature's contributions to people and drivers of their changes through the concepts of **telecoupling and nexuses** – which has not been done before at the global scale; understanding these interactions (spatially and across sectors) have direct implications for considering options for action. Framed around major international agreements such as the aforementioned post-2020 biodiversity framework of the UN Convention of Biological Diversity, the Paris Agreement of the UN Framework Convention on Climate Change and the UN 2030 Agenda for Sustainable Development and its Sustainable Development Goals **– the global assessment aims to be far-reaching and to inform decision makers and end users at all scales and sectors**. The completion of this global assessment is uniquely timed to be a major input to the Convention on Biological Diversity's fifth edition of the Global Biodiversity Outlook and its second edition of the Local Biodiversity Outlook. The global assessment has assessed progress towards the current Aichi Biodiversity Targets which will inform the next set of targets and the post-2020 biodiversity framework.

1.3 THE CONCEPTUAL BASES OF THE IPBES GLOBAL ASSESSMENT

1.3.1 The IPBES Conceptual Framework

As previous IPBES assessment reports, this global assessment is structured according to the IPBES conceptual framework (CF), described in detail in Díaz *et al.* (2015a, 2015b). The CF is a highly simplified model of those interactions between people and the rest of the fabric of life on Earth that are most relevant to IPBES's goal. It intends to bring together the perspectives and information of a wide spectrum of knowledge systems and stakeholders on the status and trends of the living world and its contributions to people's quality of life. Since its inception by approval of the IPBES member countries in 2013, the CF has provided a conceptual and analytical tool that underpins all IPBES functions and provides a consistent structure and terminology to IPBES products at different spatial scales, on different themes, and in different regions. To date, it has been used successfully to guide the IPBES pollination assessment (IPBES, 2016a), the methodological assessments on scenarios and models (IPBES, 2016b), four regional assessments (IPBES, 2018b, 2018c, 2018d, 2018e), the land degradation and restoration assessment (IPBES, 2018a), and the present global assessment.

The CF includes six primary interlinked elements (or components) that operate at various scales in time and space: nature; nature's contributions to people (NCP); anthropogenic assets; institutions and governance systems and other indirect drivers of change; direct drivers of change; and good quality of life **(Box 1.2, Figure 1.2)**. These elements have been conceived as broad, inclusive categories that should be meaningful and relevant to all stakeholders involved. The CF thus provides a common ground and terminology to facilitate cross-disciplinary and cross-cultural understanding and inter-operability in the discussion of problems and the identification of solutions to common challenges.

The CF explicitly considers that formal and informal institutions mediate human-nature interactions, facilitating or hindering the co-production of NCP and the distribution of benefits to different social groups. Built upon a long lineage of conceptual frameworks, intended to facilitate interdisciplinary collaboration and science-policy dialogues, salient innovative aspects of the IPBES CF are its participatory construction and its explicit consideration of diverse disciplines, as well as diverse stakeholders (the scientific community, governments, international organizations, civil society at different levels, with Indigenous Peoples and Local Communities sometimes being part of each of these groups), and their different knowledge systems (natural sciences, social sciences and humanities, indigenous, local and practitioners' knowledge).

Particularly relevant features of the CF are:

- **Institutions and governance:** In a shift of focus with respect to most previous initiatives, the CF highlights the central role of institutions (in the broadest sense) as key indirect drivers of change and more generally as fundamental mediators of the perceptions and values about nature and NCP as well as the relationships between humans and all other forms of life on Earth.

- **Explicit consideration of different knowledge systems:** The different knowledge systems from which each of the major elements can be approached are graphically indicated using different fonts and colours for the boxes representing the main elements in **Figure 1.2**. The headlines in larger black bold font indicate the broad, highly inclusive categories nature, nature's contributions to people (NCP), good quality of life (GQL), indirect drivers, direct drivers and anthropogenic assets. The green and blue fonts indicate the more specific categories used by different disciplines and knowledge systems to refer to them. In green are some examples of common natural and economic sciences categories, and in blue, some from indigenous knowledge systems. It is important to stress that these are simply illustrations of the many categories that could be used, and that between the green and blue categories there is a wide gradient of perspectives rather than a sharp distinction. Therefore, the clear-cut distinction between the blue and green 'circuits' in the diagram is simply a means to highlight the importance of incorporating diverse perspectives into the CF.

- **Co-production of nature's contributions to people (also called joint production in Chapter 2-nature's contributions to people – NCP):** highlights the role of human societies as co-producers of NCP through anthropogenic assets (e.g., labour, knowledge, financial and built assets). This is a change in emphasis with respect to some conservation approaches that tended to see humans almost exclusively as external drivers negatively impacting nature. From a cultural perspective, co-production of NCP also provides shared meaning in society of the way interactions with nature contribute towards a good quality of life.

- **Plurality of values and interests:** The explicit recognition that there are no uniform needs (beyond those involved in physical survival), aspirations, perceptions, or preferences towards nature and NCP across the whole humankind, but rather a highly

uneven, complex, constantly evolving mosaic of views, interests and stakes across and within societies. See Section 1.3.1.3.

The adoption of a single CF at the onset of IPBES was made in full recognition that a perfect alignment among the categories of different knowledge systems or even disciplines is unattainable. Representations of human–nature relationships may vary across cultures and knowledge systems in relation to specific worldviews and epistemologies, including between natural and social sciences and the humanities, scientific and indigenous knowledge systems, as well as among Indigenous Peoples and Local Communities. The CF is therefore mainly intended to provide a common platform for reflection and identification of options, rather than a comprehensive shared cross-cultural description of the world.

Box 1.2 describes the main elements of the CF, their interlinkages and the recognition of different knowledge systems as diagrammatically presented in **Figure 1.2**. A full glossary is presented as Supplementary Material 1.1.

Box 1 2 **The Main Elements of the IPBES Conceptual Framework.**

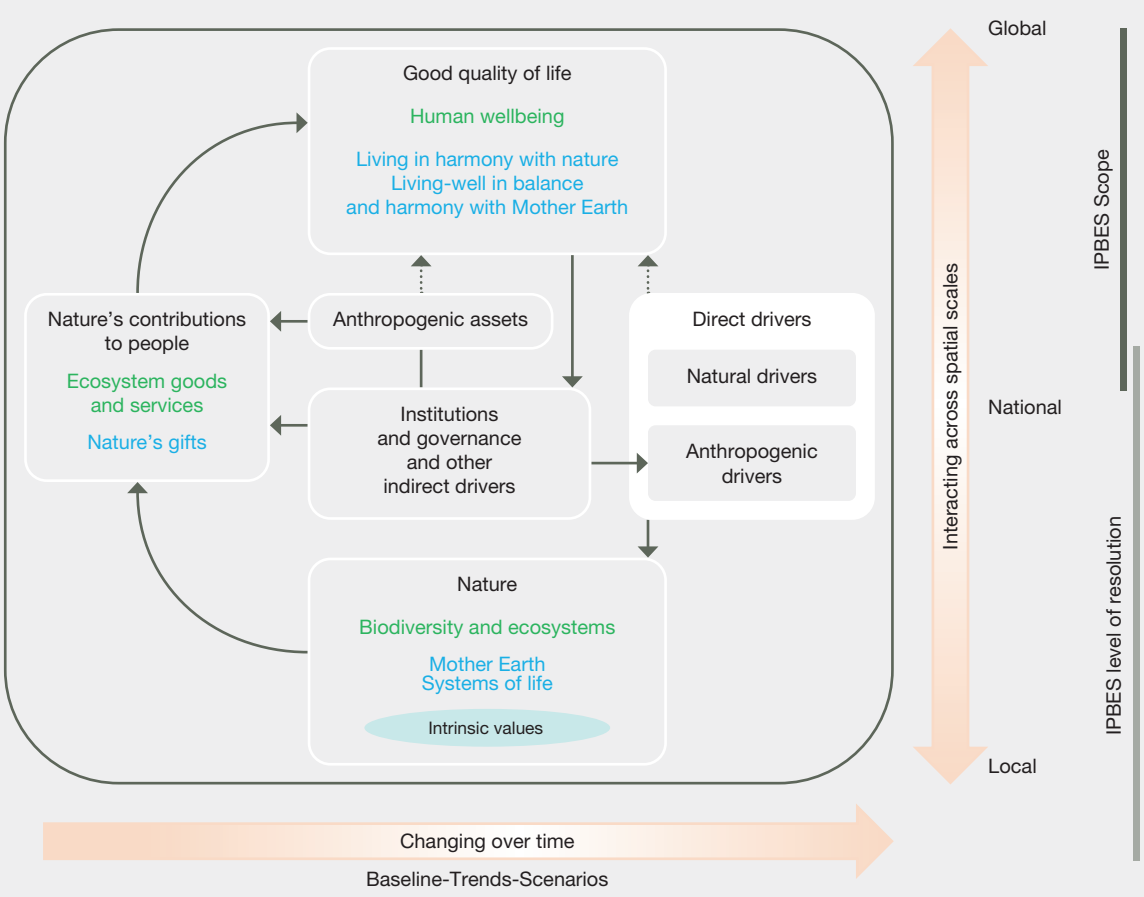


Figure 1 2 **The IPBES conceptual framework (CF). Source: Díaz *et al.* (2015a, 2015b).**

The IPBES conceptual framework is a highly simplified model of the complex interactions between the natural world and human societies. The model identifies the main elements (boxes within the main panel outlined in white), together with their interactions (arrows in the main panel), that are most relevant to the Platform's goal. "Nature", "nature's contributions to people" and "good quality of life" (indicated as black headlines and defined in each corresponding box) are inclusive categories that were identified as meaningful and relevant to all stakeholders involved in IPBES during a participatory process, including various disciplines of the natural and social sciences and the humanities, and other knowledge systems, including those of Indigenous Peoples and Local Communities. Text in green denotes scientific concepts, and text in blue denotes concepts originating in other knowledge systems. The solid arrows in the main panel denote influence between elements, and dotted

arrows denote links that are acknowledged as important, but that are not the main focus of the Platform. The thick coloured arrows below and to the right of the central panel indicate the scales of time and space, respectively. The intrinsic values of nature (represented by a blue oval at the bottom of the nature box) are interpreted as being independent from human experience and thus do not participate in these arrows (see Section 1.3.1.3). See Supplementary Material 1.1 for glossary, and Díaz *et al.* (2015a) for further explanation and examples of the links indicated by the different arrows.

This conceptual framework was accepted by the Plenary in decision IPBES/2/4, and the Plenary took note of an update presented in IPBES/5/INF/24 and in decision IPBES/5/1. Further details and examples of the concepts defined in the box can be found in the glossary.

- **Nature:** (also referred as "living nature") the nonhuman world, including coproduced features, with particular emphasis on living organisms, their diversity, their interactions among themselves and with their abiotic environment. Within the framing of the natural sciences (context of science), nature include e.g., all dimensions of biodiversity, species, genotypes, populations, ecosystems, the biosphere, ecosystem functioning, communities, biomes, Earth life support's systems, and their associated ecological, evolutionary, biogeochemical processes and biocultural diversity. Within the framework of economics, it includes categories such as biotic natural resources, natural capital and natural assets. Within a wider context of social sciences and humanities and interdisciplinary environmental sciences, it is referred to with categories such as natural heritage, living environment, or the nonhuman. Within the context of other knowledge systems, it includes categories such as Mother Earth (shared by many IPLCs around the world), Pachamama (South American Andes), se¯nluo´-wa`nxia`ng and tien-ti (East Asia), Country (Australia), fonua/vanua/whenua/ples (South Pacific Islands), Iwigara (Northern Mexico), Ixofijmogen (Southern Argentina and Chile), among many others (see Díaz *et al.*, 2015a for references). Other (non-living) components of nature, such as deep aquifers, mineral and fossil reserves, and wind, solar, geothermal and wave power, are not the focus of the Platform. The degree to which humans are considered part of nature varies strongly across these categories (see Section 1.3.1.1). Many aspects of biocultural diversity (see glossary) are part of nature, while some others pertain more to what in the CF is defined as NCP and anthropogenic assets.

- **Anthropogenic assets** refer to knowledge (including indigenous and local knowledge and technical or scientific knowledge), health facilities, technology (both physical objects and procedures), work, financial assets, built-up infrastructure, among others, that, together with nature, are essential in the co-production (or joint production) of nature's contributions to people (NCP) (Díaz *et al.*, 2018; Palomo *et al.*, 2016; Reyers *et al.*, 2013). Within some cultural contexts, this co-production also involves mutual responsibility (e.g., Comberti *et al.*, 2015; Von Heland & Folke, 2014). Anthropogenic assets have been highlighted to emphasize that a good life is achieved by a co-production of benefits between nature and societies.

- **Nature's contributions to people** (NCP) are all the contributions of nature, both positive and negative, to the quality of life of humans as individuals, societies or humanity as a whole. In earlier versions of the CF, this dimension was referred to as nature's benefits to people (NBP), with exactly the same meaning; the term was changed to better reflect that it includes negative contributions (detriments) as well positive contributions (benefits). See section 1.3.1.1 for further details.

- **Drivers of change** refer to all those external factors that affect nature, and, as a consequence, also affect the supply of NCP. The CF includes drivers of change as two of its main elements: indirect drivers (all anthropogenic) and direct drivers (both natural and anthropogenic).

- **Direct drivers**, both non-human induced and anthropogenic, affect nature directly in a physical sense. Direct anthropogenic drivers are those that flow from human institutions and governance systems and other indirect drivers. They include positive and negative effects, such as habitat conversion, human-caused climate change, or species introductions. Direct non-human induced drivers can directly affect anthropogenic assets and quality of life (e.g., a volcanic eruption can destroy roads and cause human deaths), but these impacts are not the main focus of IPBES. See Supplementary Material 1.3 for a detailed typology of drivers.

- **Indirect drivers** are human actions and decisions that operate diffusely by altering and influencing direct drivers as well as other indirect drivers. They do not physically impact nature or its contributions to people. Rather, they are the root causes of the direct anthropogenic drivers that affect nature both positively and negatively. Indirect drivers include e.g., economic, demographic, institutional, technological and cultural ones. Special attention is given, among indirect drivers, to the role of institutions and governance systems, including formal and informal systems of access to land and property rights as related to any component of nature, socially shared rules, legislative arrangements, international regimes such as agreements for the protection of endangered species, and economic policies. See Supplementary Material 1.3 for a detailed typology of drivers.

- **Institutions and governance systems and other indirect drivers** are the ways in which societies organize themselves and the resulting influences on other components. They are the underlying causes of environmental change that are exogenous to the ecosystem in question. Because of their central role, influencing all aspects of human relationships with nature, they are key levers for decision-making. "Institutions" encompasses

all formal and informal interactions among stakeholders and the social structures that determine how decisions are taken and implemented, how power is exercised, and how responsibilities are distributed. To varying degrees, institutions determine the access to and control, allocation and distribution of the components of nature and of anthropogenic assets and their contributions to people. Examples of institutions are systems of property and access rights to land (e.g., public, common-pool or private), legislative arrangements, treaties, informal social norms and rules, including those emerging from indigenous and local knowledge systems, and international regimes such as agreements against stratospheric ozone depletion or for the protection of endangered species of wild fauna and flora. Economic policies, including macroeconomic, fiscal, monetary or agricultural policies, play a significant role in influencing people's decisions and behaviour and the way in which they relate to nature in the pursuit of benefits. However, many of the drivers of human behaviour and preferences, which reflect different perspectives on a good quality of life, work largely outside the market system.

