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Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
Third session
Bonn, Germany, 12–17 January 2015
Item 5 (b) of the provisional agenda*

Initial work programme of the Platform: guides on assessments, policy support tools and methodologies, and preliminary guides on scenario analysis and modelling and the conceptualization of values

Guide on the production and integration of assessments from and across all scales (deliverable 2 (a))

Note by the secretariat

In its decision IPBES-2/5, the Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services requested the Multidisciplinary Expert Panel in consultation with the Bureau, supported by a time-bound and task-specific expert group, to implement deliverable 2 (a) of the work programme, on the development of a guide to the production and integration of assessments from and across all levels. The guide was intended to address the practical, procedural, conceptual and thematic aspects of undertaking assessments and to draw on the work of the task forces and other expert groups. Accordingly, an expert group was established to develop the guide, in accordance with the rules of procedure set out in the annex to decision IPBES-2/3 (IPBES/2/17). The annex to the present note provides information on the membership of the expert group, progress made in the development of the guide and next steps, and sets out the draft guide in its annex III. The annex is presented without formal editing.

* IPBES/3/1.

Annex

Expert group on the development of a guide to the production and integration of assessments from and across all levels

I. Membership of the Expert Group

1. Governments and other relevant stakeholders submitted 90 nominations for the expert group to prepare the draft of the Guide. The Multidisciplinary Expert Panel, at its third meeting, decided to select from this pool of nomination a small group of 9 experts, tasked, to develop the guide on assessments, together with members of the Multidisciplinary Expert Panel and the Bureau, as well as a larger group of 48 experts tasked to review the draft guide. The selection process involved members of the Multidisciplinary Expert Panel supported by members of the Bureau, together reviewing all nominations submitted, based on examination of nomination templates and curricula vitae for each nominee. Selections were made on the basis of excellence and relevance of candidates' expertise with respect to relevant areas of the work programme. Once selected on merit, further selection was focused on balancing disciplinary, regional and gender diversity, as well as sectoral aspects (i.e. government and stakeholder nominations).

2. The expert group selected included 22 percent of experts from Africa, 33 percent from Asia Pacific, 11 percent from Eastern Europe, 22 percent from Latin America and the Caribbean and 11 percent from Western European and Others Groups, with 89 percent nominations made by Governments and 11 percent by other Stakeholders, with 44 per cent males and 56 percent females. The expert group was co-chaired by Ivar Baste (Bureau) and Sebsebe Demissew (MEP). Ten other members of the Multidisciplinary Expert Panel and Bureau oversaw the work of this deliverable. The composition of the expert group is presented in annex I. Additionally, a larger group of 48 nominated experts formed a review panel for the work on policy support tools and methodologies providing peer review. The composition of the larger expert group is presented in annex II.

3. Technical support to the development of the Guide was provided by the United Nations Environment Programme World Conservation Monitoring Centre by means of an agreement on interim support to the IPBES secretariat.

II. Progress and planned next steps in the development of the guide

4. A draft version of the guide has been developed but more work remains until the guide is completed. The guide is awaiting further inputs from IPBES Task Forces and directions from the Plenary on issues such as priority capacity-building needs. Text still needs to be developed in relation to knowledge gaps and indigenous and local knowledge.

5. An early draft of the guide was subject to one round of peer review in August 2014 by the larger group of experts. The current draft will undergo a second round of review by the same group and members of IPBES Task Forces and relevant Expert Groups.

6. The guide is furthermore open for review by Members and Stakeholders of IPBES and comments should be submitted to the IPBES Secretariat by 31 January 2015 using the standard format as in annex 4. Review should focus on content within the guide as well as length and accessibility of language.

7. The expert group for the guide will address the review comments and consider whether the guide could be produced as an e-book with an overarching diagrammatic summary of practical steps to be considered. The summary is also intended to assist users in accessing the information contained within the Guide. The Multidisciplinary Expert Group will in consultation with the Bureau consider how the Guide on the production and integration of assessments from and across all scales should be published and made available. They will also explore the possibility of holding a final expert group meeting to finalise the guide.

Annex I

Members of the Multidisciplinary Expert Panel and Bureau dedicated to the work on the Guide on the production and integration of assessments from and across all scales

Name	Affiliation	Bureau/MEP
Ivar Baste	Norwegian Directorate for Nature Management	Bureau (co-chair)
Sebsebe Demissew	Addis Ababa University	MEP (co-chair)
Zakri Abdul Hamid	National Professors Council, Malaysia	Bureau
Robert Watson	University of East Anglia	Bureau
Yousef Al-Hafedh	King Abdulaziz City for Science and Technology, Saudi Arabia	MEP
András Báldi	MTA Centre for Ecological Research	MEP
Julia Carabias	National Autonomous University if Mexico	MEP
Sandra Diaz	Universidad Nacional de Córdoba	MEP
Paul Leadley	University of Paris-Sud	MEP
Jean Bruno Mikissa	National School for Water and Forest	MEP
Yosihisa Shirayama	Japan Agency for Marine Earth Science and Technology	MEP
Randolph R. Thaman	University of the South Pacific	MEP

Selected members of the expert group developing guidance on the Guide on the production and integration of assessments from and across all scales

Name	Affiliation	Country/Organisation
Dolors Armenteras	Universidad Nacional de Colombia	Colombia
Bojie Fu	Chinese Academy of Sciences	China
Edwin Iguisi	Ahmadu Bello University	Nigeria
Eun-Shik Kim	Kookmin University	Republic of Korea
Patricia Koleff	CONABIO	Mexico
Sandra Lavorel	CNRS	France

Szabolcs Lengyel	Hungarian Academy of Sciences	Hungary
Belinda Reyers	CSIR	South Africa
Sheila Vergara	ASEAN Centre for Biodiversity	ASEAN Centre for Biodiversity

Annex II

Selected members of the review panel on the Guide on the production and integration of assessments from and across all scales

Name	Affiliation	Country/Organisation
Byron Adams	Brigham Young University	Ecological Society of America
Edward Amankwah	Centre for Environmental Governance	Ghana
Detlef Bartsch	Federal Office of Consumer Protection and Food Safety	Germany
Lene Buhl Mortensen	Institute of Marine Research	Norway
Purificacio Canals	MedPAN	Mediterranean Protected Areas Network (MedPAN)
Joaquin Casillo	Ministerio de la Producción e INTA	Argentina
Kai M.A. Chan	University of British Columbia	Canada
Sudipto Chatterjee	TERI University	IHDP
David Cooper	CBD	CBD
Malachi Dottin	Ministry of Agriculture	Grenada
Berien Elbersen	Alterra	Netherlands
Markus Fischer	University of Bern	Germany
Helmut Hillebrand	Institute for Chemistry and Biology of the Marine Environment	Germany
Roberto Hoeft	CBD	Gesellschaft für Ökologie
Stefan Hotes	Philipps-University	Germany
Walter Jetz	Yale University	CBD
Daeseok Kang	Pukyong National University	Republic of Korea
Brian Klatt	Michigan State University	USA
Rakotobe Randriarimalala Lalaina	Conservation International	Madagascar
Junsheng Li	Chinese Research Academy of Environmental Sciences	China

Sandra Luque	University of St Andrews	UK
Alec Mckay	AgResearch Grasslands	New Zealand
Gichora Mercy	Ministry of Environment, Water and Natural Resources	Kenya
Luiz Fernando Merico	IUCN	Brazil
Juan Jose Neiff	Centro de Ecología Aplicada	Argentina
Oladele Ogunseitan	University of California	IHDP
Ramón Pichs	Centro de Investigaciones de La Economía Mundial	Cuba
Cibele Quieroz	Stockholm Resilience Centre	Sweden
Juan Miguel Quinonez	OTECBIO	Guatemala
Harison Rabarison	University of Antananarivo	Madagascar
Jon Paul Rodriguez	Instituto Venezolano de Investigaciones Científicas	Venezuela
Fernando Santos Martin	Universidad Autónoma de Madrid	Spain
Christine B. Schmitt	University of Freiburg	Germany
Asaye Ketema Sekie	Ministry of Environment and Forest	Ethiopia
Mette Skern-Mauritzen	Institute of Marine Research	Institute of Marine Research
Britaldo Soares Filho	IGC-Campus UFMG	Brazil
Angela Strecker	Portland State University	Canada
William Sutherland	University of Cambridge	UK
Elda Viviana Tancredi	National University of Lujan	Argentina
Ben Ten Brink	PBL Netherlands Environmental Assessment Agency	Netherlands
Majan Van Den Belt	Ecological Economics Research New Zealand at Massey University	New Zealand
Ingrid Visseren Hamakers	Wageningen University	Netherlands
Diana Wall	Colorado State University	USA

Jun Wang	Ministry of Land and Resources of China	China
Hiroya Yamano	Ministry of the Environment, Japan	Japan
Xiaoyun Zhang	State Forestry Administration	China
Álvaro Gabriel Zopatti	Secretaría de Ambiente y Desarrollo Sustentable de La Nación	Argentina

Annex

IPBES Deliverable 2(a)