- **Good quality of life (GQL)** is the achievement of a fulfilled human life. It is a highly value-laden and context-dependent concept comprising multiple factors such as access to food, water, health, education, security, and cultural identity, material prosperity, spiritual satisfaction, and freedom of choice. A society's achievement of good quality of life (GQL) and the vision of what this entails strongly influences institutions and governance systems and other indirect drivers and, through them, all other elements in the CF. The vision of what a good quality of life entails also indirectly shapes, via institutions, the ways in which individuals and groups relate to nature. Likewise, institutions and governance systems reflect and can influence a society's value system and perception of what constitutes good quality of life. IPBES does not directly address this aspect of the CF in its assessments so far, but actions that governments and societies may choose to take based on the findings of the IPBES assessments often require addressing this pathway wisely. Visions, concepts and indicators of a good quality of life are highly diverse, both in cultural roots and in geographical application. Approaches applied internationally can be based on economic (e.g., gross domestic product per capita), combined economic and social (e.g., human development index, inclusive wealth) or holistic framings (living in harmony, gross national happiness index). Other approaches, more culturally specific and place-based, include e.g., Sumak Kawsay/ Buen vivir (Central Andes), teko porã (Paraguay), vida plena (Amazonian basin), shizen kyosei shakai (Japan). See Díaz *et al.* (2015a) for references.

1.3.1.1 The Nature's Contribution to People (NCP) concept and analytical framework

Nature's contributions to people (NCP), one of the six major inclusive elements of the IPBES conceptual framework (Díaz *et al.*, 2015a, 2015b; IPBES, 2014, 2017), are all the contributions, both positive and negative, of living nature (i.e., all organisms, ecosystems, and their associated ecological and evolutionary processes) to people's quality of life (Díaz *et al.*, 2018). Beneficial contributions include, e. g., food provision, water purification, and artistic inspiration, whereas aspects of nature that can be negative to people (detriments) include e.g., disease transmission and predation that damage people or their assets. Overall, the values of nature's contributions are overwhelmingly positive as they sustain people's quality of life. However, the CF explicitly recognizes potentially detrimental NCP, and the fact that generally NCP are not inherently positive or negative, but rather this depends on spatial, temporal, social or cultural context (Ango *et al.*, 2014; Rasmussen *et al.*, 2017; Saunders & Luck, 2016; Shapiro & Báldi, 2014). What constitutes a benefit or a detriment can change with time, even for the same person, given e.g., a change in socio-economic circumstances that may alter the importance assigned to a given NCP, often a given biological entity can be at the same time a source of positive and negative contributions (Rasmussen *et al.*, 2017). This is important for conceptual and practical reasons. For example, while we are still striving to document and highlight the positive contributions (benefits) we derive from nature, many of the detriments (e.g., vector-borne diseases, livestock attacks by predators, agricultural pests) have long been recognized, valued in terms of their impacts on people, and incorporated into policy decisions. Furthermore, what are generally considered positive contributions sometimes reflect the view of dominant social actors and ignore the fact that the same contribution may be perceived as being negative in the view of less powerful sectors of society (Cáceres *et al.*, 2015). This highlights the relevance of identifying trade-offs that occur among and within many NCP as well as social trade-offs. Conflict tends to arise when negative NCP experimented by some social actors are mediated or exacerbated by decisions taken by other actors.

NCP recognizes a wide range of descriptions of the human dependence on living nature. One of such descriptions is through the concept of ecosystem goods and services (considered either separately or in bundles), pioneered in the science-policy interface by the Millennium Ecosystem Assessment (2003, 2005). The concept of NCP embraces the thriving field of ecosystem service science – in itself heterogeneous in terms of existing internal framings (Chaudhary *et al.*, 2015; Droste *et al.,* 2018) – together with a diversity of other descriptions that, although perhaps not as visible in the fields of mainstream environmental sciences,

are foundational in other fields of knowledge and schools of thought, especially in the social sciences and humanities, and underpin values, decisions and practices throughout the world (Turnhout *et al.*, 2013). The range of descriptions of the human dependence of living nature contemplated in the NCP approach is thus vast. On one extreme, nature is seen as a stock of natural capital (or natural assets) from which goods and services flow to humans unidirectionally (e.g., timber provided by forests) in the form of an ecological production function (reviewed in Polasky & Segerson, 2009). The flow depends on human agency and also on the existing physical and biological conditions needed for the persistence of the biological entity from which the flow originates. Improving or sustaining the condition of the biological entity would be akin to investing in natural capital from which an interest would accrue to society, i.e., the flow of goods and services. Maintaining the productive potential of the stock of natural capital to sustain the flow of services to society would be seen as an intergenerational social objective. On the other extreme are descriptions where both people and other biophysical entities are seen as having agency and being inextricably linked by reciprocal ties of mutual care and obligations (e.g., Berkes, 2012; Descola, 2013; Head, 2008; Ingold & Pálsson, 2013; Whatmore, 2006), described with e.g., the term nature's gifts used by many indigenous and non-indigenous cultures (Hill *et al.*, 2016), or services-to-ecosystems in some hybrid framings (Comberti *et al.*, 2015). The notion of nature's contributions to people is intended to embrace and include, rather than replace and exclude the abovementioned descriptions and any others in between.

A gradient of perspectives on human dependency on nature – implications for reporting

Within the context of an assessment report, a reporting system is the method of collecting, storing and synthesizing information and knowledge, and communicating findings. It should allow the re-organization and simplification of heterogeneous content from diverse sources in a way which is consistent, repeatable and easily communicable to a wide range of audiences. Specifically, the IPBES reporting system (Díaz *et al.*, 2018; Decision IPBES-5/1) contemplates a gradient of complementary approaches through which to give meaning to NCP, ranging from a generalizing to a context-specific perspective. While presented here as extremes of such a gradient for description purposes (see previous paragraph), these two perspectives do not have clear-cut limits; they are often blended and interwoven in the process of problem framing and knowledge generation and, although sometimes a particular study, field situation, research question or assessment undertaking is squarely placed within either a generalizing or a context-specific perspective, situations with a mixture of both are not uncommon (Berger-González *et al.*, 2016; Brondizio, 2017; Chilisa, 2017; Tengö *et al.*, 2017) **(Figure 1.3a)**.

Generalizing perspective: Typical of the scientific literature that has formed the basis of most large-scale environmental assessments, this perspective (represented in green at the bottom of **Figure 1.3a**) is fundamentally analytical in purpose; it seeks a universally applicable set of categories of flows from nature to people. Distinction between them intends to be sharp, following the traditions of culture-nature dichotomy, and agency tends to be attributed to people only. NCP categories can be seen at finer or coarser resolution, but can still be organized into a unified, self-consistent system. IPBES identifies 18 such categories for reporting NCP within the generalizing perspective, organized in three partially overlapping groups, defined according to the type of contribution they make to people's quality of life: regulating, material and non-material NCP.

- *Nature's material contributions to people* refers to substances, objects or other material elements from nature that sustain people's physical existence and the infrastructure (i.e., the basic physical and organizational structures and facilities, such as buildings, roads, power supplies) needed for the operation of a society or enterprise. They are typically physically consumed in the process of being experienced, such as when plants or animals are transformed into food, energy, or materials for clothing, shelter or ornamental purposes.

- *Non-material* contributions are nature's effects on subjective or psychological aspects underpinning people's quality of life, both individually and collectively. The entities that provide these intangible contributions can be physically consumed in the process (e.g., animals in recreational or ritual fishing or hunting) or not (e.g., individual trees or ecosystems as sources of inspiration). Examples include forests and coral reefs providing opportunities for recreation and inspiration, or particular organism (animals, plants, fungi) or habitat (mountains, lakes) being the basis of spiritual or social-cohesion experiences.

- *Nature's regulating contributions to people* refers to functional and structural aspects of organisms and ecosystems that modify the environmental conditions experienced by people, and/or sustain and/or regulate the generation of material and non-material contributions. For example, these contributions include water purification, climate regulation and the regulation of soil erosion.

Building on the insights of the social sciences and the humanities, the NCP approach acknowledges that culture is the lens through which all the elements of nature are perceived and valued. In other words, culture permeates through and across all three broad NCP groups, rather than being confined to an isolated category, i.e., there is no "cultural" or "non-cultural" NCP. In addition, the three

broad groups explicitly overlap, implying that many of the 18 NCP categories do not squarely fit into any one of the broader NCP groups **(Figure 1.3b)**, although they may be distinguished for practical reporting reasons. Material and non-material NCP are often interlinked in most, if not all, social-cultural contexts (Chan *et al.*, 2012b). For example, food can be primarily considered as a material NCP because calories and nutrients are essential for physical sustenance, but food is also full of symbolic meaning well beyond physical survival, having other less tangible impacts on people's quality of life. The cultural lens largely determines to what degree food is a non-material contribution as well as a material one and how both types of NCP are valued.

The 18 NCP defined by IPBES under the generalizing perspective (**Figure 1.3a**, see Supplement 1.2 for more details and examples) are in some cases sharply defined contributions, and in some others represent bundles of similar contributions. They were identified through a participatory process based on several pre-existing classifications at the global and regional scales (Haines-Young & Potschin, 2013; Kumar, 2010; Millenium Ecosystem Assessment, 2005; UK National Ecosystem Assessment, 2011), as well as recent empirical and conceptual advances in ecological, social and anthropological sciences.

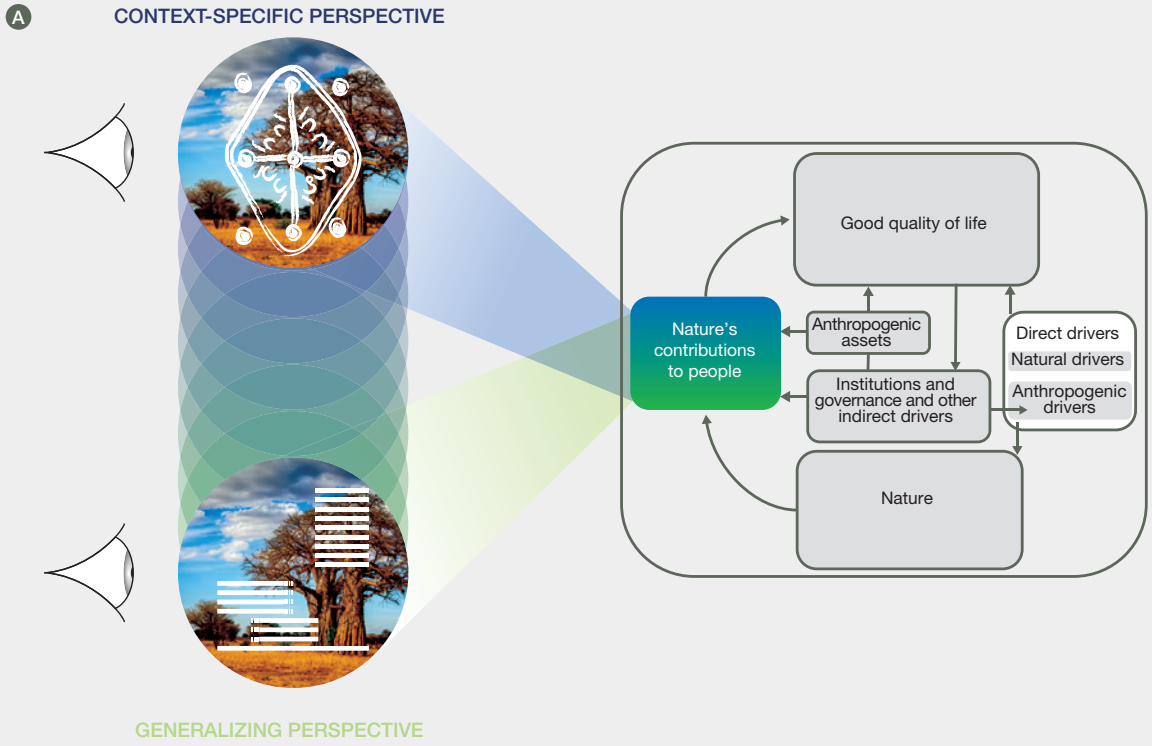
Context-specific perspective: Represented in blue at the top of **Figure 1.3a**, this perspective is typical, but not exclusive, of indigenous and local knowledge systems; here knowledge production does not explicitly seek to extend or validate itself beyond specific spatial contexts (Smith, 1999; Tengö *et al.*, 2017). Put differently, this perspective does not always contribute to, and may be difficult to align with more generalizing goals of attaining a universally applicable schema. While internally consistent, the categories are context-specific and usually not intended to be universally applicable. However, no acceptable standard classification or schema (equivalent to **Figure 1.3b**) is currently available, and designing or imposing one may be inappropriate (e.g., Smith, 1999). The context-specific perspective may instead present NCP as bundles that follow from distinct social-cultural practices, language and lexicon, and ethnoecological knowledge associated with forms of interaction with the environment, such as fishing, farming or hunting, including the spiritual significance encoded in places, organisms or entities such as sacred or otherwise protected trees, animals or landscapes (Berkes, 2012; Descola, 2013; Hill *et al.*, 2016). This may involve different degrees of human and non-human relationships expressed in terms of kinship and reciprocal care and obligations (Berkes, 2012; Comberti *et al.*, 2015; Hill *et al.*, 2016; Salmón, 2000; Surrallés & García Hierro, 2005; Von Heland & Folke, 2014).

The evidence produced through a particular framing, such as ecosystem goods and services, environmental services, ecological production functions stemming from natural capital, nature's gifts, or practices of care, can be aligned under the NCP framing, either within the 18 categories of the generalized perspective (which connects easily with classic ecosystem services categories, as done in e.g., the IPBES regional assessments), or by the use of context-specific descriptions (e.g., Supplementary Material 2 in Díaz *et al.*, 2018), or a combination of both (e.g., Hill *et al.*, 2016). In doing so, the NCP approach does not ignore or invalidate any pre-existing approach or metric used by different communities of practice. For example, it welcomes ecosystem services and their economic dimensions; but at the same time acknowledges that there are other ways of framing and engaging with the benefits or detriments from nature that results from different cognitive models about the links between people and the rest of the living world (Muradian & Pascual, 2018). Despite often deeply different descriptions, relations and causalities, the conclusions from such different knowledge systems and perspectives can often coincide or complement each other when it comes to searching for solutions.

The NCP reporting system thus allows the harnessing of pre-existing information, information that is being produced at the moment, or will be produced in the future, within the specific framings of different communities of practice, including those associated with ecosystem services, ethnoecology, environmental conservation, political ecology, etc. into a pluralistic and inclusive common ground. This gives the NCP reporting system maximum flexibility, because it avoids leaving the vast diversity of human-nature perspectives and descriptions out of the picture or shoe-honing them into pre-established categories and classifications that may deprive them of meaning to different stakeholders. By doing so it also accommodates different epistemic communities to collaborate in enlarging the existing knowledge base for sustainability (Pascual & Howe, 2018), to enrich each other in more level-field interactions (Tengö *et al.*, 2017), and to be leveraged in assessing the state of, and future options for nature and its benefits and risks to societies.