Guide on production and integration of assessments from and across all scales

Contents

Table of Boxes

Table of Figures

Table of Tables

List of Acronyms

ARIES	Artificial Intelligence for Ecosystem Services
ASA	Analytic Species Accumulation
ASEAN	Association of South East Asian Nations
ATCO	Amazonian Treaty for Cooperation
AU	African Union
BD	Biodiversity
BES	Biodiversity and Ecosystem Services
BII	Biodiversity Intactness Index
BIP	Biodiversity Indicators Partnership
BPI	Brazilian Pollinator Initiative
CARICOM	Caribbean Community
CAs	Contributing Authors
CBD	Convention on Biological Diversity
CCD	Colony Collapse Disorder
CF	Conceptual Framework
CIS	Commonwealth of Independent States
CLAs	Coordinating Lead Authors
DIK	Data, Information and Knowledge
DPSIR	Drivers-Pressures-State-Impact-Response
EBSAs	Ecologically or Biologically Significant marine Areas
EEA	European Economic Area
EEMBizkaia	Millennium Ecosystem Assessment in Biscay
EME	Spanish Ecosystem Assessment’s
ES	Ecosystem Services
ESA	European Space Agency
EU	European Union
FAO	Food and Agriculture Organization of the UN
GBIF	Global Biodiversity Information Facility
GBO	Global Biodiversity Outlook
HANPP	Human Appropriated Net Primary Productivity
HWB	Human Well Being
ICCA	Indigenous and Community Conserved Area
IEA	Integrated Environmental Assessment
IISD	International Institute for Sustainable Development
ILK	Indigenous and Local Knowledge
InVEST	Integrated Valuation of Ecosystem Services and Tradeoffs
IOC	Intergovernmental Oceanographic Commission
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IPCC-SRES	Intergovernmental Panel on Climate Change Special Report on Emissions Scenarios
ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature
LAs	Lead Authors
LINKS	Local Indigenous Knowledge Systems
LPI	Living Planet Index
LPJmL	Land Dynamic Global Vegetation and Water Balance Model
MA	Millennium Ecosystem Assessment
MEA	Multilateral Environment Agreement
MEP	Multidisciplinary Expert Panel

MERCOSUR	Southern Common Market
MIMES	Multiscale Integrated Models of Ecosystem Services
MOL	Ministry of Labour
MRV	Monitoring , Reporting and Verification
MSA	Mean Species Abundance
MTI	Marine Trophic Integrity
NAFTA	North American Free Trade Agreement
NASA	Nation Aeronautics and Space Administration
NCI	Natural Capital Index
NEA-DE	National Assessment of Ecosystems and their Services for the Economy and Society in Germany
NGO	Non-Governmental Organisation
NPP	Net Primary Production
OAS	Organization of American States
OBIS	Ocean Biogeographic Information System
RCPs	Representative Concentration Pathways
REF	Research Excellence Framework
REPOL	Rede Baiana de Polinizadores
REs	Review Editors
RLI	Red List Index
SAARC	South Asian Association for Regional Cooperation
SAfMA	Southern African Millennium Ecosystem Assessment
SAR	Species-Area Relationship
SDGs	Sustainable Development Goals
South Korean NIE	The South Korean National Institute of Environment
SSPs	Shared Socio-economic Pathways
TEEB	The Economics of Ecosystems and Biodiversity
TF DIK	The Task Force on Data, Information and Knowledge
TNC	The Nature Conservancy
TSU	Technical Support Unit
UFZ	Helmholtz Centre for Environmental Research
UK NEA	UK National Ecosystem Assessment
UK NEAFO	UK National Ecosystem Assessment Follow-On Phase
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environment Programme
UNEP-WCMC	United Nations Environment Programme World Conservation Monitoring Centre
UNESCO	United Nations Education, Scientific and Cultural Organization
WRI	World Resources Institute
WWF	World Wide Fund for Nature

Introduction

The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)

Societies are faced with threats to long-term human well-being from the loss of biodiversity and degradation of ecosystem services. Invigorated responses to the challenge among public and private sector at local, national and international levels include multiple efforts for conservation and sustainable use of biodiversity. Examples at international level include the Strategic Plan for Biodiversity 2011-2020 and its Aichi Targets prepared under the auspices of the Convention on biological Diversity, the 10-year strategic plan and framework (2008-2018) of the United Nations Convention to Combat Desertification (UNCCD), and the development by the UN General Assembly of the post-2015 Development Agenda and a set of sustainable development goals (SDGs). However, a steadily strengthened environmental governance system has to date not been sufficient to stem the increasing human pressures on the biosphere.

The situation calls for an improved understanding of the kind of ecosystem degradation that is undermining long-term human wellbeing. Decision makers need scientifically credible, legitimate and relevant information on the often complex interactions between biodiversity and society that defines nature's benefits people. They also need effective methods to interpret this scientific information in order to make informed decisions. The scientific community on the other hand needs to understand the needs of decision makers better in order to provide them with the relevant information. These needs can be met by strengthening the science policy interface and enhancing the dialogue between the scientific community, governments, and other stakeholders on biodiversity and ecosystem services.

Science-policy interfaces are critical forces in shaping the environmental governance system. The system can be seen as a polycentric one consisting of nested public, private and non-governmental decision-making units operating at multiple scales within rule and value systems that differ from one another to some extent. Interactions between science and policy are challenged by the complexity of the environmental governance system and of the problems it seeks to address. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is a structured formal response to this challenge.

IPBES was established in April 2012 as an independent intergovernmental body whose objective is "to strengthen the science-policy interface for biodiversity and ecosystem services for the conservation and sustainable use of biodiversity, long-term human well-being and sustainable development". In order to achieve this objective, IPBES performs four key functions (Box A).

Box A: The Four Key Functions of IPBES

1. Facilitate access to the scientific information needs of policymakers, promoting and facilitating the generation of new knowledge where this is necessary;

2. Deliver global, regional, sub-regional and thematic assessments as requested, and at the same time promote and facilitate assessments at the national level;

3. Promote the development and use of policy support tools and methodologies so that the results of assessments can be more effectively applied; and

4. Identify and prioritize capacity building needs for improving the science-policy interface at appropriate levels, and provide, call for and facilitate access to the necessary resources for addressing the highest priority needs directly relating to its activities.

Source: UNEP/IPBES.MI/2/9

This Guide[1] aims to help address conceptual, procedural and practical aspects of IPBES assessments at all scales, and to promote consistency across different scales. The Guide serves as a 'Roadmap' and focuses on key elements assessment practitioners may want to take into account when undertaking an assessment within the context of IPBES.

The Guide has been developed for experts who are taking part in assessments approved under IPBES be they thematic, methodological or general assessments of biodiversity and ecosystems at global, regional and sub-regional level. The Guide is also meant to assist those who might want to undertake IPBES inspired assessment at sub-regional, national and local level and to help facilitate that such assessments are compatible with larger scale IPBES approved assessments.

What is an IPBES assessment?

An IPBES assessment is a critical evaluation of the state of knowledge in biodiversity and ecosystem services. It is based on existing peer-reviewed literature, grey literature and other knowledge systems such as indigenous and local knowledge. It does not involve the undertaking of original research. The assessment may involve a literature review, but is not limited to such a review. The process of evaluating the state of knowledge involves the analysis, synthesis and critical judgement of information by experts and the presentation of such findings to governments and relevant stakeholders on their request.

IPBES assessments need to be credible, legitimate and relevant. They typically:

- Involve governments and other stakeholders in the initiation, scoping, review and adoption of the assessment reports. (This involvement promotes credibility, legitimacy and relevance at policy level);
- Operate through an open and transparent process, run by a group of experts that has a balance of disciplines, geography and gender. They use agreed conceptual frameworks, methodologies, and support tools and are subject to independent peer review. (This process promotes credibility, legitimacy and relevance at scientific level); and
- Present findings and knowledge gaps that are policy relevant but not policy prescriptive, where the level of confidence and the range of available views are presented in an unbiased way (This approach promotes relevance at both scientific and policy level).

IPBES assessments focus on what is known, but also what is currently uncertain. Assessments play an important role in guiding policy through identifying areas of broad scientific agreement as well as areas of scientific uncertainty that may need further knowledge generation such as through scientific research.

What are the IPBES assessment types?

IPBES will undertake a number of different types of assessments at sub-regional, regional and global levels. It will also encourage and help catalyse other assessments at lower scales such as those with a local, national and a more limited sub-regional scope. IPBES is currently engaged in or has planned to undertake:

[1] The first IPBES programme of work 2014-2018 was agreed in December 2013 setting out a number of deliverables, including the development of guidance materials and the scoping and completion of thematic and regional assessments. This Guide is deliverable 2(a) of the first work programme of IPBES.

- **Global assessments** to assess biodiversity and ecosystem services and their interlinkages at the global scales. The global assessments will draw upon the work undertaken by the regional assessments.
- **Regional assessments** to assess biodiversity and ecosystem services and their interlinkages at the regional and, as necessary, sub regional levels. Regional assessments will provide the building blocks for the global assessments.
- **Thematic assessments** that is, assessments that address a particular theme at an appropriate scale or a new topic.
- **Methodological assessments** to conduct a rapid methodological evaluation of a topic (e.g. valuation) and how the methods can be taken into account in the Platform's activities.

How to use this assessment guide

The assessment guide is divided into six sections (each containing a number of chapters) covering conceptual issues, assessment processes, methodologies, knowledge resources, utilising assessments and capacity building.

Each chapter of the Guide first sets out the issues and concepts and defines key terms. Second, the chapters provide a roadmap with recommended practical steps to be followed for different IPBES related assessments, indicating amongst others where there is flexibility in application. Finally, the chapters lists key resources, including by pointing to other guidelines, plans, strategies and approaches that could be of use to practitioners (Box B).

It is anticipated that as the work of the Platform progresses, chapters could be updated or new ones added, in particular within the methodological section. This guide is a living document and will be updated periodically. Users should always ensure that they have the latest version of the guide, which is downloadable from the IPBES website.