1.3.1.2 Evolution of thinking, approaches and terminologies on the links between nature and its contributions to people's quality of life

Like most of integrative frameworks, the CF builds on pre-existing structures and originates in the context of particular intellectual, social and political circumstances. The CF explicitly recognizes rooting in the Millennium Ecosystem Assessment (2003, 2005), its most immediate antecedent in terms of broad conceptual scope and intent. Early in the process of building IPBES, it became clear that Millennium Ecosystem Assessment framing, although useful and the



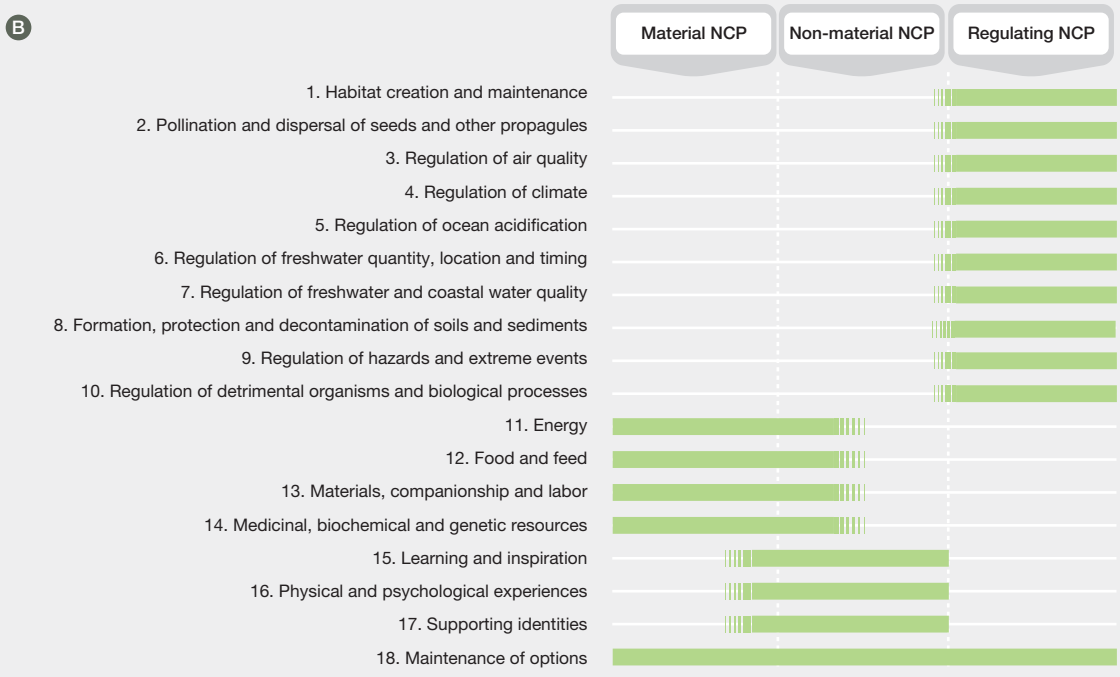


Figure 1 3 **The nature's contribution to people (NCP) approach and reporting system.**

A Two perspectives on nature's contributions to people (NCP) [Source: Díaz et al. (2018)]. NCP can be seen from the generalizing (green, bottom) or from the context-specific perspectives (blue, top). From a more generalizing perspective, 18 NCP are distinguished and organized in three broad groups – material, non-material and regulating– of general applicability (represented by the white-line figure overlapping the landscape at the bottom, shown in full in B. From a context-specific perspective these more universally applicable categories may or may not be meaningful depending on the issue and/or context. For example, a symbolic domain, such as the Warlpiri perspective on nature-human relationships (represented in a highly simplified version by white-line figure overlapping the landscape at the bottom) is only one of very many possible

context-specific framings of NCP. The Warlpiri explanation of a given ecological process, however, may have significant overlap with other explanations, including a scientific one. Therefore, it is important to consider these two extremes, generalizing and context-specific perspectives, as part of a gradual transition with many potential points of overlap. Depending on the context, a stakeholder can report a specific NCP as part of any of the 18 NCP in the generalizing perspective, as part of a bundle of context-specific NCP or as transitional between the two. Ⓑ The 18 NCP reporting categories used in IPBES assessments mapped onto three broad groups distinguished within the generalizing perspective [Source: Díaz *et al.* (2018)]. See main text of Section 1.3.1.1 for description of the broad groups, and chapter 2-NCP, Supplementary Material 1.2 and Díaz *et al.* (2018) for further description, examples and references concerning the 18 categories. Most NCP straddle across groups to some degree. To indicate this, the NCP in the material and non-material groups extend into their respective columns. The non-material dimension of regulating NCP is not necessarily as widely recognized across cultures; therefore, they are represented as encroaching only slightly beyond their column in the Figure. Maintenance of options (NCP 18), conveys the various dimensions of the potential opportunities offered by nature, and thus spans all three NCP groups.

most comprehensive available, would not be sufficient for the task at hand. The adoption by IPBES of a pluralistic and inclusive framework with its associated language including concepts such as nature, nature's contributions to people and quality of life was necessary on three grounds: fuller and more symmetric consideration of diverse stakeholders and worldviews, a richer evidence base to inform action, a broader inclusion of contemporary categories and questions of the social sciences and humanities. We elaborate on these three aspects below.

First, there are increasing calls for considering issues of *legitimacy, fairness, social equity* (Görg *et al.*, 2016; Pascual *et al.*, 2014) and rights (including human rights to the environment and to cultural identity; Knox, 2017) in environmental science-policy interfaces (CBD, 2010; ISSC *et al.*, 2016), and this is reflected in the mandate of IPBES. This new emphasis is partly due to a recognition that environmental decision-making has in the past often benefited majority populations (e.g., urban, wealthy, ethnic majority) with limited or negative outcomes for minority populations (e.g., rural, poor, minority groups). This can in turn have negative implications for environmental management itself, as poor, rural, indigenous or local populations are generally key actors in environmental management or deterioration. The implications of context such as gender have also been demonstrated to be of critical importance in environmental outcomes (Keane *et al.*, 2016). From the beginning, it became clear that the CF had to represent diverse views. For example, participants in the process rejected the notion that "ecosystem services", at least in its most widespread versions, effectively represented all ways of understanding the diverse contributions that nature makes to human quality of life. It was necessary to use a different term, with less baggage in any particular intellectual tradition (Castree, 2013; Rey, 1983), and with immediate meaning to as many people as possible. That different and broader term became "nature's contributions to people", with the assumption that it encompassed all the diverse and interesting research on ecosystem services, as well as other views and sources of evidence (Díaz *et al.*, 2015a, 2015b, 2018). By creating this intellectual space, IPBES does not compromise intellectual rigor; rather it recognizes the legitimacy and relevance of other views in understanding what nature can do for and with us. Therefore, through its explicit recognition of different worldviews and epistemic categories, the CF framing, including NCP, facilitates the practical incorporation of these considerations in the assessment process, and fosters broader ownership and adoption of its results across disciplinary, regional and cultural contexts. Regarding the use of terminology, the CF provides a more neutral way to refer to our links with the non-human living world in which we are inextricably linked as part of the fabric of life on Earth. We use 'people' to denote that we inclusively refer to all genders, ages, social groups (be them based on citizenship, ethnicity, class or occupation). In the broader community (i.e., beyond IPBES), different stakeholders will refer to e.g., women, children, clients, patients, particular ethnic groups, workers, entrepreneurs, etc.

Similarly, we use 'nature' to denote all non-human living entities and their interaction with other living or non-living physical entities and processes. Nature embodies different concepts for different people, including biodiversity, ecosystems, Mother Earth, Country, se¯nluo´-wa`nxia`ng and other analogous concepts (see **Box 1.2**). We use 'quality of life' to denote the vision and the achievement of a fulfilled human life. Different stakeholders will refer specifically to e.g., income, satisfaction, human development, happiness, sense of identity, vida plena, buen vivir (see **Box 1.2**). Finally, we use 'NCP' to denote all the beneficial and detrimental contributions that we obtain from and with nature. Different stakeholders, according to their goals, needs, motivations and preferences, will use other terminology such as goods, ecosystem services, gifts from nature, living natural resources, products, experiences, environmental endowments, among many others (see **Box 1.2** and Section 1.3.1.1).

Second, the IPBES CF, including the NCP concept, *expands the conceptual, methodological and empirical evidence base* from which assessments can produce options for action, and provides important opportunities for the evolution of research. The construction of the new

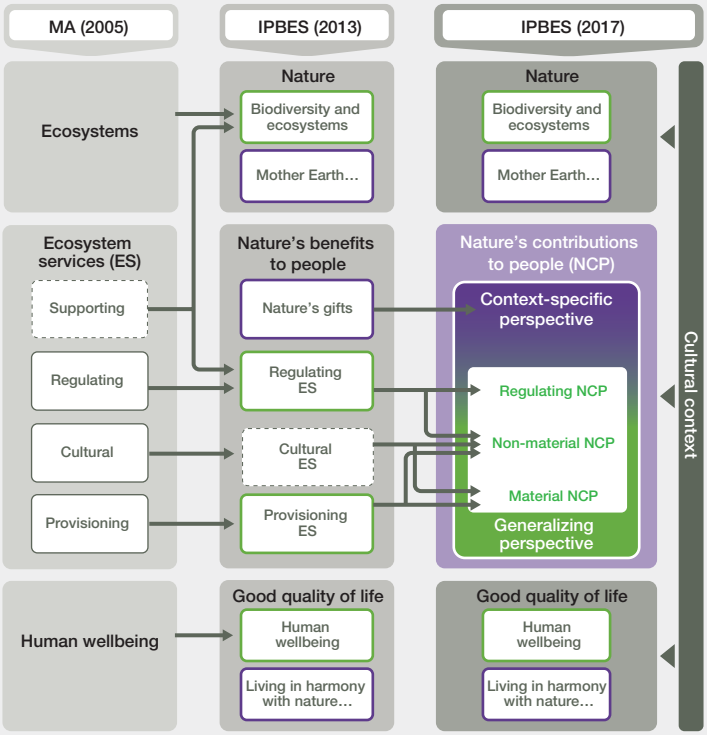


Figure 1 4 **Evolution of nature's contributions to people (NCP) and other major categories in the IPBES CF (Díaz *et al.*, 2018) with respect to the concepts of ecosystem services and human wellbeing as defined in the Millennium Ecosystem Assessment (2003, 2005).**

The element "nature's benefit to people" was adopted by IPBES Second Plenary, and further developed into NCP by the fifth session of the Platform's Plenary (IPBES-5) (Decision IPBES-5/1) in order to fully capture the fact that the concept includes all contributions to people, both positive (benefits) and negative (detriments). Concepts pointed by arrow heads replace or include concepts near arrow tails. Concepts in dotted-line boxes are no longer used: following the present view of the MA community (Carpenter *et al.*, 2009; Reid & Mooney, 2016), supporting ecosystem services are now components of nature or (to a lesser extent) regulating NCP. Cultural ecosystem services was defined as a separate ecosystem service category in the MA; IPBES instead recognizes that culture mediates the relationship between people and all NCP. For more details of NCP according to the generalizing and conceptual perspectives, see **Figure 1.3**.

framework **(Figure 1.2)** was informed by the increasing number of papers and assessments in the ecosystem service and conservation literature that had been striving to accommodate values and metrics beyond those of ecology and economics, and opened to the call from social and political sciences and humanities working from outside those paradigms to incorporate their concepts and questions and not just their data (Castree *et al.*, 2014; Nadasdy, 2011; Olsson *et al.*, 2015). In full recognition of all these intellectual streams that inspired it, the IPBES CF, including the NCP approach, strives to formalize and strengthen them in a cohesive structure suitable for operation in the science-policy interface. This additional input can have direct practical positive implications for science and policy: for example, ILK can serve to address issues of uncertainty in ecosystem management, through processes that have been honed at local levels from generations of feedback learning (Berkes *et al.*, 2000). Furthermore, it allows a more appropriate representation of concepts within and between categories of nature´s contributions or ecosystem services, building upon developments produced during the past decade, many of them within the evolving context of ecosystem service research. Prominently, it adopts the representation of culture as a crucial lens by which we understand nature and its effects, rather than as a category of service (Chan *et al.*, 2012b; Fish, 2011; Pröpper & Haupts, 2014). It takes into account critiques to the natural capital stock-and-flow model from conservation and evolutionary ecology, stressing the value of nature beyond flows and economic production functions (e.g., Faith, 2018; Silvertown, 2015). It also recognizes that people may perceive and value the contributions from nature in diverse ways, including different classes or bundles at group or individual levels (Klain *et al.*, 2014; Martín-López *et al.*,

2012; Milcu *et al.*, 2013). Non-material and material benefits from nature are often intimately intertwined, not separate categories for separate things (Chan *et al.*, 2012a; Klain & Chan, 2012; Turner *et al.*, 2008).

Finally, the IPBES CF, including the notion of NCP, allows *a broader inclusion of the categories and questions of the social sciences and humanities*. The insights above were largely derived from fields of social sciences and humanities that received scant inclusion within dominant ecosystem service framings (Daniel *et al.*, 2012; Stenseke & Larigauderie, 2017), even though these insights did percolate to some degree into the ecosystem services literature. This includes long-term acknowledged insights that human and societal interactions with nature are complex, articulated through emotions and practices, and, moreover, that human-environment relations are dynamic as social structures and physical conditions change over time (Castree, 2017; Macnaghten & Urry, 1998; Setten *et al.*, 2012). This is not restricted to ILK systems. Qualitative approaches in humanistic and social science point to a less linear understanding of human societies and social change, beyond what a systems perspective can account for (Harris, 2007; Setten *et al.*, 2012; Shove, 2010), thus requiring full attention to different cultural perspectives and value systems.

By building the above insights into the structure of the NCP approach, the hope is that NCP might better include diverse perspectives (Díaz *et al.*, 2018). Furthermore, it may help avoid the problematic simplification of relationships with nature (Faith, 2018; Norgaard, 2010; Turnhout *et al.*, 2014) and appeal to a more diverse set of social scholars, given relatively widespread reservations about ecosystem services (Dempsey & Robertson, 2012; Droste *et al.*, 2018; Satterfield *et al.*, 2013; Satz *et al.*, 2013).

In summary, like any transition in concepts and terminology and any meeting of frameworks, the challenges – conceptual, epistemological, methodological, even ontological– are formidable. Also like in any transition, there is contestation, coexistence and cross-fertilization with previous framings. For example, the ecosystem service framework, after it was created and became widespread by its adoption by the MA, coexisted for a long time, and still coexists, with the framework of renewable natural resources. Because of its flexibility, the CF framing does not require drastic re-framing of existing initiatives, organizations or research programs that do not feel the need to change, although many could easily transition to it and benefit from a wider "conversation". In other words, the concept of NCP, together with a flexible reporting system, helps IPBES to meet the requirements for successful knowledge mobilization for sustainability: legitimacy, salience, credibility and usability (Clark *et al.*, 2016; Fazey *et al.*, 2014).

1.3.1.3 Diverse conceptualization of the multiple values of nature and its contributions to people

Understanding values and their diversity, how they are conceptualized and formed and how they change over time and across contexts and scales, is critical to the understanding of human-nature relationships, and thus to inform decision-making and policy design. The ways in which nature and its contributions to people for a good quality of life are perceived and valued may be starkly different between regions, societies and sectors within societies (Martínez-Alier, 2002). Multiple values can be associated with multiple cultural and institutional contexts – different agents may assign very different values to the same object, contest the values of others, and justify their actions on the basis of such differences. Value conflicts may emerge due to uneven power relations because those with more power see their values enacted, while those with less power see their values ignored in practice (Arias-Arévalo *et al.*, 2018; Berbés-Blázquez *et al.*, 2016). Ignoring different types of values associated with material, non-material, and regulating contributions of nature and thus not incorporating them in economic decisions is considered among the most significant factors underlying the loss of nature and its contributions to people (Duraiappah *et al.*, 2014; Kumar, 2010).