Box B: The IPBES Catalogue of Assessments and other key IPBES resources

Development of a "Catalogue of Assessments on Biodiversity and Ecosystem services" was called for in 2012 at the meeting that established IPBES. Deliverable 4b of the Work Programme 2014-2018 requests the continued maintenance and enhancement of this online Catalogue, which can be found at http://catalog.ipbes.net/. The Catalogue brings together information on and experiences from undertaking assessments of biodiversity and ecosystem services from the global to the sub-national scale. It offers direct access to assessment reports, and supporting technical documents as a resource for assessment practitioners and policy makers. Containing over 200 assessments, the Catalogue provides a platform from which lessons can be learnt from existing and ongoing assessment processes so as to inform the future development of IPBES. The inclusion of IPBES assessments in the Catalogue is encouraged in order to keep the Catalogue up-to-date and to guide future IPBES assessments. The Catalogue is managed by UNEP World Conservation Monitoring Centre (UNEP-WCMC) on behalf of the IPBES Secretariat and maintained with the direct involvement of assessment practitioners within existing networks and initiatives, including the Sub-Global Assessment Network (www.ecosystemassessments.net).

Other key IPBES resources include:

- Procedures, approaches and participatory processes for working with indigenous and local knowledge systems (Deliverable 1c)

- A guide for scenario analysis and modelling of biodiversity and ecosystem services (Deliverable 3c)
- A guide for the diverse conceptualisation of values of biodiversity and nature's benefits to people including ecosystem services (Deliverable 3d)
- Information and data management plan (Deliverable 4b)
- Catalogue of policy support tools and methodologies (Deliverable 4c)

Section I: Addressing Conceptual issues

This section considers how to use the IPBES Conceptual Framework and how to deal with the question of scale in assessments. There are several other considerations that should be taken into account in the scoping processes and these are also dealt with here.

Chapter 1: The IPBES Conceptual Framework and how to use it

Coordinating Author: Sandra Díaz

Authors: Sebsebe Demissew, Julia Carabias, Sandra Lavorel, Berta Martín-López, Rosemary Hill

1.1 The IPBES Conceptual Framework

All assessments carried out by IPBES are expected to be based on the IPBES Conceptual Framework (hereafter CF[2]). This is important to give structure to the assessments' analytical and synthetic work, to interpret the information that forms their basis, and to facilitate consistency and comparability across various assessments (different spatial scales, different themes, and different regions). The CF is a highly simplified model of the complex interactions within and between the natural world and human societies. The model identifies the main elements, together with their interactions, that are most relevant to the Platform's goal and should therefore be the focus for assessments and knowledge generation to inform policy and the required capacity building.

IPBES embraces different disciplines (e.g. natural, social, and engineering sciences), stakeholders (e.g. the scientific community, governments, international institutions, civil society organisations at different levels, the private sector), and knowledge systems (western science, indigenous knowledge, local and practitioners' knowledge). Accordingly, the CF explicitly incorporates all these aspects. Rather than a comprehensive model of how the world works, the CF should be seen as a tool for achieving a shared working understanding across the different disciplines, knowledge systems and stakeholders that are expected to be active participants in the Platform. While a single CF has been retained for the practical purposes of IPBES assessments (as explained in the text), it is recognized that representations of human-nature relationships (i.e. conceptual frameworks) may vary from culture to culture in relation to specific worldviews/cosmologies, including between scientific and indigenous knowledge systems, as well as among indigenous cultures.

1.1.1 The key elements of the IPBES Conceptual Framework

The CF includes six interlinked elements constituting a social-ecological system that operates at various scales in time and space (Figure 1.1): nature; nature's benefits to people; anthropogenic assets; institutions and governance systems and other indirect drivers of change; direct drivers of change; and good quality of life. These elements are general and comprehensive enough to resonate with the categories of different knowledge systems, and of different disciplines within western science. In Figure 1.1, categories in black and bold font are inclusive, whereas categories in green and blue illustrate the concepts used by Western science and other knowledge systems respectively. Within these broad and cross-cultural categories, different assessments are invited to identify more specific subcategories, associated with knowledge systems and disciplines relevant to the task at hand, without losing view of

[2] For full description of the IPBES Conceptual Framework see Díaz S., Demissew, S., Carabias, J., et al. 2015. The IPBES Conceptual Framework - Connecting nature and people. Current Opinion in Environmental Sustainability. In Press.

their placement within the general picture. For example, there is a large gap between the ways in which ecosystem goods and services ("green" category) and gifts of nature ("blue" category) in Figure 1.1 are conceptualized, valued and used according to different world views, but both categories are concerned with the things that societies obtain from the natural world, which are collectively represented by the inclusive category nature's benefits to people ("bold and black" category). For consistency across assessments, and to follow the spirit of the CF, authors of assessments are encouraged to use the inclusive "bold and black" categories as the starting point of their task, and then refer back to them in the conclusions, although more specific categories, strongly dependent on discipline, knowledge system and purpose are likely to be used in their analytical work during the assessment.

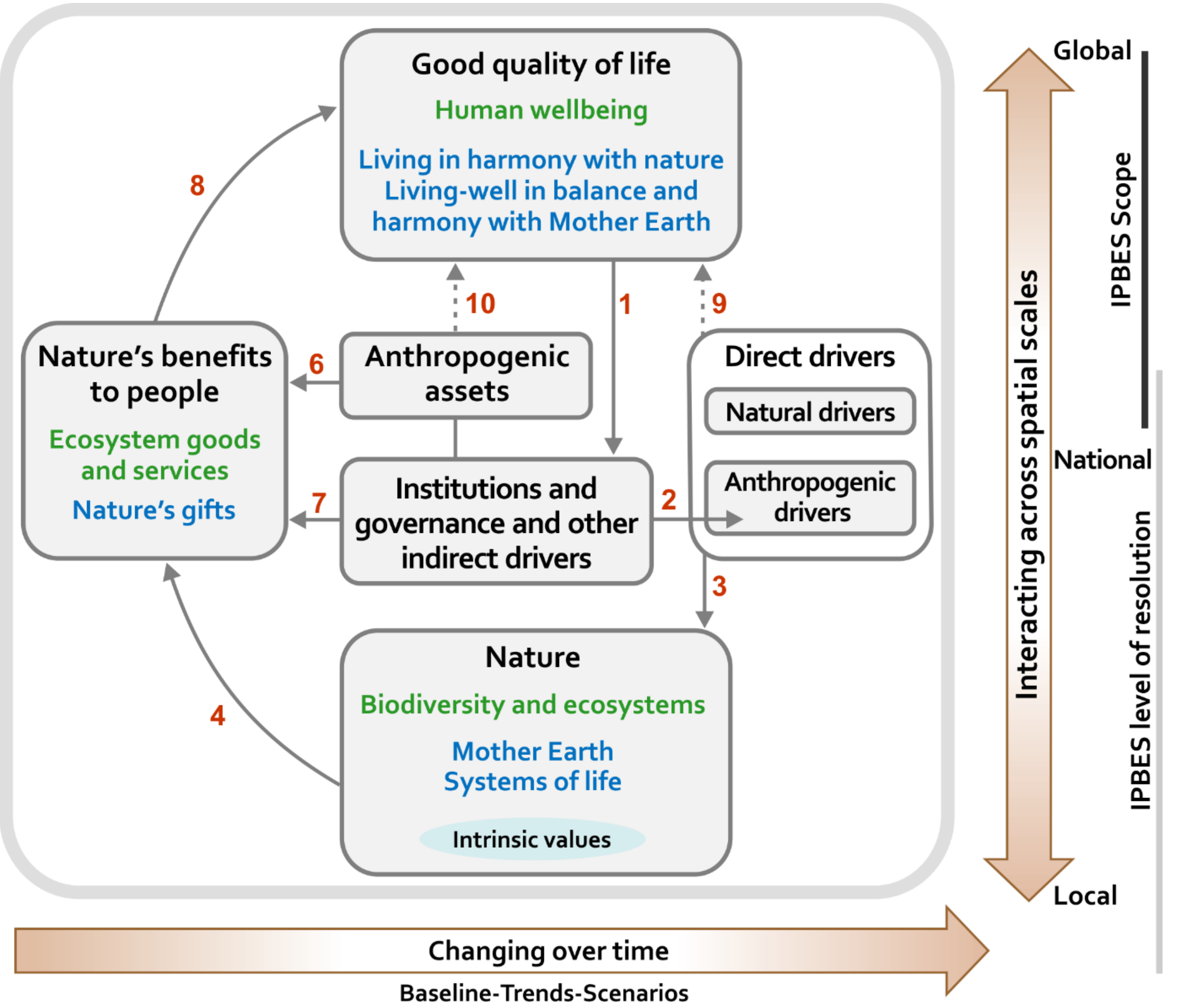

Figure 1.1: The analytical Conceptual framework of IPBES (CF). In the main panel, delimited in grey, boxes and arrows denote the elements of nature and society that are the main focus of the Platform. In each of the boxes, the headlines in black are inclusive categories that should be intelligible and relevant to all stakeholders involved in IPBES and embrace the categories of western science (in green) and equivalent or similar categories according to other knowledge systems (in blue). The blue and green categories mentioned here are illustrative, not exhaustive, and are further explained in the main text. Solid arrows in the main panel denote influence between elements; the dotted arrows denote links that are acknowledged as important, but are not the main focus of the Platform. Links indicated by a numbered arrow are described in the main text and illustrated in the boxed examples. The thick coloured arrows below and to the right of the central panel indicate that the interactions between the elements change over time (horizontal bottom arrow) and occur at various scales in space (vertical

arrow). The vertical lines to the right of the time arrow indicate that, although IPBES assessments will be at the supranational (subregional to global) geographical scales (scope), they will in part build on properties and relationships acting at finer (national and subnational) scales (resolution). This figure (extracted from Díaz et al. 2014 and Diaz et al. 2015) is a simplified version of that adopted by the Second Plenary of IPBES (IPBES-2/4), it retains all its essential elements but some of the detailed wording explaining each of the elements has been eliminated within the boxes to improve readability.