The global assessment recognizes that the word 'value' is always defined in the context of a given worldview and cultural context and can refer to a preference someone has for a particular state of the world, the importance of something for itself or for others, or simply a measure (IPBES, 2015; Pascual *et al.*, 2017). Acknowledging the need for a pluralistic approach towards the values of nature and its contributions to people is necessary but not sufficient to better inform policy options intended to transform society's relationship to nature in order to achieve common societal objectives such as those expressed in the Sustainable Development Goals and the Aichi Biodiversity Targets. Given the unequal capacity by different actors to express and support their own values regarding nature in the context of decision-making, it is important for policy to capture the diversity of values and find ways to reconcile them.

Furthermore, valuation of nature and its contributions is based on a specific set of ethics and normative positions determining what value system is seen as culturally appropriate and thus applied. Such normative positions in valuation may be starkly different and even conflicting between regions, societies and sectors within societies. In general, the valuation of natural resources, ecosystem services and –more recently– NCP has tended to rely on a unidimensional-value approach, where a dominant view over nature prevails in decision-making. Most often, such views clash, as they tend to either derive from a utilitarian economic perspective, or a biocentric stance that imparts

intrinsic values to species and nature. The global assessment acknowledges the influence of both value lenses and the conflicts that may arise when decision-making trumps one perspective over another; it also supports an inclusive valuation perspective consistent with the IPBES CF (Pascual *et al.*, 2017). This is important as the ways in which values are assessed carries wide implications for the analysis of trade-offs of benefits and detriments to different people, for nature, and for the future of both. For instance, when a resource is extracted from nature, embedded are the land and water inputs, the carbon emitted, the pollution produced, the biodiversity affected, the limitations on other users as well as the aesthetic beauty that some appreciate, the sacred value embedded in place, and the social relations directly or indirectly linked to such resource.

As depicted in **Figure 1.5**, the analytical framework used in the global assessment places types of values along a gradient of anthropocentric to non-anthropocentric values, including instrumental, relational, and intrinsic values, on nature, nature's contributions to people and a good quality of life (Pascual *et al.*, 2017). The colour gradient indicates that both instrumental and relational values (anthropocentric values) can be ascribed to nature's contribution to people, and highlights examples of sources of value based on what people may seek in the pursuit of a good quality of life through interaction with nature; it also explicitly includes perceived intrinsic worth (non-anthropocentric value).

The three major types of values considered in IPBES are:

- **Intrinsic values** refers to the value of an entity (e.g., an organism, an ecological process) independent of how it relates to humans.
- **Instrumental values** are associated with an entity that serves to achieve a human end, interest or preference. Instrumental value includes economic values, regardless whether the entity is directly or indirectly used, or not used (existence and bequest values).
- **Relational values** are associated to the meaningfulness of relationships, including the relationships among humans and nature and among humans, including across generations, via nature (Chan *et al.*, 2016). These values are attached to the entity itself in ways that make it not substitutable, hence not serving an instrumental or utilitarian perspective (O'Neill, 2017), and represent what people consider meaningful about nature (e.g., attachment, responsibility, commitment). Relational values can also be associated with relationships with nature towards achieving a good life, e.g., when choosing "the right thing to do" or in the context of a "meaningful life." (Pascual *et al.*, 2017).

While all types of values are considered to some degree in the global assessment, the chapters examine instrumental

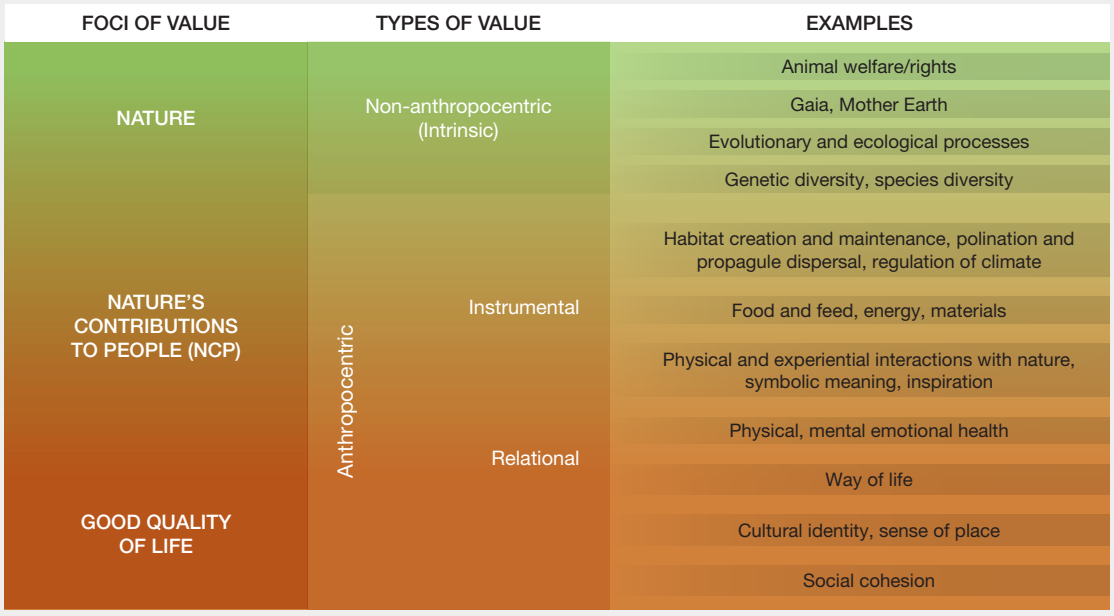


Figure 1 5 **Diverse values related to nature, nature's contributions to people (NCP) and a good quality of life (GQL), following Pascual *et al.* (2017).**

The grading in the colors indicate that both instrumental and relational values can be ascribed to the value of nature's contributions to people, and to highlight that nature's contributions to people are intertwined with nature and a good quality of life.

and relational values in much more detail. The analyses presented in Chapters 2 to 6 take into account, to various degrees, how diverse types of values underlie societies' relationships with nature, the appropriation of NCP to support a good quality of life, and the ways in which values are embedded in, and can be transformed by policy instruments and collective action.

1.3.1.4 Good quality of life – its links with nature and nature's contributions to people

Numerous conceptualizations of quality of life have been proposed over the years (Stiglitz *et al.*, 2009), combining different notions of basic human needs (Maslow, 1943; Max-Neef, 1991), freedoms and capabilities (Nussbaum, 2000; Sen, 1999), or opportunities (Costanza *et al.*, 2007). The Millennium Ecosystem Assessment (2005) represented a significant advance in recognizing multidimensional aspects of well-being and their relationships to different types of ecosystem services. The IPBES CF builds upon these efforts, recognizing that human quality of life is multidimensional, including objective and subjective dimensions, all of which pose challenges to measurement and interpretation.

Recognizing that human quality of life is a context-dependent state of individuals and human groups, the CF includes the inclusive notion of Good Quality of Life (GQL), understood as the achievement of a fulfilled human life, including material and non-material dimensions (Díaz *et al.*, 2015a). Under the umbrella of GQL, multiple concepts and terminologies may be used to reflect different sociocultural perspectives or assessment goals. For example, this includes, the concept of human well-being, which is widely used in national policy and international development reports includes subjective cultural values and personal aspirations (livelihoods, happiness, vulnerability, freedom of choice, security, etc.), relationships (social relations, action and participation in society, etc.) and access to resources (food, water, energy, shelter). It is often reported through synthetic indicators such as the 'human development index' (HDI) that build on standardized per capita income as well as other indicators such as based on education, child mortality, and life expectancy, although it does not include considerations to environmental and subjective aspects of human well-being (see **Box 1.2** for more details).

The global assessment intends to be inclusive in its approach to assess nature's contributions to a good quality of life, including not only different notions of what a good life entails, but also its linkages to patterns of inequality associated with changes in nature. **Table 1.1** presents a list of 14 categories of material and non-material indicators intended to capture the various aspects of GQL. These categories build upon and expand the categories used in the Millennium Ecosystem Assessment (2005), and are used throughout the present assessment, such as to discuss the implications of specific aspects of NCP, indicators of progress in societal goals (e.g., Aichi Biodiversity Targets, SDGs), implications of future scenarios to GQL, and the situation of IPLCs relative to other groups.

1.3.1.5 Institutions in the IPBES Conceptual Framework

The global assessment follows the widely accepted definition of institutions, understood as formal and informal rules and norms that structure individual and collective behaviour (Ostrom, 1990, 2005). In other words, institutions are collectively produced by actors and in turn shape their behaviour, stimulating, directing or restricting action (Giddens, 1986). The IPBES conceptual framework places institutions at the centre of our relationship to nature and biodiversity. This approach has helped to fill gaps in previous assessments, where the role of institutions at different societal levels was not elaborated. Institutions are the expression of the plurality of individual and collective practices underlying human individual and social behaviour towards each other and towards biodiversity and nature. Institutional arrangements act upon and mediate processes of natural resources claim and uses, and therefore the management of nature and biodiversity.

A variety of formal and informal institutional arrangements mediate interactions between our demand for a good quality of life and the pressures it puts on nature and biodiversity, and thus nature's contributions to people. Institutions as politically relevant social rules and norms can be thought of in terms of institutional orientations (e.g., social narratives, social expectations and behavioural norms, as well as social hierarchies and ascribed status), and allocative and distributive mechanisms (e.g., property systems and access rights to common and public goods, markets, formal and customary laws, policies including taxes, subsidies). Institutions are not equivalent to organizations, however the latter are composed of multiple institutions representing systems of rules and norms, for instance ministries, political parties, advisory boards, corporations, among others. Institutions also underlie, *inter alia*, investment initiatives and multilateral environmental and trade agreements, as well as their effects on other components of the conceptual framework.

As institutions emerge from interactions between people and social structures, they influence how decisions are taken and implemented, how power is exercised, and how responsibilities are distributed. Institutions determine to various degrees the access to, allocation and distribution of the various forms of resources and the benefits we derive from them. They can be organized along a

Table 1 1 **Material and non-material dimensions of a good quality of life (GQL) used across chapters of the global assessment.**

Adapted from the Millennium Ecosystem Assessment (2005).

GOOD QUALITY OF LIFE	DESCRIPTION
MATERIAL dimensions	
Food security	Involving components of knowledge, availability, access, utilization, stability, diversity and cultural preference
Water security	Involves quality, sufficiency, and access
Energy security	Involves availability, access and affordability without incurring health and physical risks
Shelter	Ability to live in a clean and safe shelter, reduce risk and vulnerability to hazards and stochastic events
Livelihood and income security	Ability to access resources, income necessary to fulfil material needs and social obligations, and pursue education, health, leisure, and work opportunities
Health	Including being nourished and functional, free of diseases, psychological satisfaction
NON-MATERIAL dimensions	
Good Social relationships	Including social cohesion, mutual respect, good gender and family relations, the ability to help others and provide for children, and the opportunity for active participation in one's society
Equity	Concerns evidence of parity in processes and outcomes across gender, age, race and ethnicity, income and other social indicators or dimensions of difference
Sense of cultural identity	Feeling of belonging to one or more social groups (as related for instance to locality, country, ethnicity, religion, activity, gender, generation), being respected for self-determination, practice of language, education and transmission, and ability to carry out activities related to intangible values and culturally valued means of existence
Personal and physical security	Including secure access to natural and other resources, safety of person and possessions, and socially equitable access to supporting systems and living conditions to be resilient to natural and human-caused disasters
Freedom of choice and action	Including having control over what happens and being able to achieve what a person values doing or being
Access to knowledge and education	Ability to pursue formal and informal education and knowledge in culturally appropriate languages, learning new skills, and accessing information necessary for participation in society and pursuit of culturally valued aspirations
Freedom to exercise spirituality	Ability to exercise one's faith, beliefs, and religious practices
Access to recreation and leisure	Ability to dedicate time to physical and psychological health, to have access to socially valued activities and spend time with family and friends
Enjoyment of natural beauty	Capacity to enjoy the beauty of nature, healthy and unpolluted landscapes and seascapes, also reflecting one's sense of place, artistic and spiritual inspiration, physical and emotional comfort

continuum of temporal and geographical scales spanning from the organizations of local groups and resource users to national governments to global institutions, such as in international treaties and policies or an intergovernmental platform such as IPBES. Also, at the global level, an international climate agreement for instance is an example of an institution that has both formal aspects (e.g., agreed emissions quotas) and informal aspects (e.g., a country's moral pledge). At all levels, institutions are expressed in the policies, property systems, the organization of markets, and the formal and informal agreements that create incentives and/or restrictions on our behaviours and attitudes towards nature. Institutions are thus behind the ways we monitor, control, reward and sanction behaviours, including defaulting to no action at all, e.g., the absence of a norm or rule regulating the use of a resource represents itself a mode of action.

The global assessment examines a plurality of institutional arrangements that have emerged within different contexts over the past 50 years to promote the sustainable management of nature and biodiversity and to address global problems such as climate change (Young, 2010). From local to global levels, chapters examine the ways institutions, for instance those related to conservation, are challenged by competing values and power dynamics, changing contexts and environmental conditions, its congruency with other institutions operating at intersecting social and ecological boundaries.

Consideration of formal and informal institutions in the global assessment is done in various ways depending on the focus of analysis, including how the respective institutions create and mediate particular drivers of change, their potential effectiveness or lack thereof in reducing the impact of drivers on nature and people, their short and long-term effectiveness in reaching goals in a cost effective and, not least, equitable manner, i.e., their effects on distribution of benefits and costs across individuals and groups within society. Another important aspect considered in institutional analyses in the global assessment relates to understanding how institutional arrangements interact, support and/or contract each other, and match or mismatch to ecosystem boundaries at different scales (Bodin, 2017; Brondizio *et al.*, 2009). Understanding the mismatches between institutional arrangements and ecosystems is particularly critical to understand social-ecological changes at regional and global scales. At these levels, common pool resource systems, such as a water, climate and atmosphere, the oceans, migratory species and other resources exhibit inherently emergent and transboundary properties, affected both by level-specific and cross-level institutions and decision-making, including distant drivers of change.

1.3.1.6 Direct and indirect drivers of change and their telecouplings

Within the global assessment we differentiate between indirect drivers (all anthropogenic in our framework), and direct divers (natural, anthropogenic, and natural-anthropogenic-interaction), and how they interact **(Box 1.2)**. Decisions such as macroeconomic policies implemented through formal institutions may not be the direct cause of a change in an ecological system but may have a direct influence on the direction and intensity of direct drivers of change such as land use, pollution, direct exploitation, and different manifestations of climate change. In turn, formal and informal institutions also mediate these interactions. The difference between direct and indirect drivers have important implication for policy considerations, i.e., while a direct driver can be addressed through more focused efforts and instruments, addressing indirect drivers may require more fundamental and systemic change.

Building upon previous efforts and typologies of drivers of change, the global assessment analyses drivers in two main ways: the analysis of direct and indirect drivers, and the analysis of their distant interactions, i.e., telecoupling. The first way in which drivers are analysed in this assessment is by the use of a common typology, applied consistently across chapters, although some variation in terminology is inevitable as the literature on the topic is diverse and continues to evolve (**Table 1.2**; Supplementary Material 1.3). Direct drivers have direct physical (e.g., mechanical, chemical, noise, light) impacts on nature and/or people. They are also sometimes referred to as 'pressures' (e.g., CBD, 2014; MA 2005) or 'proximate sources' (e.g., Lambin *et al.*, 1999, 2006; Turner *et al.*, 1990, in the literature in the context of other initiatives. According to the typology adopted by the global assessment, direct drivers include, *inter alia*, natural drivers such as eruptions and earthquakes, anthropogenic drivers such as pollution, land/sea use change, and direct exploitation and extraction of resources, and drivers that are derived from natural-anthropogenic interactions, such as different manifestations of climate change and invasive alien species (including zoonoses). Indirect drivers are drivers that operate diffusely by altering and influencing direct drivers. They do not impact nature directly, rather, they do it by affecting the level, direction, rate, and/or intensity of direct drivers. They have been referred to as 'underlying causes' or underlying 'driving forces' in the context of other initiatives (e.g., Lambin *et al.*, 1999; Maxim *et al.*, 2009). Both direct and indirect drivers can also affect other indirect drivers through different chains of relationship, varying in type, intensity, duration, and distance. These relationships can also lead to different types of spill-over effects (Liu *et al.*, 2013). Indirect drivers include institutions, economic, demographic, technological, governance, regional conflicts and wars, sociocultural and socio-psychological, and health related drivers. As discussed above, attention is given, among indirect drivers, to the role of institutions (both formal and informal) and impacts of the patterns of production, supply and consumption on nature, nature's contributions to people and to quality of life. Also, in the scenarios chapters (4 and 5), indirect drivers play an important role within the causal linkages to biodiversity and ecosystem change (IPBES, 2016b). Many global environmental scenarios are constructed on the basis of assumptions related to the development of these indirect drivers according to different storylines. Commonly, scenarios include indirect drivers such as model of economic development, demographic trends and factors, technological development, governance and institutions, and socio-cultural context. These analyses are developed on the basis of assumptions about how indirect drivers interact with current trends, providing the qualitative and (semi-) quantitative basis for models on the implications of direct drivers for nature, its contributions to people and to quality of life.

Drivers can be analysed from the perspective of distant influences and interdependencies, usually referred to as teleconnections and telecoupling, respectively (Friis *et al.*, 2016; Liu *et al.*, 2013, 2015). In the global assessment, the concept of 'telecoupling' is used to emphasize that human-nature interactions are interconnected through different chains of relationships, attributions, and impacts which may influence each other, varying according to type, intensity, duration, and distance of the interaction, and often exhibiting nonlinear patterns over space and time. Thus, telecoupling is used in the assessment as an umbrella concept encompassing processes that are distant not only

Table 1 2 **Typology of drivers used in the IPBES Global Assessment.**
See Supplementary Material 1.3 for a more detailed description.

DIRECT DRIVERS	**Natural**	Eruptions, earthquakes, natural climatic variability		
	Anthropogenic	Pollution (emissions, disposal, spill-overs, noise, others)		
		Land/sea use change	Transformations	
			Intensity changes	
		Direct disturbance, exploitation and extraction (of components of nature)		
	Natural-Anthropogenic (interaction)	Manifestation of climate change (e.g., changing temperature and precipitation, frequency and intensity of weather events, sea level change, ocean acidification)		
		Invasive alien species including zoonoses and pest outbreaks		
INDIRECT DRIVERS		Institutions (formal and informal)		
		Economic drivers	Patterns of supply	
			Patterns of production	
			Patterns of consumption	Economic affluence
				Inequality
				Poverty
		Demographic drivers		
		Technological drivers		
		Governance drivers		
		Conflicts and wars		
		Sociocultural and socio-psychological drivers (values, beliefs, norms, education)		
		Health problems as indirect drivers		

spatially but also in the temporal and functional senses. The term applies to a range of relevant phenomena related to nature, NCP and GQL, such as food trade impacts (Chaudhary & Kastner, 2016; Easter *et al.*, 2018; Sun *et al.*, 2017), food security (Nelson *et al.*, 2016), large-scale land acquisition (e.g., land-grabbing) (Rulli *et al.*, 2013), freshwater demand, and a variety of resource trades (Xiong *et al.*, 2018). Telecoupling approaches have been used to examine the relationship between resource demands and declines in biodiversity and ecosystem services, competition for water, the impact of tourism, processes of species invasion, the impact of foreign investment on the environment, the spread of diseases and connectivity of ecosystems, among others. In different parts of the assessment, authors use the perspective of telecoupling to examine ecological, physical, climatic and other natural telecouplings, as well as economic telecoupling such as trade and investments, sociocultural telecoupling such as in the circulation of expressive culture, symbols and narratives, and legal telecoupling, such as related to the impact of domestic regulations or international agreements on far-away areas and stakeholders. Global input-output (IO) analysis is used to quantify and qualify the economic interdependencies, such as to assess the trade and supply chains that connect primary producers and final consumers, often geographically far removed from each other.

1.3.2 Incorporating Indigenous and Local Knowledge and issues concerning Indigenous Peoples and Local Communities: a systematic and multi-facet approach

1.3.2.1 Defining and conceptualizing Indigenous Peoples and Local Communities, and Indigenous and Local Knowledge

Indigenous Peoples and Local Communities (IPLCs) is a term used internationally by representatives, organizations, and conventions to refer to individuals and communities

who are, on the one hand, self-identified as indigenous and, on the other hand, are members of local communities that maintain inter-generational connection to place and nature through livelihood, cultural identity and worldviews, institutions and ecological knowledge. The term, as other similar regional terms, has gained usage in international forums during the past 2 decades. The term is not intended to ignore differences and diversity within and among Indigenous Peoples and between them and local communities. It is used largely to denote that there are communalities and shared concerns for Indigenous Peoples and Local Communities that are important to be represented in international forums, such as the CBD, IPCC, IPBES, among many others.

Indigenous and Local Knowledge (ILK) is a closely related term also widely used internationally and in published literature to refer to the worldviews, knowledge, practices, and innovations embedded in the relationship between people and nature, as expressed in local knowledge about the natural world, techniques and technologies of resource management, as well as in local institutions governing social relations and relationship to nature. Equivalent terms include Traditional Ecological Knowledge and Local Ecological Knowledge, among several others. ILK is understood as situated in place and social context, holistic but at the same time open and hybrid, continuously evolving through the combination of written, oral, tacit, practical, and scientific knowledge attained from various sources, validated by experimentation and in practice of direct interaction with nature. As IPLCs are confronting pressures and undergoing sociodemographic, cultural, economic changes worldwide, inter-generational transmission of ILK is declining fast in many regions of the world (e.g., Turnbull, 2009).

Both terms, IPLCs and ILK, are used as umbrella terms to represent the most culturally diverse segment of the world's population, which in spite of such diversity, share many common concerns (see section 1.3.2.2). The global diversity of IPLCs –cultural and historical, social and political, economic and environmental– defy a common definition for the term as a whole and for each of its two components. While the United Nations has recognized and used multiple criteria to define 'Indigenous Peoples', including ancestry, distinct cultural features such as language, religion, membership in tribal systems, material culture, cosmology, livelihood, origin and residence, among others, no common definition has been adopted internationally. Instead, the United Nations, as many countries, have increasingly adopted self-identification, by individuals and their acceptance by a community, as a primary criterion. Likewise, no single definition of 'local communities' is internationally accepted. In the CBD, as other international platforms such as IPBES and IPCC, local communities are recognized for their diversity, yet having historical linkages to place and natural resources, their multiple domains of ecological knowledge, dynamic and hybrid resource management techniques and technologies, their customary and formal institutions to manage natural resources, their diverse worldviews and forms of relationship to nature.

In the absence of a comprehensive general definition of IPLCs, authors of the global assessment were particularly concerned with recognizing intra- and inter-regional differences in definitions regarding IPLCs and ILK. Many Indigenous Peoples and Local Communities are not recognized as such, or at all, by their respective countries or in the literature. For historical, political and language reasons, some groups are highly visible and others invisible to policymakers, scholars, society, and even representatives of IPLCs. For these and other reasons, authors of the global assessment were sensitive to the fact that definitions of ILK and IPLCs are context-specific and should be recognized as such, and as inclusive as possible when evaluating data and literature. The operational strategy developed to include ILK and IPLCs in the assessment recognizes the criteria of self-identification and self-determination for IPLCs.

Table 1.3 shows 15 dimensions used as a reference to contextualize the diversity of IPLCs around the world. In practical terms, this meant maintaining literature review data disaggregated to allow different interpretations of whom to include as IPLCs and what as ILK. Likewise, as expressed in the questions guiding the work on ILK and IPLCs in the assessment (**Box 1.3** and Supplementary Material 1.4), we have placed a particular emphasis on the relationship between knowledge, practice, and innovations. As such, these guiding questions are intended to highlight that irrespective of cultural differences, importance was given to assessing the contributions of IPLCs to the stewardship and management of nature, and its contributions locally and to the larger society, without romanticizing ILK. Literature review and dialogue workshops also allowed authors to assess the pressures experienced by IPLCs in different parts of the world as well as relevant policy options and instruments concerning, directly or indirectly, IPLCs.

It is important to note that many groups of farmers, ranchers, pastoralists, fishers, and foresters who also have multi-generational roots in place, close connection to nature, and directly contribute to the management and conservation of biodiversity, may not be included, for multiple reasons, as belonging to the broader category of IPLCs. Independently, authors of the assessment have also used and included literature regarding the management and conservation practices found in regions around the world.

Estimates suggest that Indigenous Peoples (IP) include some 5000 groups, comprising between 300–370 million people (Hall & Patrinos, 2012), ranging from isolated groups to large populations across most regions of the planet, including in urban centres. Local Communities (LC) on

Table 1 3 **Recognizing the global diversity of Indigenous Peoples and Local Communities.**

DIMENSIONS	GRADIENT OF CONDITIONS		
1. Demography	Small population	⟷	Large population
2. Social identity	Unrecognized	⟷	Formal
3. Language	Endangered	⟷	Expanding
4. Environment relationship	Continuous, inter-dependent	⟷	Sporadic/aesthetic/specialized
5. Land/territorial security	Informal/contested	⟷	Formal/recognized
6. Economic relations	Self-sufficiency, reciprocity	⟷	Market, trade
7. Property system	Open, common	⟷	Private, dispossessed
8. Technology use	Local techniques	⟷	Conventional, energy-intensive
9. Knowledge base, transmission	Oral/culturally coded	⟷	Recorded
10. Urban relationships	Distant	⟷	Inter-dependent
11. Socio-economic conditions	Poverty	⟷	Security
12. Security, pressures	Low	⟷	High
13. External dependency	Self-sufficient	⟷	Aid-dependent
14. Existence and Persistence	Millennia	⟷	Decades to centuries
15. Degree of self-governance	Autonomy and sovereign rights	⟷	External control

the other hand involve an even larger, and equally diverse population ranging from communities in peri-urban and coastal zones to rural communities isolated from urban centres inhabiting sparsely populated landscapes, coastal areas, and small towns around the world (see **Box 1.4**). While representing large sectors of the rural population in developing countries, they also represent important segments of the population in developed countries, producing diverse food and products, managing cultural and production landscapes, safeguarding agrobiodiversity and the genetic diversity of domesticated animals, and carrying the know-how of material culture and technology, food cultures and medicines and associated intangible heritage. As the application of the term may vary according to national or regional context, there are no clear ways to estimate the world population that could be classified as local communities. Proxy estimates based on factors such as distribution of smallholders in rural areas and land managed under customary rights would suggest a population around well above 1 billion people **(Box 1.4)**. They include micro-, small- and medium-scale farmers, herders and pastoralists, fishers, extractors and foragers, foresters and agroforesters managing a significant portion of the world's terrestrial and coastal landscapes and biodiversity.

In some regions, the IPLCs experience marginalized socioeconomic conditions. Many IPLCs share conditions of poverty, experience violence, have limited access rights to land and resource, and lack of access to conventional and to culturally sensitive health care systems. They also lack access to education appropriate to local culture, as well as public services such as water, energy, and sanitation (Ding *et al.*, 2016; Hall & Patrinos, 2012; Pearce, 2016; Romanelli *et al.*, 2015). Throughout the world, the IPLCs experience contestation of customary rights, physical and legal conflicts with mining companies, large-scale agriculture, forest companies, multinational oil corporations, as well as displacement associated with these pressures, from migration to government development programs. On the other hand, as the chapters of the assessment show, a multitude of examples exist of IPLCs leading innovation and collaborative efforts to manage and conserve nature, implement sustainable management practices, and find solutions to local problems.

Box 1 3 Global estimation of lands held and/or managed by Indigenous Peoples and Local Communities and 'counter-mapping' efforts.

The lands held in rights and/or managed by Indigenous Peoples and Local Communities (IPLCs) are found in all inhabited regions of the world (Dubertret & Alden Wily, 2015). It is estimated that between half and two-thirds of the world's lands are under customary tenure or community-based regimes, mostly held by IPLCs (Alden Wily, 2011). Estimates suggest that customary tenure, a significant portion of which overlap with different types of government, corporate, and/or private control, may extend to over 8.54 billion hectares or around 65% of the global land area inhabited by around 1.5 billion people (Alden Wily, 2011). Among them, between 300 and 370 million self-identify as Indigenous Peoples, who currently inhabit and manage around 28% of the global land area (Nakashima *et al.*, 2012; Garnett *et al.*, 2018). Pastoralists and agropastoralists, estimated to represent around 120 million people at the global level, move over larger areas and across altitudes within and beyond borders and across land held in different types of customary rights, often following pathways with long histories of transhumance (Rass, 2006). Still, only 10% of the world's land are formally recognized as indigenous and/or community lands (Rights and Resources Initiative, 2015). There are no global estimates available for the customary rights of IPLCs in freshwater and marine systems.

While representing the most up-to-date evaluation of IPLC lands globally, these estimates are limited by both the lack of visibility of IPLC lands in many regions and limited data. About 70% of land properties in low-incoming countries are unregistered (McDermott *et al.*, 2015), and 90% of Africa's rural land is estimated to be not formally documented (Byamugisha, 2013). Even when land titles have been issued to communities, relevant data and statistics regarding them may not be produced, such as in Peru where IPLC lands are not included in the official cadastral records, although communities have legal ownership rights over a third of the country's land area (IBC, 2016). However, decades of "counter-mapping" are progressively contributing to fill this lack of information: an ever-increasing number of maps are produced by and for IPLCs in all parts of the world, often used as means to depict the lands and resources they hold and use for asserting their customary land rights (e.g., Peluso, 1995). Local, national, or regional geographic platforms giving visibility to these maps multiply quickly[6]. For instance, the LandMark initiative (LandMark, 2018), has been scaling up these efforts by providing a global picture of IPLC lands, but, although more than a million maps covering 11.2% of the world's land have already been gathered on the platform, it is still far from complete. The existing geographic information on the matter is often scattered in many communities and organizations, some may see more harm than good in publishing politically sensitive IPLC land claims, and a large part of the world's IPLC lands are yet to be mapped. In another effort, using published open access data sources, Garnett *et al.* (2018) aggregated maps of indigenous lands for 87 countries. Another example is the Indigenous and Community Conserved Areas registry (ICCA Registry) has been instituted since 2009 through UN institutions, IUCN, the ICCA Consortium and additional partners to appropriately recognize the conservation and livelihoods role of IPLCs. While much has to be done to clarify the cartography of IPLC lands, ongoing efforts to fill critical gaps in information on the location and extent of indigenous and community lands has gained an important momentum (Corrigan *et al.*, 2016). Geospatial data integration, satellite monitoring, participatory mapping and transparency of information are increasingly playing a role in strengthening the tenure security of indigenous and community lands (Di Gessa, 2008).