"Nature", in the context of the Platform, refers to the natural world with an emphasis on biodiversity. Within the context of western science, it includes categories such as biodiversity, ecosystems (both structure and functioning), evolution, the biosphere, humankind's shared evolutionary heritage, and biocultural diversity. Within the context of other knowledge systems, it includes categories such as Mother Earth and systems of life, and it is often viewed as inextricably linked to humans, not as a separate entity. Other components of nature (non-living natural resources), such as deep aquifers, mineral and fossil reserves, wind, solar, geothermal and wave power, are not the focus of the Platform. *Nature* contributes to societies through the provision of benefits to people (instrumental and relational values, see below) and has its own intrinsic values, that is, the value inherent to *nature*, independent of human experience and evaluation and thus beyond the scope of anthropocentric valuation approaches (represented by an oval at the bottom of the *nature* box in Figure 1.1).

"*Anthropogenic assets*" refers to built-up infrastructure, health facilities, knowledge -including indigenous and local knowledge (ILK) systems and technical or scientific knowledge-, as well as formal and non-formal education), technology (both physical objects and procedures), and financial assets, among others. *Anthropogenic assets* have been highlighted to emphasize that *a good life* is achieved by a coproduction of benefits between nature and societies (see *Nature's benefits to people* for further explanation).

"*Nature's benefits to people*" refers to all the benefits that humanity obtains from *nature*. Ecosystem goods and services are included in this category. Within other knowledge systems, nature's gifts and similar concepts refer to the benefits of *nature* from which people derive *a good quality of life*. The notion of *nature's benefits to people* includes detrimental as well as beneficial effects of *nature* on the achievement of a *good quality of life* by different people and in different contexts. Trade-offs between the beneficial and detrimental effects of organisms and ecosystems are not unusual and they need to be understood within the context of the bundles of multiple effects provided by a given ecosystem within specific contexts. For example, wetland ecosystems provide water purification and flood regulation but they can also be a source of vector-borne disease. In addition, the relative contribution of *nature* and *anthropogenic assets* to a *good quality of life* varies according to the context. For example, the level at which water filtration by the vegetation and soils of watersheds contributes to quality of life in the form of improved health or reduced treatment costs is based in part on the availability of water filtration by other means, for example, buying bottled water from another location, or treating water in a built facility.

Nature provides a number of *benefits to people* directly without the intervention of society, for example the production of oxygen and the regulation of the Earth's temperature by photosynthetic organisms; the regulation of the quantity and quality of water resources by vegetation; coastal protection by coral reefs and mangroves; and the direct provision of food or medicines by wild animals, plants and microorganisms. Many benefits, however, depend on or can be enhanced by the joint contribution of *nature* and *anthropogenic assets*. For example, some agricultural goods such as food or fibre crops depend on ecosystem processes such as soil formation, nutrient cycling, or primary production as well as on social intervention such as farm labour, knowledge of genetic variety selection/modern breeding and farming techniques, machinery, storage facilities and transportation.

The importance of **nature's benefits to people** can be expressed through a diverse set of valuation approaches and methods (briefly presented in Chapter 2 and discussed in further detail in Chapter 5).

Drivers of change refers to all those external factors (i.e. generated outside the CF element in question) that affect *nature*, *anthropogenic assets*, *nature's benefits to people* and a *good quality of life*. *Drivers of change* include *institutions and governance systems and other indirect drivers*, and *direct drivers* -both natural and anthropogenic (see below)**.**

"Institutions and governance systems and other indirect drivers" are the ways in which societies organize themselves (and their interaction with nature), and the resulting influences on other components. They are underlying causes of change that do not get in direct contact with the portion of nature in question; rather, they impact it –positively or negatively- through *direct anthropogenic drivers*. Institutions encompass all formal and informal interactions among stakeholders and social structures that determine how decisions are taken and implemented, how power is exercised, and how responsibilities are distributed. Various collections of institutions come together to form governance systems, that include interactions between different centres of power in society (corporate, customary-law based, governmental, judicial) at different scales from local through to global. Institutions and governance systems determine, to various degrees, the access to, and the control, allocation and distribution of components of *nature* and *anthropogenic assets* and their *benefits to people*. Examples of institutions are systems of property and access rights to land (e.g. public, common pool, or private), legislative arrangements, customary laws, treaties, informal social norms and rules, and international regimes such as agreements for the protection of endangered species of wild fauna and flora, or against the stratospheric ozone depletion. 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. Many drivers of human behaviour and preferences, however, which reflect different perspectives on a *good quality of life*, work largely outside the market system.

"Direct drivers", both natural and anthropogenic, affect *nature* directly. ***"Natural direct drivers"*** are those that are not the result of human activities and whose occurrence is beyond human control (e.g. natural climate and weather patterns, extreme events such as prolonged drought or cold periods, cyclones and floods, earthquakes, volcanic eruptions). ***"Anthropogenic direct drivers"*** are those that are the result of human decisions and actions, namely, of *institutions and governance systems and other indirect drivers*. (e.g. land degradation and restoration, freshwater pollution, ocean acidification, climate change produced by anthropogenic carbon emissions, species introductions). Some of these drivers, such as pollution, can have negative impacts on *nature*; others, as in the case of habitat restoration, can have positive effects.

"Good quality of life" is the achievement of a fulfilled human life, a notion which varies strongly across different societies and groups within societies. It is a context-dependent state of individuals and human groups, comprising access to food, water, energy and livelihood security, and also health, good social relationships and equity, security, cultural identity, and freedom of choice and action. From virtually all standpoints, a *good quality of life* is multidimensional, having material as well as immaterial and spiritual components. What a *good quality of life* entails, however, is highly dependent on place, time and culture, with different societies espousing different views of their relationships with nature and placing different levels of importance on collective versus individual rights, the material versus the spiritual domain, intrinsic versus instrumental values, and the present time versus the past or the future. The concept of human well-being used in many western societies and its variants, together with those of living in harmony with nature and living well in balance and harmony with Mother Earth, are examples of different perspectives on a *good quality of life*.

1.1.2 Interlinkages between the elements of the conceptual framework

A society's achievement of *good quality of life* and the vision of what this entails directly influence institutions and governance systems and other indirect drivers (arrow 1 in Figure 1.1) and, through them, they influence all other elements. For example, to the extent that a good life refers to an individual's immediate material satisfaction and individual rights, or to the collective needs and rights of present and future generations, it affects institutions that operate from the subnational scale, such as land and water use rights, pollution control, and traditional arrangements for hunting and extraction, to the global scale, as in subscription to international treaties. The views of what constitutes a *good quality of life* also indirectly shape, via institutions, the ways in which individuals and groups relate to nature. Perceptions of *nature* range from *nature* being considered as a separate entity to be exploited for the benefit of human societies to *nature* being seen as a sacred living entity of which humans are only one part.

Institutions and governance systems and other indirect drivers affect all elements and are the root causes of the *direct anthropogenic drivers* that directly affect *nature* (arrow 2 in Figure 1.1). For example, economic and demographic growth and lifestyle choices (*indirect drivers*) influence the amount of land that is converted and allocated to food crops, plantations or energy crops; accelerated carbon-based industrial growth over the past two centuries has led to anthropogenic climate change at the global scale; synthetic fertilizer subsidy policies have greatly contributed to the detrimental nutrient loading of freshwater and coastal ecosystems. All of these have strong effects on biodiversity, ecosystem functioning and their derived benefits and, in turn, influence different social arrangements intended to deal with these problems. This may be seen, for example, at the global level, with institutions such as the United Nations Framework Convention on Climate Change, the Convention on Biological Diversity, the Convention on the Conservation of Migratory Species of Wild Animals or, at the national and subnational levels, arrangements in ministries or laws that have effectively contributed to the protection, restoration and sustainable management of biodiversity.

Institutions and governance systems and other indirect drivers also affect the interactions and balance between *nature* and *human assets* (arrows 5, 6, 7) in the co-production of *nature's benefits to people*, for example by regulating urban sprawl over agricultural or recreational areas. This element also modulates the link between *nature's benefits to people* and the achievement of *a good quality of life* (arrow 8), for example, by different regimes of property and access to land and goods and services; transport and circulation policies; and economic incentives as taxations or subsidies. For each of *nature's benefits* that contribute to a *good quality of life*, the contribution of institutions can be understood in terms of instrumental value, such as access to land that enables the achievement of particular dimensions of human wellbeing such as food, water or energy, or in terms of relational values, spiritual beliefs and regimes of property that both represent and allow human lives deemed to be in harmony with nature. The links between *nature* and *anthropogenic assets* are not by definition negative and they do not necessary trade off in every case. Different bio-cultural systems are living examples of how different knowledge systems and physical practices create and maintain biodiversity (e.g. the many cultivated varieties of rice, potatoes, maize and other crops obtained from wild relatives and maintained by ancestral and contemporary agricultural societies; the highly diverse meadows and pasturelands maintained by traditional pastoral use). Many cultures around the world also have spiritual and religious practices in which certain places, water bodies, forests, animals, trees are considered sacred, serve as totems, are protected by rituals and taboos, and/or are revered as gifts imbued with ancestral and divine presence and significance. *Nature* and *good quality of life* influence each other. Different societies experience different elements of the natural world (different animals, different vegetation types, different seasonal and decadal cycles); and they do so with different immediacy (from everyday intimate contact to sporadic contact through the mass communication media). These are important factors shaping their perspectives on a *good quality of life*.