1.3.2.2 Scaling-up the analysis of contributions of Indigenous Peoples and Local Communities to biodiversity management, conservation, and regional economies

Recognition and documentation of indigenous and local ecological knowledge, practices, and innovations (ILK) of Indigenous Peoples and Local Communities (IPLCs) show that they date back millennia, always evolving in dynamic and adaptive ways. They have been recorded in oral history and accounts in written texts such as large non-conventional scholarly texts of medical systems (e.g., Chinese or ayurvedic medicines), diverse art forms, popular literature, and various types of reports (Motte-Florac *et al.*, 2012). Oral histories, storytelling, songs and poems, objects and artifacts continue to be powerful and as relevant today as forms of knowledge transmission. In 2015, for instance, Australian researchers showed that Aboriginal memory regarding coastal inundation in Australia could be traced to over 7000 years (Nunn & Reid, 2016).

Today, evidence shows that IPLCs have shaped the ecologies and resource economies of vast regions of the world, from managing forests, soil fertility, grasslands, mountains, watersheds, and coastal areas to the cultivation and nurturing of domesticated and wild species and the management of vast social-ecological production landscapes for humans and non-humans. Such knowledge forms the basis of traditional medicines and modern pharmacological compounds, the foundational genetic basis of local and global crops, domesticated animals and an array of microorganisms used for making

6. Among many examples, see http://tierrasindigenas.org/ for Paraguay, https://raisg.socioambiental.org/ for the Amazon, www.mappingforrights.org/ for the Congo Basin, etc.

bread, cheese, preserves, and beverages. Currently, IPLCs manage, under various property regimes, a high proportion of global terrestrial and biodiversity rich landscapes, and a significant portion of coastal areas, and transboundary watersheds. Land managed by Indigenous Peoples alone cover at least ~38 million km^2 in 87 countries on all inhabited continents. This represents over a quarter of the world's land surface and intersects about 40% of all terrestrial protected areas and ecologically intact landscapes (Garnett *et al.*, 2018).

While local in action, IPLC management of nature provides contributions to the larger society, in rural and urban areas alike, including the provisioning of food, fibers, material, and medicine to local and to export markets, and the management of agrobiodiversity of major regional and global crops. In many regions IPLC lands contribute to the conservation of watersheds that supply large regional populations. Increasingly, scientific research and reports recognize the central role played by IPLCs to advance climate change mitigation initiatives and for the implementation of CBD's Strategic Plan for Biodiversity 2011–2020 and the 2050 Vision. Similarly, there is a wide body of evidence documenting the impact of economic development and cultural/social change on IPLCs, impacts that have accelerated since the 1970s and continue to do so in many regions.

While evidence on these contributions and transformations is robust, it is still regionally dispersed and includes significant gaps at the global level. The global assessment builds on previous and ongoing efforts to contribute to bridge these gaps through knowledge syntheses and integration and systematic literature reviews, the use of available geospatial data, online and face-to-face consultations with IPLC representatives and experts on indigenous and local knowledge and issues. Bringing together representatives of and experts on indigenous and local knowledge and issues in dialogue workshops, and producing synthetic reports, has helped in particular to identify commonalities among IPLCs across regions, specifically related to drivers of changes affecting them. Likewise, synthesis and upscaling has been facilitated through the examination of common themes, such as agrobiodiversity, local indicators of environmental change, protected areas, climate change mitigation, among others; themes which are relevant from local to global levels.

The global assessment builds upon a long history of efforts. Since the 1950s, numerous international efforts have emerged to recognize the rights and the knowledge of Indigenous Peoples in particular, including the Indigenous and Tribal Populations Convention of 1957, first international convention for the protection of Indigenous Peoples, and put forward by the International Labour Organization (ILO). In the early 1980s, the United Nations Economic and Social Council (ECOSOC) created the Working Group on Indigenous Populations (WGIP) and in 2000 established the United Nations Permanent Forum on Indigenous Issues (UNPFII), a body which continues to grow in scope and influence (also referred as United Nations Permanent Forum on Indigenous Peoples – UNPFIP). By 1989, a landmark international convention, the Indigenous and Tribal Peoples Convention or ILO Convention 169, advanced the original 1957 ILO convention. Finally, in 2007, after two decades of negotiations, the United Nations adopted the Declaration on the Rights of Indigenous Peoples. In spite of representing major advances, these conventions and declarations have not been without contestation and controversies, including on the definition and recognition of Indigenous Peoples in different parts of the world.

Along with growing concerns on environmental deterioration and human rights, and interest in locally developed and alternative approaches to managing the environment since the 1980s, attention has expanded to include a wide range of local communities, including forest peoples, farmers, fishers, herders, pastoralists, diversely manifested around the world. In many regions of the world, Indigenous Peoples and Local Communities joined forces with scientists, artists, civil organizations, and policymakers to raise attention to the interlocked plight of IPLCs and environmental degradation, progressively recognizing the distinct contributions to the larger society, including to international agreements on biodiversity conservation, sustainable development, and climate change. This expanded attention to local communities was already captured in the establishment of the Convention of Biological Diversity (CBD) in 1992, in particular the provision under Article 8(j) pertaining to IPLCs. Along with the efforts mentioned above, the CBD article 8(j) represented a watershed moment for the recognition of the knowledge, practices, and concerns of IPLCs, one that continues to grow today[7]. As part of this process, IPLC networks have expanded and are becoming increasingly instrumental in linking local to global concerns and voices of IPLCs.

The systematic inclusion of ILK and issues concerning IPLCs in global-scale assessments have been limited or at best based on case studies; however, they have been central to advance both understanding and the participation of IPLCs in such efforts. For instance, in 1999 UNEP published "Cultural and Spiritual Values of Biodiversity" as a complementary contribution to the First Global Biodiversity Outlook (UNEP, 1999). The Millennium Ecosystem

7. Article 8(j) has been a catalyst for advancing understanding and action to 'respect, preserve and maintain the knowledge, innovations and practices of Indigenous Peoples and Local Communities relevant for the conservation of biological diversity and to promote their wider application with the approval of knowledge holders and to encourage equitable sharing of benefits arising out of the use of biological diversity.' (CBD Working Group on Article 8(j)). https://www.cbd.int/convention/wg8j.shtml. Accessed April 2, 2018.

Assessment, published in 2005, included sections dedicated to ILK and IPLCs, particularly within its chapters related to 'cultural ecosystem services'. A rich array of regional assessments and syntheses has been developed, while focusing on different themes and issues. For instance, the Arctic Biodiversity Assessment (CAFF, 2013) prepared by the working group Conservation of Arctic Flora and Fauna (CAFF) of the Artic Council examined issues related to Indigenous Peoples and biodiversity in the Arctic including oral histories and other types of evidence on traditional ecological knowledge[8] (TEK).

During the last 20 years, international agencies under the United Nations, the World Bank, Consortium of International Agricultural Research Centres (CGIAR) research centres, and numerous Non-Governmental Organizations have published regional and global reports on various issues of concern to IPLCs. In parallel to these efforts, academic and non-academic literature dedicated to ILK and to issues of concern to IPLCs have expanded exponentially, increasingly written with and by representatives of IPLCs. Of particular relevance in recent years were the efforts carried out by organizations representing IPLCs in the CBD and other forums. A notable example was the publication in 2016 of the report *Local Biodiversity Outlooks: Indigenous Peoples' and Local Communities' Contribution to the Implementation of the Strategic Plan for Biodiversity 2011–2020* (FPP *et al.*, 2016) developed by the Indigenous Network of the Convention on Biological Diversity. The coverage of IPLCs and ILK in reports of the Intergovernmental Panel on Climate Change (IPCC), while limited, has also been progressively increasing (Ford *et al.*, 2016).

The establishment of IPBES' first work programme in 2012 represented a landmark in institutionalizing the inclusion of ILK in global and regional level assessments. The approval of IPBES' culturally-inclusive conceptual framework and related analytical tools (such as on nature's contributions to people and multiple values of nature), provided the foundation to include ILK as part of the IPBES's assessments on pollination, land degradation and restoration, and the four regional assessments covering the Americas, Europe and Central Asia, Africa, and the Asia-Pacific region. These assessments also contributed to advance mechanisms for consultation with IPLC representatives, such as through the organization of dialogue workshops incorporated as part of the assessment process. From the onset, IPBES formed a Task Force on ILK dedicated to developing guidelines for integrating ILK in IPBES activities. This task force is currently involved in developing a participatory mechanism that contributes to expand the participation of IPLC-based networks.

8. Other terms often used interchangeably with ILK include Local and Indigenous Knowledge Systems (LINKS), Traditional Ecological Knowledge (TEK), among others.

Table 1 4 **Operationalization strategy for systematically including Indigenous and Local Knowledge (ILK) and issues of concern to Indigenous Peoples and Local Communities (IPLCs) in the global assessment.**

i. Question- based approach	Three overarching questions and 36 chapter-specific questions were developed to guide authors in literature review and to guide consultations and dialogues activities.	**Inclusive definition of IPLCs and ILK**
ii. Systematic and inclusive review of published evidence and geospatial data	The global assessment integrates evidences from multiple sources. 1) systematic literature search in indexed journals and search engines; 2) information from other IPBES assessments and proceedings of earlier ILK Dialogue Workshops; 3) geospatial data from international research centres and national institutions; 4) information derived from an on-line 'Call for Contribution' platform developed specifically for the global assessment; and, (5) inputs received from face-to-face presentations and consultations with IPLC networks and organizations. The chapters include over 3000 bibliographic references, including articles, books, and reports, relevant to ILK and IPLC issues.	
iii. Author's Liaison group	28 authors (Coordinating Lead Authors and Lead Authors) and 32 Contributing Authors directly participated in the analysis of evidence of literature on ILK/IPLCs. Several authors participated in dialogue and consultation workshops	
iv. Online Call for Contributions	An international Online Call for Contributions was carried out between August and December 2017 receiving 363 contributors from over 60 countries and providing over 1200 bibliographic resources.	
v. Face-to-face consultation and dialogues	Multiple forms of dialogues and consultations with representatives of IPLCs and the scientific community were carried out in international fora and community grounds involving representatives of Indigenous Peoples and Local Communities, experts and practitioners. These include: UN Permanent Forum on Indigenous Issues, USA, 2017, 2018; Dialogue on Human rights and Conservation, Kenya, 2017; Society of Ethnobiology, Canada, 2017; Arctic Dialogue, Finland, 2018; CBD: SBSTTA and 8j, Canada, 2017; Communities, Conservation and Livelihoods Conference, CCRN-IUCN, Canada, 2018; International Society of Ethnobiology, Brazil, 2018.	

Implementing an operational strategy for ILK and IPLCs in the global assessment: The global assessment builds upon these efforts to accomplish its mandate to include ILK and issues of concern to IPLCs as an integral part of the assessment process. To accomplish these goals, a scoping document and an operationalization strategy dedicated to IPLCs and ILK was developed at the onset, discussed and reviewed by multiple constituencies within IPBES and in dialogues with experts and IPLC representatives. This operationalization strategy was used to guide authors to coordinate activities within and across chapters. **Table 1.4** presents a synthesis of the scoping and operationalization strategy for the inclusion of ILK and IPLCs in the global assessment. This strategy includes five main components (see Supplementary Material 1.4): i. A question-based approach **(Box 1.4)**; ii. Systematic and inclusive review of published evidence and geospatial data; iii. A dedicated ILK liaison authors' group; iv. Online Call for Contributions; and, v. Dialogue and consultation with representatives of IPLCs and experts.

This strategy, particularly the detailed set of questions guiding this component within each chapter, set forward an ambitious agenda for synthesis and reflection on issues related to topics of concern to IPLCs and the contributions of their knowledge and practices to nature and its contributions to people. Because of data gaps and difficulties in integrating data from different parts of the world, languages, and representing different knowledge systems, responding to some questions has been challenging and, in some cases, only limited advances were possible. Consultation and dialogue workshops were organized and carried out in fora where representatives and experts from various regions and stakeholder groups could come together. The global assessment is also intended to help identify knowledge gaps, therefore the efforts presented here are also meant to encourage and stimulate research groups and practitioners working on different aspects of ILK and IPLCs, at different levels and regions, to carry out research and synthesis to inform future assessments.

1.3.3 Scenarios of future change

Two chapters of the global assessment review future scenarios and possible pathways to achieve them and consider the implications of achieving or missing of internationally agreed goals such as the Aichi Biodiversity Targets and the SDGs. In chapter 4, scenarios are used to explore a range of plausible futures, based on potential trajectories of direct and indirect drivers. Chapter 5, on the other hand, evaluates pathways and policy intervention scenarios in order to achieve desirable futures, paying particular attention to the interactions of various SDGs

Box 1 4 ILK/IPLCs Guiding Questions for the Global Assessment.

A question-based approach provided a common reference for authors to review empirical evidence and as a basis for consultations and dialogues activities. Three overarching questions were developed within the scope and mandate of assessment, which were then further detailed into 36 chapter-specific questions used to guide the work of chapters 2 to 6.

1. *'What have been the contributions of indigenous and local knowledge (ILK), practices, and innovations to the sustainable use, management and conservation of nature and nature's contributions to people at regional and global scales?*

   This question is based on accumulated evidence indicating that while knowledge, practices, and innovations of IPLCs related to nature are locally based, they are manifested in regional landscapes and ecosystems, and are globally relevant.

2. *'What are the most important features, pressures and factors related to and/or enabling or constraining these contributions, as well as impacting present and future quality of life of IPLCs?'*

   This question is based on accumulated evidence indicating that in many regions IPLCs are at the forefront of social, economic, political and environmental/ecological pressures that directly affect the environment; they are socially and economically marginalized and are experiencing high rates of social and environmental changes.

3. *'What policy responses, measures, and processes can contribute to strengthen and improve the institutions and governance of nature and its contributions to people with regard to IPLCs?'*

   This question is based on accumulated evidence recognizing an important role for IPLCs in supporting the global biodiversity strategy pre- and post-2020, the 2030 Sustainable Development Goals, and climate mitigation goals in the Paris Agreement on Climate.

Thirty-six chapter-specific questions are available in Supplementary Material 1.4. They include questions related to the management of landscapes, ecosystems and watershed, species diversity, agrobiodiversity, protected areas, institutions and customary systems, drivers of environmental and social change, climate change impacts and adaptation, the contributions of IPLCs to international conventions, among several others.

between now and 2050 (SDGs, 2050 Vision). The objective is to facilitate a better understanding of the types of socio-economic development pathways leading to outcomes that are closest or furthest to these goals. This complementarity between scenarios and pathways in the context of the IPBES conceptual framework and the global assessment is illustrated in **Figure 1.4 and Figure 1.6**.