Direct drivers cause a change directly in *nature* (arrow 3) and, as a consequence, in the supply of *nature's benefits to people* (arrow 4). *Natural drivers* of change affect *nature* directly, for example, the impact by a massive meteorite is believed to have triggered one of the mass extinctions of plants and animals in the history of life on Earth. Furthermore, a volcanic eruption can cause ecosystem destruction, at the same time serving as a source of new rock materials for fertile soils. These drivers also affect *anthropogenic assets* directly (arrow not shown), such as the destruction of housing and supply systems by earthquakes or hurricanes; they can also have direct impacts on *quality of life* (arrow 9), as may be seen with heat stroke as a result of climate warming or poisoning as a result of pollution. In addition, *anthropogenic assets* directly affect the possibility of leading a *good quality of life* through the provision of and access to material wealth, shelter, health, education, satisfactory human relationships, freedom of choice and action, and sense of cultural identity and security (arrow 10). These linkages are acknowledged in Figure 1.1 but not addressed in depth because they are not the main focus of the Platform.

1.2 How to apply and adapt the conceptual framework

In order to follow the general goal and spirit of IPBES, each assessment should follow the steps set out below. Three case studies demonstrating the application of the CF can be found in Boxes 1.1-1.3.

Step 1. Use the CF as theoretical and methodological scaffolding

Consider all the different elements (boxes) of the CF and the interlinkages between them (arrows). The inclusive categories (black and bold font in Figure 1.1) should be used at least at the starting point and in the synthesis stage, to ensure general consistency across IPBES products. An effective way of doing this is through a "mapping out" exercise, in which specific content is assigned to the different boxes and arrows of Figure 1.1 within the context of the assessment. For example, in the case of the thematic assessment of the impacts of pollination and pollinators on food production, pollinator networks could embody the *nature* box, pollination services in the production of food would be the focal aspect within the *nature's benefits to people* box, although other benefits could also be considered, such as the cultural values derived from the pollinated plants or from the pollinators themselves.

Step 2. Consider the broadest possible set of values of nature and its benefits to people.

The CF encourages broad consideration of the full suite of values in all IPBES assessments. A major distinction adopted in the CF is between intrinsic values and anthropocentric values, including instrumental and relational values. Intrinsic values are those inherent to *nature*, independent of human judgement, such as non-human species' inherent rights to exist. Intrinsic values of *nature* as defined here thus fall outside the scope of anthropocentric values and valuation methods. Within anthropocentric values, instrumental values are closely associated with the notion of *nature's benefits* as far as they allow people to achieve a *good quality of life,* be it through spiritual enlightenment, aesthetic pleasure or the production or consumption of a commodity. They are generally linked to economic values (including, but not restricted to monetary valuation) as they reflect the extent to which they confer satisfaction to humans either directly or indirectly. Relational values therefore they depart from an economic valuation framework; they are imbedded in desirable (sought after) relationships, including those between people and *nature* (as in 'living in harmony with nature'), regardless of whether those relationships imply trade-offs to obtain nature's benefits. Relational values are also related to the notion of held values because specific principles or moral duties can determine how individuals relate with nature and with other individuals. Therefore, all *nature's benefits to people* have instrumental values and relational values, and often a given aspect of *nature* (a species, an ecosystem, a network of ecological interactions) can provide more than one *benefit to people*, with different instrumental and relational values (see Box 1.1). These two broad categories of values can be expressed in diverse ways within the CF as they can be experienced in a non-consumptive way (both relational and instrumental values) or through consumption (specific instrumental values), and they can range from spiritual inspiration (both relational and instrumental values) to market-based values (specific instrumental values). They also include existence value (the satisfaction obtained from knowing that nature continues to be there) and future-oriented values. These future-oriented values include bequest value (the preservation of nature for future generations) or the option values of biodiversity as a reservoir of yet-to-be discovered uses from known and still unknown species and biological processes, or as a constant source, through evolutionary processes, of novel biological solutions to the challenges of a changing environment (see Chapter 5).

Step 3. Contemplate different disciplines, knowledge systems and stakeholders right from the start

Different disciplines, knowledge systems and stakeholders should be considered throughout an assessment: in the definition of the major questions to be addressed, the collection of evidence, and the synthesis of findings and options for policy and practice. It is essential to engage indigenous and local peoples, as well as sciences from different disciplines, from the earliest stages of an assessment. This gives the opportunity for their perspectives to influence the framing of the assessment as well as contributing information. Most importantly, a dialogue between knowledge holders is the basis for fruitful engagement.

The first step is to identify relevant ILK networks (see e.g. Box 1.1). ILK may be held '*ex-situ*', for example in books, videos and collections; and '*in-situ*' in the living cultural systems based on oral traditions and performances. Dialogue workshops between scientists help to identify ILK relevant to various boxes and arrows in the CF in a 'mapping out' exercise. Holding dialogue workshops between scientists and ILK holders can enable the diverse perspectives to influence the framing, such as through assigning content, and identifying examples of high quality *in-situ* ILK, as mentioned above. After initial dialogue, relevant information can be gathered through engaging concurrently with collection and draft syntheses of *ex-situ* and high-quality examples of *in-situ* knowledge. Finally, catalysing the synergies between the ILK and western science contributions requires further dialogue focused on synthesis. For a discussion of approaches to these dialogues, and to issues of validity and recognition of the evidence coming from different streams of knowledge, see Chapter 7.

Box 1.1. Example of application of the CF to assessments – Marine wild fisheries

There are more than 28,000 fish species recorded in 43 ecoregions in the world's marine ecosystems and probably still many more to be discovered (*nature*). With a worldwide network of infrastructure such as ports and processing industries, and several million vessels (*anthropogenic assets*), about 78 million tons of fish are caught every year (arrow 6). Fish are predicted to become one of the most important items in the food supply of over 7 billion people (*nature's benefits*). This is an important contribution to the animal protein required to achieve food security and livelihood security (*good quality of life*), especially within the subsistence sector of developing countries.

Campaigns and promotion of the benefits of fish protein have induced changes in consumption patterns (arrow 8) and have brought about an increased demand for fish in the global markets with an improvement in the diet (*good quality of life*). This, together with the dominance of private short-term interests over collective long-term interests, weak regulation and enforcement of fishing operations, and perverse subsidies for diesel, are *indirect drivers* underlying (arrow 2) the overexploitation of fisheries by fishing practices (*anthropogenic direct drivers*) that, because of their technology or spatial scope or time scale of deployment, are destructive to fish populations and their associated ecosystems. In many case, lack of recognition of the *formal and informal institutions* of indigenous and local peoples and their customary marine tenure systems is a further *indirect driver*, that allows their sustainable knowledge and use systems to be over-ridden by the practices of actors that carry out larger-scale commercial operations to supply fish into the global economy. The impacts of these practices are combined with those of chemical pollution associated with agriculture and aquiculture runoff, the introduction of invasive species, diversions and obstructions of freshwater flows into rivers and estuaries, the mechanical destruction of habitats, such as coral reefs and mangroves, and climate and atmosphere change, including ocean warming and acidification. All *anthropogenic direct drivers* affect marine biodiversity directly (arrow 3).

The steep decline in fish populations can dramatically affect nature, in the form of wildlife, ecological food webs, including those of marine mammals and seabirds, and ecosystems from the deep sea to the coast (*nature*). Increasingly, depleted fisheries have also had a negative effect on *nature's benefits to people* and the *good quality of life* that many societies derive from them, in the form of decreases in catches (*nature's benefits to people*; arrow 4), reduced access (arrow 8), and the impaired viability of commercial and recreational fishing fleets and associated industries across the globe *(anthropogenic assets*). In the case of many small-scale fisheries in less developed countries, this disproportionally affects the poor and women (*quality of life)*, either through direct displacement by industrial and commercial fishers, or by declines in harvests in their areas (*nature's benefits to people)* due to industrial pressure elsewhere (*indirect divers*). In some cases it also affects *nature* and its *benefits to people* well beyond coastal areas, for example by increasing bushmeat harvest in forest areas and thus affecting populations of wild mammals such as primates, and posing threats to human health (*good quality of life*).

Institutions and governance systems and other indirect drivers at the root of the present crisis can be mobilized to halt these negative trends and aid the recovery of many depleted marine ecosystems (*nature*), fisheries (*nature's benefits to people*) and their associated food security and lifestyles (*good quality of life*). Examples include strengthening and enforcement of existing fishing regulations, such as the Code of Conduct for Responsible Fisheries of the Food and Agriculture Organization of the United Nations (FAO), the zoning of the oceans into reserves and areas with different levels of catch effort, enhanced control of quotas and pollution, recognition of indigenous and local peoples' customary marine tenures and sustainable use systems. In addition, anthropogenic assets could be mobilized towards this end in the form of the development and implementation of new critical knowledge, such as fishing gear and procedures that minimize by-catch, or a better understanding of the role of no-catch areas in the long-term resilience of exploited fisheries.

Step 4. Identify relevant scales for the assessment

Scale should be considered both in terms of the scope of reporting and of the information used as raw material for the assessment. The Platform will focus on supranational (from subregional to global) geographical scales for assessment. The properties and relationships that occur at these coarser spatial scales will, however, be partially linked to properties and relationships occurring at finer scales. For example, the thematic assessment on the impacts of pollination and pollinators on food production is to report at the regional to global scales, but can usefully use case studies at the landscape scale, including those with indigenous and local peoples, as raw material. The most relevant time scales are years to decades, with trends over millennia mostly beyond the scope of the assessment.