In chapter 4, four main types of scenarios are distinguished: exploratory, target-seeking, policy screening, and retrospective policy evaluation **(Figure 1.6)**. The chapter focuses on exploratory scenarios, which assume the absence of explicit policy intervention, and often combine extrapolations of past trends with new assumptions. Exploratory scenarios are often developed using participatory methods and can be either qualitative, often in the form of storylines, or quantitative, often in the form of models (van Vliet & Kok, 2013). Some groups of scenarios developed in the last few decades share many aspects of their storylines and are considered here as "archetype scenarios"; these archetypes vary mainly in the degree of dominance of markets, globalization, and policies toward sustainability. Chapter 4 follows the IPBES methodological assessment on scenarios and models (IPBES, 2016b) for the adoption of 'scenario families' (van Vuuren *et al.*, 2012), also covering archetypes based on scenarios developed by the Global Scenarios Group (GSG) (Hunt *et al.*, 2012; Raskin, 2005). The scenarios analysed include those that are often restricted to particular temporal or spatial scales and limited in scope and incomplete regarding quantitative information about nature, ecosystem services, and quality of life. Although recent advances in integrated assessment modelling seek to overcome these restrictions (e.g., Harfoot *et al.*, 2014), important gaps related to conservation of biodiversity remain in global scenarios, such as integrated scenarios for vulnerable areas, and socioeconomic scenarios developed for and in collaboration with IPLCs (Furgal & Seguin, 2006).

In order to design the means of achieving international biodiversity targets and development goals, and to assess the role of biodiversity and ecosystems in achieving the SDGs, Chapter 5 examines recent knowledge about target-seeking or normative scenarios relating to nature, nature's contributions, and quality of life, and their interlinkages. The chapter focuses on both the quantitative aspect of scenarios, i.e., technical options, and their qualitative assumptions, i.e., how change will be addressed in terms of values, institutions and governance. In that sense, scenarios are viewed as plausible and relevant narratives about the future in the frame of major uncertainty, rather than forecasts or predictions (Ferrier *et al.*, 2016; Raskin, 2005). A clear distinction is made between the terms 'scenarios' and 'pathways'; while scenarios use narratives to explain outcomes generated by a model, pathways are possible trajectories toward the achievement of specific outcomes, for instance biodiversity conservation goals and targets in the context of the SDGs. Multiple scenario studies are combined here to inform such pathways, and three backbone angles are considered: a) different types of scenarios as developed in Chapter 4 (target-seeking, sustainability-oriented i.e., global and regional sustainability archetypes, and some policy-screening scenarios), b) a cross-scale focus (global to local as fine spatial resolutions provide contextual insights that global scenarios alone may not capture), and c) a nexus approach based on clusters of SDGs and complemented by relevant literature. Building on the IPBES regional assessments meta-analyses, Chapter 5 also seeks to give emphasis on local and participatory scenarios, especially visions based on ILK, highlighting how interactions between spatial and temporal scales are relevant for future pathways.

Scenarios, as a way of thinking critically about the future of nature and NCP, have the potential to feed major phases of decision-making in the policy cycle, from agenda setting and design to implementation and review. Accordingly, chapters 4 and 5 provide important elements for chapter 6 on policy options **(Figure 1.6)**. Policy and decision-making processes rely on estimates of anticipated future socio-economic pathways, and on knowledge of the potential outcomes of actions across distinct geographic regions, scales, sectors and social groups, especially in the face of high uncertainty and unpredictability (Peterson *et al.*, 2003). In the IPBES context, scenarios and models play complementary roles in describing possible futures for drivers of change or policy interventions and translating those scenarios into projected consequences for nature and its contributions to people (IPBES, 2016b)

1.3.4 Units of analysis

The subdivision of the Earth's surface into spatial units for the purpose of analysis is notoriously controversial and there is no single agreed-upon system that IPBES can adopt as its standard. The global assessment thus adopts the term 'Units of Analysis' also used in other IPBES assessments. The term Units of Analysis refers to a broad-based classification system at the global level, considering both the state of nature in classes equivalent to what is commonly called 'biomes' or 'ecoregions', and classes where ecosystem structure and function have been severely altered through human management, which can be called 'anthromes' or anthropogenic environments (Ellis & Ramankutty, 2008).

The classification of Units of Analysis was developed over several years of consultations with experts involved in various IPBES regional and thematic assessments as well as the global assessment. The current Units of Analysis took into account previous classifications of biomes, ecoregions

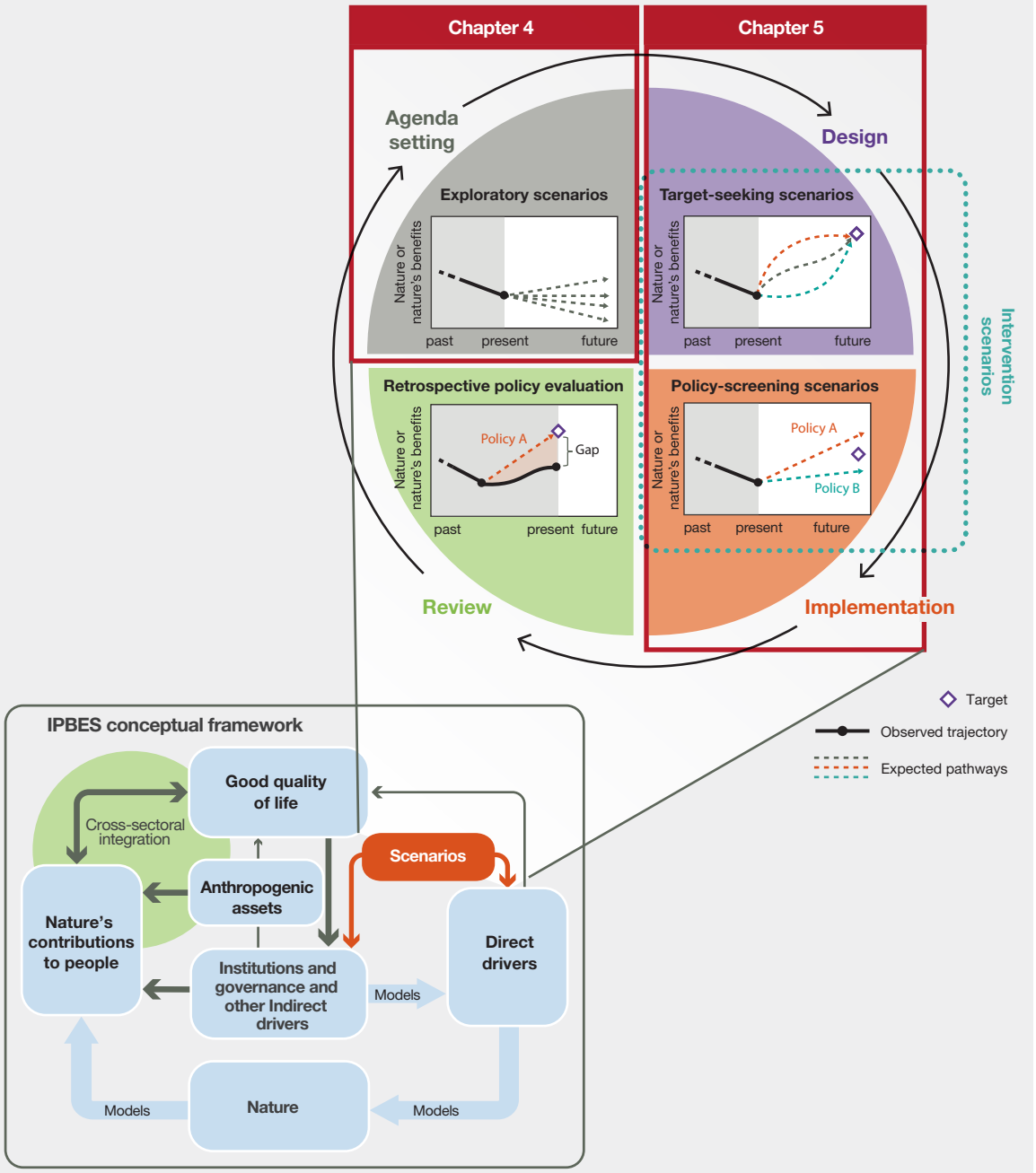


Figure 1 6 **Scenarios in the Global Assessment.**

The right-hand side of the figure shows what Chapters 4 and 5 assessed in terms different types of scenarios within major phases of the policy cycle. The left-hand side of the figure shows the relationships between scenarios (burgundy arrows), models (blue arrows) and the key elements of the IPBES conceptual framework. This figure was modified from the Summary for policymakers of the methodological assessment of scenarios and models of biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES 2016b).

(Olson *et al.*, 2001; WWF, 2018), Millennium Ecosystem Assessment reporting categories (MA, 2005) and regional habitat classifications (i.e., European nature information system, EUNIS; EEA, 2018). The goal of the Units of Analysis is to serve the needs of the coarse level of global analysis, reporting and communication in a policy context. Given differences among regions and the needs of regional assessments, this list of global units may not match the regional units.

#	UNIT OF ANALYSIS	TERRESTRIAL	FRESH-WATER	MARINE	HUMAN
1	**Tropical/subtropical forests**	**xxx**			
2	**Temperate/boreal forests/woodlands**	**xxx**			
3	**Mediterranean**	**xxx**			
4	**Arctic and mountain tundra**	**xxx**			
5	**Tropical/subtropical grasslands**	**xxx**			
6	**Temperate grasslands**	**xxx**			
7	**Deserts and xeric shrublands**	**xxx**			
11	**Cryosphere**	**xx**	x	x	
8	**Wetlands**		xxx		
13	**Inland waters**		xxx		
14	**Shelf ecosystems**			xxx	
15	**Surface open ocean**			xxx	
16	**Deep sea**			xxx	
9	**Urban/Semi-urban**	**..**	..		xxx
10	**Cultivated areas**	**..**	..		xxx
12	**Aquaculture**	**..**	..	..	xxx
17	**Intensive/multiple use coastal areas**	**..**	..	..	xxx
		8	**2**	**3**	**4**

The list of 17 global Units of Analysis includes 13 biomes, and 4 anthromes **(Figure 1.7)**. Of the 13 biomes, 7 are terrestrial, 2 are freshwater, 3 are marine and one cuts across all three. The four anthromes include 2 exclusively terrestrial ones, where ecosystem function is transformed to a very high degree from natural pathways to human ones – urban/semi-urban areas and cultivated areas. The aquaculture anthrome mirrors 'cultivated areas' but may be derived from terrestrial, freshwater or marine biomes. Finally, the 'intensely and multiply used coastal' anthrome reflects the unique position of the coastline and our use of it, sandwiched between land and sea and a nexus for terrestrial, marine, freshwater and climatic processes. The anthromes layer over biome units (e.g., a city in a grassland area) but are so transformed that the original biome may no longer exist there.

Definitions for each unit are given in Supplementary Material 1.5 and defined and examined more fully in Chapter 2.2 (Nature). They combine standard definitions (such as from existing biome classifications) and operational elements to cope with variation over the globe and data limitations for mapping and determining their precise boundaries.

1.3.5 Use of Indicators

The global assessment adopted a multi-dimensional system of indicators to examine status and trends, progress towards international goals such as the Aichi Biodiversity Targets and the SDGs, evaluate policy instruments, and consider plausible future scenarios. Indicators are considered synthetic forms of data, information, and knowledge that are harmonized to help understand the status, cause or outcome of an object or process both quantitatively and qualitatively. In other words, indicators are measures of different aspects of nature that help monitor, compare and communicate changes in the state of nature over time. Indicators have advantages and limitations depending on the scale of aggregation and/or how complex is the phenomena an indicator aims at expressing. Indicators are best seen as nested and can range from directly measurable parameters that are included in monitoring to aggregated indices. Standardized indicators are of great importance for assessments because they provide a common set of categories and common language to talk about status and trends in nature, thus providing common threads and quantitative points of comparison from which expert

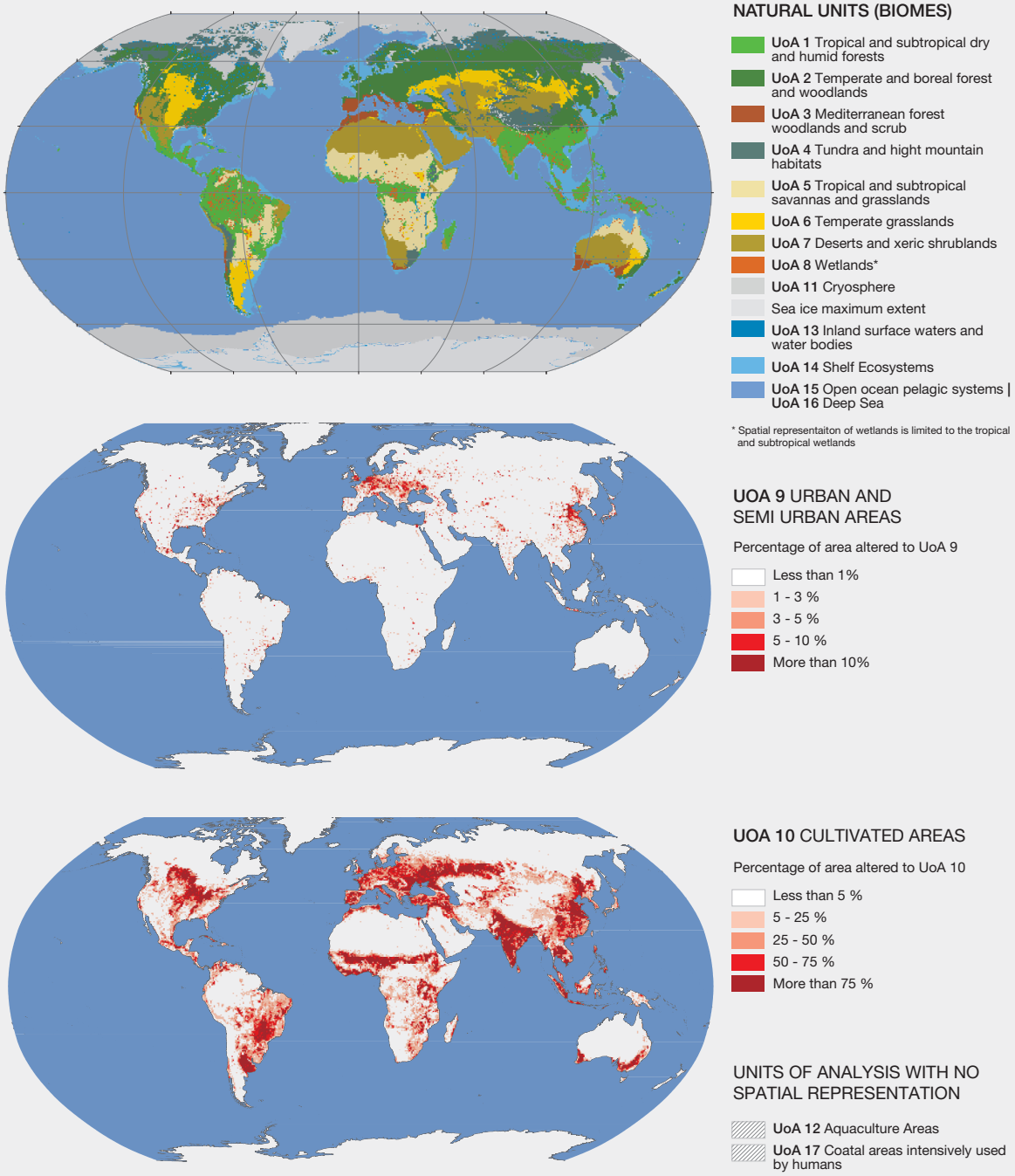


Figure 17 **Maps of the IPBES Units of Analysis; depicting both natural biomes and anthromes for the globe.**

The top map illustrates the biomes, followed by two maps of anthrome extent: urban and semi-urban areas (in the middle), and cultivated areas (in the bottom). Higher percentages of anthrome area are represented by deeper red tones. For more information on the description of IPBES Units of Analysis please see Supplementary Material 1.5.
Access the spatial data layers here: https://doi.org/10.5281/zenodo.3975694.

judgment can be deliberated (Turnhout, 2009; Turnhout *et al.*, 2007). Yet, as it has also been noted in the discussion of the NCP and values above, the selection of indicators reflects specific views and values.