Identify the possibly different scales of the elements and linkages that affect the focal issue of the assessment. For example, possible declining trends in pollinators in a region may be related to direct drivers at the regional scale (e.g. agricultural intensification), which in turn could be driven by institutions and socio-economic trends at the same scale, as well as much larger scales, such as global demand for grains, or institutions favouring the use of pesticides. For further details see Chapter 2.

Step 5. Carefully consider institutions, governance systems and other indirect drivers and their close links with visions of a good quality of life.

These drivers are given high prominence in the CF as root causes of the present state of *nature* and *nature's benefits to people*, and are perceived as key points of action in order to improve trends. They therefore need to be considered in detail. Focusing predominantly on *direct drivers* without a proper consideration of the indirect drivers that underpin them often leads to ineffective or incomplete solutions.

Step 6. Identify options for policy and practice, as well as state, trends and scenarios for the future.

These options should also have an identifiable scale, and be assigned to specific boxes and arrows of the CF. Options can be clearly related to policy-relevant findings and contexts. For example, take a possible measure aimed at improving pollinator health. Is it based on changes in how much unploughed land is left in agricultural landscapes (arrow 3); does it consist of changes in technology and/or the way in which farmers handle pollinators nesting sites (arrow 6); or is it related to changes in international and national regulation of trade in bees or in bee products (arrow 7). Consider carefully distinguishing the findings and related options to address it (usually there will be more than one). Identify the specific arrow that a proposed policy or practice option targets. Consider whether there are policy relevant findings that would enable identification of where the problem is primarily located, and therefore which are the priority interventions. However, recognise that often further information about the policy context and policy windows that are outside the scope of these assessments will be needed for effective prioritisation.

Box 1.2. Example of application of the CF to assessments – Terrestrial invasive species

Invasions by alien species, whether transported unintentionally from other regions or intentionally introduced for agriculture, forestry, horticulture or other human activities produce critical changes in biodiversity and ecosystems (*nature*). Alien species invasions have increased exponentially over the last decades due to increased globalization and associated transport of goods, trade in agricultural products or wood, and demand for exotic horticultural species and pets *(institutions and governance systems and other indirect drivers*; arrow 2*)*. These introduced species meet favourable conditions for their expansion as a result of a number of *direct anthropogenic drivers* that modify the availability of resources or the capacity of native communities and food webs to resist invasion (arrow 3). Examples of these *direct anthropogenic drivers* are forest clearing, physical disturbance of soils, increased nitrogen deposition, widespread pesticide use, and changes in temperature and rainfall and extreme events (floods, cyclones, fires).

Invasions are estimated to have caused average local declines of almost 25% of species richness across taxa and biomes (*nature;* arrow 3). In Boreal and Northern temperate forests, the impact of biological invasions are stronger than those of other causes of biodiversity loss, such as habitat loss and land-use change (which are prevalent causes of species loss in the tropics). For instance, in the case of plants, introduced species tend to exclude native plant and animal species, increase biomass production, accelerate nutrient cycling, decrease water run-off and promote more frequent fires. Introduced vertebrates modify habitat structure by consuming vegetation (e.g. introduced deer deeply affect forest structure on islands), are predators of native species (e.g. foxes and stoats in Australia and New Zealand), and can be dispersers of invasive plants (e.g. introduced frugivorous birds spreading *Rubus* species and guava in Indian Ocean island forests). Alien arthropods and pathogens directly affect crop and forest production and can also disrupt native food webs. Ants, for example, have led to the decimation of crab populations on Christmas Island in the Indian Ocean and the loss of seabird populations on many islands; avian malaria is one of the factors responsible for the extinction of endemic birds in Hawai'i; and taro leaf blight has been responsible for the cessation of a multi-million dollar loss of taro production, the main staple food and export crop in Samoa. An estimated cost to the global economy of $1.4 trillion a year results from invasive species management costs plus direct negative impacts of invasive species on multiple *nature's benefits to people*, such as crop or wood production, and availability of drinking water and hydropower, and on human health and security (*good quality of life*) (arrow 4).

The assessment and management of alien species invasions (arrow 3) therefore is a critical challenge for the maintenance or improvement of human well-being (arrow 8). The first priority must be to prevent invasions by addressing the demand for exotic species (visions of a good *quality of life*), strengthening the *institutions* around the trade and transport of potential invaders, and for the detection of potentially invasive species and the detection and monitoring of their spread once introduced. Community-based monitoring by indigenous and local peoples is a key front-line opportunity in this context. For already established invaders, control by biological agents can be an efficient solution, where risks to non-target species are low, and where eradication processes are designed together with indigenous and local peoples to respect customary institutions and values associated with the target species. Native predators or pathogens of the problem species may be available and have been weakened by past or ongoing management. Then, restoration of suitable habitat for source populations or engineering of green infrastructure will facilitate control of problem species such as crop weeds and pests (*nature*, arrow 3). Introduction of control agents has also been successful in some instances, although unintended cascading effects are a strong risk. This has been the case for the cane toad introduced to Australia to control pests decreasing sugar cane production, but which has turned into a major pest itself spreading to natural ecosystems, killing native reptiles and upsetting associated food webs (*nature*). In all cases, it is most likely that successful control of introductions and invasions will require a combination of *institutional* change (arrow 2), management of natural or modified ecosystems (arrow 3), understanding of different views and priorities concerning invasive species, careful manipulation of control agents and possible innovations such as genetic change, all of which must be supported by the continued development of knowledge and financial and human resources (*anthropogenic assets*).

Also, beyond the intended *benefits to people* of intentionally introduced species, in some cases alien species can also provide unintentional or unforeseen benefits. First, introduced species may provide biodiversity conservation benefits by providing habitat or food resources to rare species, serving as functional substitutes for extinct taxa (*nature*), and providing *benefits to people* such as soil retention in areas submitted to increasing intense rainfall events, or increased soil fertility by nitrogen fixation. Perceptions about whether an alien species is a pest or an asset are highly influenced by world-views and experiences (arrow 5); for example Martu people in western Australia value non-native cats as a food source, and have incorporated them into their systems of customary law and lore. Evidence suggests that cats arrived several centuries before British occupation of Australia, perhaps from visiting Dutch boats. Second, it has been speculated that alien species might contribute to achieving conservation goals in the future because they may be more likely than native species to persist and provide *benefits to people* in areas where climate and land use are changing rapidly (*natural and anthropogenic drivers*). In general, the emergence of so-called 'novel ecosystems' (*nature*) assembled around alien species may be an inevitable feature of the future, and welcomed by some as sources of *nature's benefits to people*. Community-based monitoring by indigenous and local peoples is a key front-line option that also enables identification of cases where novel ecosystems are considered from the perspective of both their benefits and disbenefits (losses) to various sectors of society. In this context, changes in societal values (*visions of a good quality of life*) and a renewal in *institutions* may need to be better understood and supported in order to foster adaptation to such changes.

Box 1.3 Example of application of the CF to assessments – The benefits of pollinators in food production

Many animals are considered important pollinators: bats, butterflies, moths, birds, flies, ants, non-flying mammals and beetles. Bees are the most important of these. There are approximately 20,000 identified bee species worldwide, inhabiting every continent except Antarctica (*nature*).

Pollination is important for maintaining the populations of many plants, including wild and cultivated species considered useful or important by people (*nature's benefits to people*, arrow 4). It is critical in agricultural systems; ~75% of our global crops are pollinator-dependent. The global value of pollination for commercial food production has been estimated at approximately $351 billion (USD)/yr; in addition it contributes to the subsistence agricultural production that feeds many millions of people worldwide (arrows 4 and 8). Therefore, a substantial decline in pollinator populations threatens food production for both local consumption and global food markets.

Aside from pollination benefits, there are also products directly produced from some species of bees such as honey, pollen, wax, propolis, resin, royal jelly and bee venom (*nature's benefits to people*), which are important for nutrition, health, medicine, cosmetics, religion and cultural identity (*good quality of life*, arrow 8). There are some societies that are particularly vulnerable to pollinator declines such as indigenous communities and/or local subsistence farmers, whose *quality of life* will be disproportionally affected by a decrease in pollinator communities. For example, indigenous communities that rely on stingless bee honey, as both a sweetener and medicine, would be more affected than people in urban centres with access to an array of alternative sweeteners, medicines and remedies in the case of a local stingless bee population decline. There are also many links between bee populations, the honey they produce and cultural values. For example, in the case of the Tagbanua people of the Philippines, honey collecting is tightly linked to their community's cultural belief system (i.e. bee deities and spirits) and traditional swidden farming practices. If bee populations were to decline in these areas, aspects of the Tagbanua culture and farming practices may be lost.

Pollination benefits will become increasingly more important as the demand for pollinator-dependent crops increases with growing human populations (*good quality of life and indirect drivers*, arrow 1). For example, in the United States, fruit and vegetable imports (representing demand) has tripled in the last two decades. Many of these products include pollinator-dependent crops such as citrus fruits, strawberries, berries, tropical fruits, peaches, pears, and apples.

Land use change (i.e. habitat loss, fragmentation, conversion, agricultural intensification, urbanization etc.), pollution, pesticides, pathogens, climate change and competing alien species are *direct anthropogenic drivers* that threaten pollinator populations (*direct drivers*, arrow 3). Some potential indirect drivers behind them include human population growth, global economic activity, and science and technology. For instance, large-scale agricultural production involving the combined use of genetically modified crops, new pesticides and agricultural machinery reduce food resources and nesting habitats for pollinators. *Direct drivers* can act in tandem, for example, the phenomenon of Colony Collapse Disorder (CCD) describes the effect of several combined factors (i.e. pesticides, disease, and mites) causing losses of approximately 30-35% of hives of managed honey bee (*Apis mellifera*) in the United States and some European countries (arrows 3 and 4), which has affected some sectors of their agricultural economies (arrow 8). It is not only managed honey bees that are declining, but there is strong evidence that wild bee populations are also decreasing in some regions, many of which are efficient crop pollinators.