Authors are aware of the limitations of indicators, both single or composite, to capture the complexities of the 'real world' or to represent different perspectives on a problem (i.e., proxy). Indicators are by nature restricted to what can

be measured and for which there are available data at a given unit of analysis and resolution, ideally generated with the same methods, referring the same system boundaries, and being of comparable quality. These limitations are especially significant when it comes to nature's non-material contributions to people and aspects of a good quality of life, as well as to represent the perspectives of Indigenous Peoples and Local Communities. As no single indicator can provide information on all policy relevant aspects, assessments rely on selected sets of indicators that are available at, or that can be aggregated or scaled up to the global level. **Figure 1.8** shows a conceptual diagram illustrating connections among types of evidence as used in an assessment. The flow of data to information and knowledge relevant to an assessment involves both direct use and interpretation through different disciplinary and knowledge system lenses, such as how raw data on temporal or spatial variation in drivers and pressures on nature can be used independently or combined with other types of evidence to derive conclusions and inferences, such as those used for future projections.

The initial discussion of IPBES indicators began in 2015, aimed at providing common indicators for the IPBES

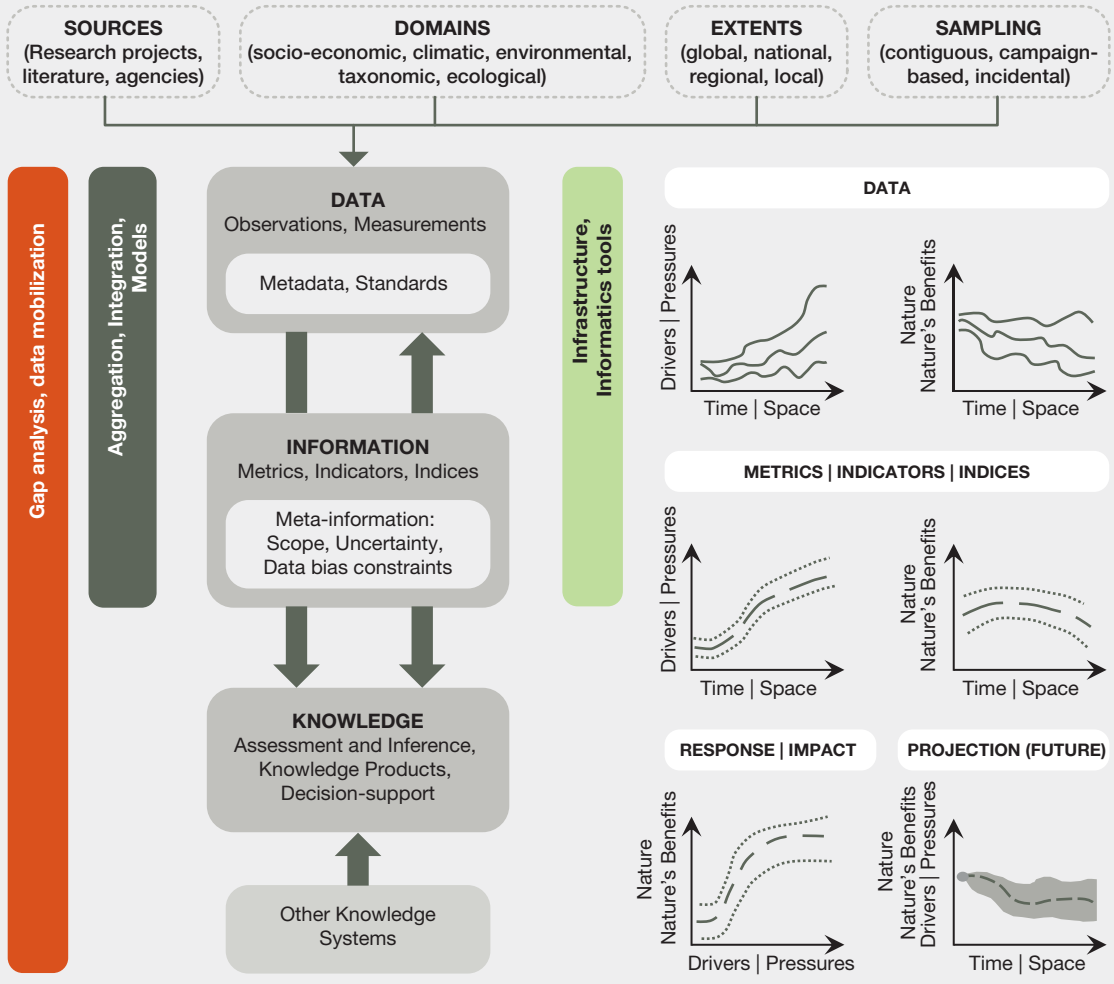


Figure 1 8 **Conceptual connection among types of evidence.**

The left side conveys the flow of data to information and knowledge relevant to IPBES, facilitated by a variety of approaches highlighted in colored boxes. Data may lead to knowledge directly or, outside this hierarchy of scientific inference, come from other knowledge systems. The right portion illustrates how raw data on temporal or spatial variation in drivers and nature (biodiversity and ecosystem properties and processes) may be combined to establish information about them, such as in the form of metrics, indicators or indices. Other knowledge systems directly contribute to assessment and inference for future projection. A combination of data or information from science and other sources contribute to knowledge about causal associations between drivers and impacts, which may then be used for projection. Source: Walter Jetz, Yale University.

For more information on the list of Core and Highlighted Indicators please see Supplementary Material 1.6 and 1.7.

Box 1 5 **IPBES principles for choosing indicators[6].**

1. **Policy relevant:** Indicators should provide policy-relevant information at a level appropriate for decision-making. Where possible, indicators should allow for assessment of changes in ecosystem status related to baselines and agreed policy targets.
2. **Scientifically sound:** Indicators should be based on clearly defined, verifiable, and scientifically acceptable data, collected using standard methods with known accuracy and precision or based on traditional knowledge that has been validated in an appropriate way.
3. **Simple and easy to understand:** Indicators should provide clear, unambiguous information that is easily understood. It is important to jointly involve policymakers, major stakeholders, and experts in selecting or developing indicators to ensure that the indicators are appropriate and widely accepted.
4. **Practical and affordable:** Obtaining or using data on the indicator should be practical and affordable.
5. **Sensitive to relevant changes:** Indicators should be sensitive and able to detect changes at time frames and spatial scales that are relevant to the decision-making. At the same time, they should be robust to measurement errors or random environmental variability in order to prevent "false alarms". The most useful indicators are those that can detect change before it is too late to correct the problems.
6. **Suitable for aggregation and disaggregation:** Indicators should be designed in a manner that facilitates aggregation or disaggregation at a range of spatial and temporal scales for different purposes. Indicators that can be aggregated for ecosystem as well as political boundaries are very useful.

regional assessments process; this originally involved regional assessment authors and experts of the IPBES Knowledge and Data Task Force, specifically, the task group on indicators. In addition to indicators related to Quality of Life **(Table 1.1)**, two main sets of biodiversity-related indicators were considered in the global assessment: 1) Core Indicators (n=30) and 2) Highlighted Indicators (n=42), which are presented and described in Supplementary Materials 1.6 and 1.7. Assessment authors used all available core and highlighted indicators in addition to other indicators or data sources they considered appropriate based on expert judgment (see **Box 1.5**).

Complementary sets of indicators were used when needed and available for analysing the Aichi Biodiversity Targets and the SDGs, which have their specific lists of indicators associated with different targets and goals. Chapters 2 and 3 also benefited from using indicators considered more relevant to Indigenous Peoples and Local Communities. In the case of Chapter 3 this was done through a systematic literature review for each Aichi Biodiversity Target and SDG analysed. Chapter 2 also considered indicators from and relevant to Indigenous Peoples and Local Communities as applied to different units of analysis.

Finally, at the level of experimentation, the global assessment piloted the concept of 'bundles of social-ecological indicators' (SES indicator bundles) with the theme of food security. Following a targeted workshop held around this theme, multiple bundles of indicators were identified tying together socio-ecological indicators with existing IPBES Core and Highlighted indicators. This category of social-ecological indicators emerged from the process of identifying Core and Highlighted Indicators as it became evident that there are large gaps in the existing indicator sets relevant to IPBES assessments in terms of evaluating the relationships embedded in the IPBES conceptual framework, including nature's contributions to people and good quality of life. Although these SES indicators and their bundles were used only experimentally, the piloting exercise provided useful guidelines for authors to examine issues of food security using as many and diverse indicators as possible.

1.3.6 Literature review

The scope of the IPBES global assessment is vast, examining past, present and possible future trends in multi-scale interactions between people and nature, taking into consideration different worldviews and knowledge systems. Within the science-policy interface the challenge is to approach, package and communicate the findings, which emerged from systematic evaluations of evidence in combination with input from transparent and open reviews, in a way that can be accessible and useful to decision makers.

The global assessment is based on existing data (including, as appropriate, national data), published scientific and grey literature and other information, including indigenous and local knowledge (see section 1.3.2.2), according to the guidelines of IPBES. Grey literature includes government publications, policy documents and briefs, online publications, technical reports and datasets etc. Based on the broad search strings and filters for output

9. Guide on the production and integration of assessments from and across all scales (deliverable 2 (a)); Modified from Ash et al. 2010 IPBES/4/INF/9 – IPBES Guide on the production and integration of assessments from and across all scales (deliverable 2 (a)).

results for systematic reviews in various databases/search engines, grey literature was not excluded from output results and held to the same criteria as all other literature and publications. The global assessment also considers IPBES' regional, thematic and methodological assessments and guidelines, as well as other relevant global assessments such as the Global Biodiversity Outlook series, the IUCN Red List of Threatened Species, assessments by the Food and Agriculture Organization of the United Nations, the Global Environmental Outlook series, the reports of the Intergovernmental Panel on Climate Change (IPCC), the Millennium Ecosystem Assessment, the first World Ocean Assessment (WOA I) and other assessments prepared under the Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including socio-economic aspects.

How authors approach the assessment of the growing evidence base is a critical step in how the key findings are developed. Apart from this Chapter 1, all chapters used a combination of systematic and expert-based reviews to evaluate available evidence. A flexible protocol for systematic review was developed as a framework to guide authors, based on methods developed by the Collaboration for Environmental Evidence (2013)[10].

The suggested protocol within the global assessment aimed to achieve:

- **Transparency:** methods for identifying and selecting resources are reported;
- **Equivalent quality across chapters:** each chapter follows a similar approach;
- **Reduced bias:** resources known to authors are weighed against the best available resources; published and grey literature are searched concurrently;
- **Repeatability:** methods of identifying resources can be repeated or refined in subsequent assessments;
- **Efficient use of author time:** clear guidelines on how to search helps authors plan their work;
- **Efficient use of existing resources**: international efforts to compile environmental evidence for policy and practice are actively incorporated;
- **Balance** between the rigor of systematic review and the timeline and literature cut-off dates of an IPBES assessment.

The process involves two main sequential steps: 1) when applicable, concurrent database searches of different kinds of literature (e.g., peer reviewed and "grey" published literature, unpublished but openly available reports and databases) to minimize potential biases and 2) personal knowledge and experience of authors regarding key seminal resources or publications not appearing as an output from first step. The cut-off date for the inclusion of published sources was 30 April 2018. However, exceptions for including sources published after this date were made on the basis of reviewers' comments and the publication of relevant new evidence. In addition to systematic literature reviews carried out across chapters, an additional effort was made in chapter 3 to carry out systematic literature review to evaluate each Aichi Biodiversity Target and relevant SDG from the perspective of Indigenous Peoples and Local Communities. 32 Contributing Authors were involved and a total of 1760 literature references were compiled and analysed for this purpose (see chapter 3). In addition to this systematic review, the analysis of ILK/IPLC issues also benefited from an "Online Call for Collaboration"[11] (Table 1.4, Supplementary Material 1.4), which contributed around 1200 references, which were reviewed and selected to inform specific sections of the assessment.

In most cases, the method for literature review also included a priority order for inclusion of scientific evidence in the assessment: **Collated synopsis or summary > Systematic Review > Meta-analysis > Review >Individual Studies or case studies > compiled expert opinion.**

This order of priority assumes resources at each level are of equivalent quality and relevance. A combination of resources was discussed by authors to represent the most relevant and highest quality evidence. During chapter meetings, authors discussed the highest level of synthesis available as a priority and supplemented with levels below if necessary to fully cover and evaluate the subject/topic, or to include the most up to date information.

Across all chapters of the global assessment in the underlying chapter text, references are cited in-text with the full reference at the end of each chapter. Across all chapter executive summaries and the summary for policymakers' background text, traceability is indicated to chapter subsections enclosed in curly brackets. Each chapter includes a discussion of the literature review process in the main text or as part of the chapter's supplementary materials.

10. http://environmentalevidence.org/wp-content/uploads/2014/06/Review-guidelines-version-4.2-finalPRINT.pdf

11. Launched 25 July 2017.

1.3.7 Confidence framework

A qualitative method of communicating the level of uncertainty and confidence in a key finding or statement using accessible and agreed upon terms and language has been essential to communicate assessment findings to decision-makers. The evaluation of confidence of assessment findings in the global assessment is based on the experience of previous IPBES assessments, which in turn benefited from other international and intergovernmental assessments, such as the Millennium Ecosystem Assessment, the Intergovernmental Panel on Climate Change (IPCC), and the UK National Ecosystem Assessment (UK-NEA).

The global assessment followed the schematics and criteria presented in **Figure 1.9** to guide authors in the process of assessing and communicating the degree of uncertainty, or confidence, related to key findings. This four-box confidence framework developed for IPBES assessments and its key findings are based on level of agreement of experts using their judgment (x-axis) in combination with the quantity and quality of evidence assessed (y-axis – **Figure 1.9**). The evidence includes publications, data, theory, models and information etc. Further details of the approach are documented in the note by the secretariat on the information on work related to the guide on the production of assessments (IPBES/6/INF/17).

The summary terms to describe the evidence are*:*

- ***Well established:*** comprehensive meta-analysis or other synthesis or multiple independent studies that agree.
- ***Established but incomplete*:** general agreement although only a limited number of studies exist; no comprehensive synthesis and/or the studies that exist address the question imprecisely.
- ***Unresolved*:** multiple independent studies exist but conclusions do not agree.
- ***Inconclusive*:** limited evidence, recognizing major knowledge gaps.

Following other IPBES assessments, the global assessment does not use a likelihood scale or probabilistic certainty scale.

The synthesis of this large volume of evidence is challenging and complex and relies strongly on authors' expertise and joint deliberations, including authors from multiple disciplinary backgrounds and knowledgeable of issues related to other knowledge systems, particularly Indigenous Peoples and Local Communities. These confidence terms inform and communicate to decision-makers what the assessment author teams have high confidence in as well as what requires further investigation to allow decision makers to make informed decisions.

Figure 1 9 **The four-box model for the qualitative communication of confidence.**

Confidence increases towards the top-right corner as suggested by the increasing strength of shading. Source: IPBES (2016).

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