Besides affecting the *nature's benefits to people* described above, the adverse effects of pollinator declines can affect nature in other ways; for example loss of pollinators can cause changes in wild plant diversity (arrow 3) which might in turn can impact on animal communities, including birds, mammals and insects, dependent on these plants for food, shelter and other resources.

Institutions and governance, and other indirect drivers, affecting pollinators and pollination benefits include policies for agri-environmental schemes, environmental stewardship schemes, and conservation and trade policy for honey bee hive transport (arrows 2, 7). For instance, in some parts of Europe agri-environment and stewardship schemes provide monetary incentives to farmers who adopt biodiversity- and environmentally-friendly management practices. A specific example comes from Switzerland, where an agri-environment scheme called 'ecological compensation areas' (wildflower strips, hedges or orchards etc.) maintained at a minimum of 7% of the land, were found to house a significantly higher pollinator community compared to farms without 'ecological compensation areas'. Two international efforts, the Indigenous Pollinators Network and the Sentimiel Program, aim to construct a network of cooperative initiatives, traditional beekeepers and honey harvesters, farmers, and indigenous and local people to strengthen knowledge concerning pollination by sharing and engaging with the scientific community, hence strengthening *anthropogenic assets* and *institutional arrangements* that contribute to bees' diverse *benefits to people* (arrows 5, 6, 7).

There are a number of regional and national initiatives specifically focused on pollinators, targeting all types of communities on different scales, (visions of a *good quality of life*) that play an important role in connecting people, encouraging knowledge and data sharing, and mainstreaming pollination and biodiversity towards conservation (*institutions and governance and other indirect drivers, nature's benefits to people* and *good quality of life*, arrows 7 and 8). For example, the Pollinator Partnership, which is a nonprofit organization focused on the protection of pollinators in North

America, initiated National Pollinator Week. This national celebration aims to raise awareness and educate citizens on issues related to pollinator conservation. Another example is the Brazilian Pollinator Initiative (BPI) and the Rede Baiana de Polinizadores (REPOL) organizing the International Pollinator Field Course, which trains and educates researchers, teachers and conservationists on the topic of pollination and pollinator conservation.

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Chapter 2: IPBES assessments across scales

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2.1. Scales in assessments - key terms and concepts

In a general sense, "scale" means a reference system of measurements to compare quantities. In this guide, scale is defined in both a spatial and a temporal sense. In a spatial sense, scale can refer either to the (i) extent of study, which is the physical size (e.g. area) of the entity under inquiry or to the (ii) grain of study, which is the size of the smallest unit for which unique information is available. In ecology, these dimensions are defined by the physical boundaries of the area (e.g. an ecosystem, a watershed or a biome) and the size of the biological units under study (e.g. an individual or the entire population of a species). In social sciences, these dimensions refer to units of governance (e.g. administrative boundaries of countries and regions) and/or social organisation (e.g. household, local community, nation etc.). Here we use "social/institutional scale" to reflect the extent of the organisation of societies. In a temporal sense, "extent" means the time period over which observations or measurements are collected and "grain" means the time period which is necessary to collect one observation or measurement.

IPBES undertakes assessments at the global and near-global level and at different regional and subregional levels. The global, regional and subregional assessment levels have characteristic spatial scale, temporal process and social/institutional scales,(Table 2.1). These specific scales are referred to as 'core' scales in this guide.

Table 2.1. Scope of IPBES assessments of biodiversity and ecosystem services and their characteristic ('core') spatial scale, temporal process and social/institutional scales.

	Scales		
Scope	**Spatial**	**Temporal**	**Social/institutional**
Global	very large (Earth)	very long (10^5 years)	global (≈ UN)
Regional	large (≈ continental)	long (10^4 years)	continental (e.g. AU, EU/EEA, OAS)
Subregional	medium (≈ supranational)	historical (10^3 years)	supranational (e.g. ASEAN, CARICOM, CIS, MERCOSUR, NAFTA, SAARC)

Note. While spatial and institutional scales are directly linked with the assessment scope, the same is not true for the temporal scale (i.e., more than one temporal scale may fit a particular scope, depending on the focus of the assessment and data availability e.g. Global assessments often use short term data).

Biodiversity, and, as a consequence, ecosystem services provided by components of biodiversity, are intrinsically ***scale-dependent*** concepts. Biodiversity encompasses several entities at each level of the hierarchy of biological organisation from genes through individuals, populations, species and communities to habitats/ecosystems. ***Biodiversity patterns*** arise by the interaction of different components in different quantities in various spatiotemporal organization. For example, "patterns in species diversity" encompass the list of species, the quantity of all species and their spatiotemporal organisation. ***Biodiversity processes*** encompass all the past, present and future temporal changes in the identity, quantity and structure of components of biodiversity. The quantification of ***biodiversity patterns and processes*** will depend not only on the level of biological organisation studied but also on the ***spatial and temporal scales*** at which they are measured. For example, the species diversity can be considered at small spatial scales (e.g. diversity of macroscopic invertebrates in a stream) and large ones (e.g. diversity of macroscopic invertebrates in European river systems) and at small temporal scales (e.g. few days) to large ones (e.g. evolutionary times). Similarly, ***ecosystem services*** provided by the components of biodiversity will also depend on the spatial and temporal scales at which they are viewed and on the social/institutional scale as well (e.g., household vs. national) – that affects the demand side.

Assessments of biodiversity patterns and processes and ecosystem services thus need to consider the ***spatial and temporal scales at which biodiversity patterns and processes operate***. When small-scale patterns and processes are assessed at broad scales, or, when large-scale patterns and processes are addressed at small scales, ***scale mismatches*** occur, which can greatly undermine the efficiency of assessments and conservation actions (Cumming et al., 2006). Scale mismatches can also occur when ***coarse-grained ecosystems***, characterised by a few large components, are assessed at a grain size too small relative to the large components, which can result in superfluous measurements, too detailed information and in statistical non-independence of the measurements. Similarly, scale mismatches can occur when ***fine-grained ecosystems***, characterised by a larger number of smaller components, are assessed at a grain size too large relative to the smaller components, which can result in missing information on important small-scale variation within and among the components, overlooking key small-scale processes and biased estimates for the assessment. Although the concept of ***granularity*** of the studied ecosystem is relative, it needs to be considered when determining the grain size of the assessment to avoid mismatches. Thus there is a ***need to match the scales***, both in terms of extent and grain size, at which (i) the drivers shaping biodiversity patterns and processes operate, (ii) the ecosystems to be assessed function and provide services, and (ii) the assessment is carried out.

The IPBES Conceptual Framework classifies social-ecological systems that operate at various scales in space and time into six interlinked elements (see Chapter 1). Because the scope of IPBES assessments ranges from global to regional and, if necessary, subregional, these three spatial scales are given priority in this guide (Table 2.1), although many of the considerations are also valid at smaller scales (national, landscape, local).

"Nature" encompasses the natural world with a focus on biodiversity patterns and processes as well as ecosystem structure and functioning. There is increasing scientific knowledge regarding the scale-dependence of biodiversity patterns

"Anthropogenic assets" encompass infrastructure, knowledge systems, including indigenous and local knowledge (ILK), technology and financial assets, among others. The importance of each of these components will vary across scales ranging from global, through regional and subregional. For example, there will be different levels of infrastructure, e.g. roads and built-up areas, in different regions, which may have a bearing on biodiversity and ecosystem services. Similarly, financial assets are not distributed equally globally or regionally, whereas ILK will vary at even smaller scales (often locally). The scale-dependence of these assets thus need to be considered in assessments.

"Nature's benefits to people" encompasses all benefits that humanity obtains from the living natural world. Because these benefits are often delivered and perceived at the local scale (individuals, families, local communities), it is very important to assess both the scale at which benefits originate and the possibly multiple scales at which benefits are received. Moreover, in many cases, benefits will be reaped by people in other regions or subregions than those from where they are produced. A classic example for this is that of mountain regions which act as key sources of benefits for surrounding regions through their role of water towers and through cultural services. Therefore, there is a need for upscaling in assessments, i.e., to consider benefits arising at scales larger than the focal scale. It is also possible that nature's benefits are reaped by several different groups. For example, climate regulation by carbon sequestration e.g. by afforestation, may benefit people both at large and local scales.

"Drivers" may be direct and indirect ones as defined in the CF. ***"Direct drivers"*** encompass both natural drivers and anthropogenic drivers that affect nature. ***Natural drivers*** such as volcano eruptions, tsunamis etc. usually happen at small scales but can affect people over large scales through indirect effects (e.g. climate modification from volcanic ash). Other natural drivers such as solar storms can influence people over large scales. However, due to the unpredictable frequency and uncontrollability of such events, they are usually not considered in assessments.

"Anthropogenic drivers", on the other hand, should always be explored in assessments at any scale. Many drivers, such as ecosystem conversion, logging and fishing are self-evident, but one should be aware of drivers that act insidiously, for example, pollution and climate change. ***"Indirect drivers"*** operate by altering the level or rate of change of one or more direct drivers.

Drivers may be scale-invariant or scale-sensitive. ***Scale-sensitive*** means that the intensity and spatial or temporal heterogeneity/variability of the driver change with the scale at which the driver is assessed. Scale-sensitive drivers and the corresponding ecosystem impacts operate at different spatial and temporal scales. For example, habitat loss and degradation and fire have instant local impacts on biodiversity, e.g. a decreasing area of ecosystems, reduced abundance of populations and reduced migration, which may in turn result in local extinction and declining species richness. In contrast, climate change has a long-term, more gradually accumulating impact (decennia) on a much wider, continental and global scale. In general, drivers characterised by high impact, large scale and persistence have the largest share in total impact. The MA (2005) identified habitat loss and fragmentation, invasive species, population growth, pollution, over-exploitation and consumption, climate change and fire as the main direct and indirect drivers of ecosystem change at the global scale.

In terms of ***temporal scales***, it is important to consider how rapidly drivers and the biodiversity and ecosystem features change and account for uncertainty in the time span and frequency of measurements (Magurran et al., 2010). For example, it may suffice to monitor long-lived species on a less frequent basis than short-lived one, although monitoring change generally requires long-term data sets to be able to detect any change of low to moderate degree. Further, the uncertainty of distinguishing what is natural variability from anthropogenic change needs to be acknowledged (Magurran et al., 2010).

Lastly, there are interactions among drivers operating at different scales. Climate change (slow, large scale) results in changes in local fire regimes with potentially fast switches from fire free to fire prone ecosystems. One particularly important interaction and feedbacks in this case takes place between climate change and land use change. Conversely, effects of locally acting drivers may accumulate across spatial and temporal scales (Leadley et al., 2014). For example, incremental, small-scale habitat loss has accumulated and exceeded a threshold in many parts of the world, beyond which species that depend on that habitat rapidly decline to regional and even global extinction.

Ultimately, the appropriate spatial and temporal scales for each driver are ***specific*** to the context and the assessment. For instance, natural forest regeneration may be positive for biodiversity in one part of Europe (Proença et al., 2010), but negative in another (Eriksson et al., 2002). Similarly, ***different drivers*** may act at on biodiversity and ecosystem services ***at different scales*** (e.g. Tzanopoulos et al., 2013). For example, the primary driver for the diversity of a garden can be the diligence of its owner, for a park it can be the spreading of invasive plants, for a city the proportion of green infrastructure, and for a region the agricultural subsidy system. Moreover, there is no one single right spatial or temporal scale for each driver. However, scale-sensitive drivers generally require more spatially explicit data and more data for upscaling from local to regional or global levels. In addition, one needs to be aware of effects across the boundary of the study area as these may originate quite far from the study area. For example, upstream events, such as erosion, water regulation (dams, irrigation) and pollution will affect ecosystems, biodiversity and humans downstream.

Because assessment studies ultimately aim to analyse the role of ***nature*** for ***good quality of life***, it is necessary to understand the interrelationships of all the ecological and social components to define appropriate response options at different spatial and temporal scales (Liu et al., 2007). Therefore social scales also need to be defined for ecosystem services assessment (Martin-López et al., 2012). Social, political, and economic processes can be more readily observed at some scales than others, and these may vary widely in terms of duration and extent. Furthermore, social organisation scales have more or less discrete levels, such as the individuals, household, community, and higher levels groups that correspond broadly to particular scale domains in time and space.

"Institutions and governance systems and other indirect drivers" encompass the ways societies organise and regulate themselves and they influence all aspects of human relationships with nature. Institutions, their governance and their instruments (e.g. policies) have a hierarchy both within and above the level of nations, which need to be considered in assessments at any scale. The scale-dependence of institutions and governance systems is unique because the interactions across scales are often and increasingly regulated in a top-down way, i.e., larger-scale (e.g. global) institutions and governance systems likely influence smaller-scale (e.g. regional) institutions and governance systems. However, increasing attention is also being paid to the role of local scale governance in generating innovative solutions that can have large scale impacts (Ostrom et al., 1999).

The relevant institutions will obviously ***change with spatial scale*** from global through regional to subregional. In general, the institutions and governance systems at smaller scales are likely to differ more because smaller administrative levels will have institutions and governance systems developed for their local needs. However, because the institutions and governance systems of countries geographically closer to one another (e.g. countries of Europe vs. those of Africa) will likely be more similar, assessments at smaller, e.g. subregional, scales are also likely to encounter ***more similar institutions and governance systems*** than assessments at a larger, e.g. regional and global, scale. These differences and similarities may represent an increased risk of mismatches between the scales of institutions/governance systems and the scales of the biodiversity patterns and ecosystem services under assessment. Typical examples for increased risks of mismatches are watersheds stretching over administrative boundaries or ecosystems that span across several institutional units. Moreover, it is very typical that small-scale patterns in biodiversity and ecosystem services are influenced by larger-scale institutions and policies, for example, the number of African Grey Parrots in the wild can be closely linked to the limitations and restrictions set forth in the global Convention on International Trade in Endangered Species of Wild Fauna and Flora. Therefore, as a general rule, assessments at a certain scale need to consider the institutional/governance settings from higher scales.

"Good quality of life" is a multidimensional concept that has both material and immaterial/spiritual components to describe human well-being. Global scale assessment uses easily-accessible large-scale indicators. However, such indicators may not reflect what is considered good quality of life by people because this will be highly dependent on place, time, culture and society and thus there will be substantial variation related to the concept at smaller scales. This will also cause difficulties when aggregating from small to large scales, which involves integrating very heterogeneous elements such as different cultures, value systems etc. However, working at small scales enables the assessment to include specific views on what is considered as a good quality of life by different cultures and societal groups. This particularly relevant for the successful integration of indigenous and local knowledge.

Interactions and interlinkages across CF components – In addition to the inherent scale-dependence of the six elements of the CF described above, there are scale-sensitive interlinkages among the elements. These interlinkages across scales can be visualised as arrows between scale-layers of the six elements of the CF (Figure 2.1). In many cases, drivers and institutions from multiple scales will influence local, small-scale biodiversity and related local benefits of nature and quality of life. It is also possible that benefits from smaller-scale ecosystems will flow from the local to global scales. These cross-scale ***interlinkages need to be carefully explored, mapped and quantified*** in assessments carried out at any scale. The importance of such cross-scale linkages often justifies ***multi-scale assessments***.

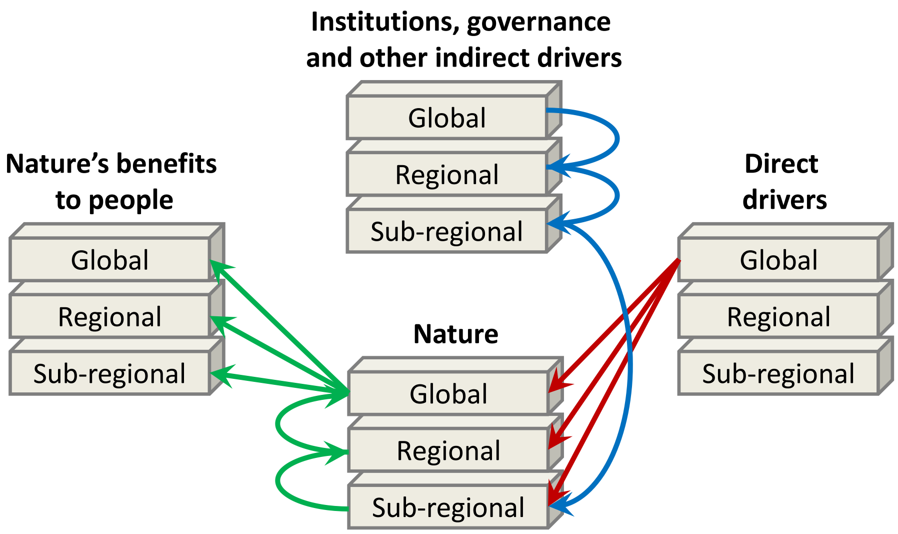

Figure 2.1. Part of the IPBES conceptual framework with the components extended to the three scales of IPBES assessments to depict cross-scale interlinkages between components. A global anthropogenic driver such as climate change will influence nature at each scale (global, regional, sub-regional, red arrows). In response, institutions and policy instruments may coordinate small-scale action to address global drivers such as climate change (blue arrows). In an ideal case, small-scale positive effects on nature will scale up to global levels, which will then influence nature's benefits to people at each scale (green arrows).

2.2. Multi-scale and cross-scale considerations

Assessments usually cover many issues; one scale may not be appropriate for all of them (Scholes et al., 2003; 2010; 2013). Both human and natural systems tend to have hierarchically nested subsystems (Kolasa & Pickett, 1991; Ostrom et al., 1999): a broad 'forest biome' contains many specific sorts of forests, within each there are patches of different history or environmental circumstances. Economic regions contain nation-states which contain provinces and local authorities, while values defining the criteria for a good life are constructed through the interactions between individual, household, local community and broader scales. In addition, it is critical in every assessment that mismatches are avoided between the scale at which ecological processes occur and the scale at which decisions on them are made. Thus, the adoption of a single scale of assessment limits the types of problems that can be addressed, the modes of explanations that are allowed, and the generalizations that are likely to be used in analysis. This leads naturally to the adoption of multi-scale and cross-scale assessments.

A multi-scale approach, defined as a structured hierarchical approach where individual assessments are performed at several scales and then integrated, is preferred for IPBES assessments if at all feasible. Multi-scale assessments have several benefits because they allow to uncover and understand the dynamics occurring at each scale and the complex cross-scale spatial and temporal linkages, they allow to engage stakeholders at different scales, and they can provide policy recommendations at the appropriate scale (Pereira, Domingos & Vicente, 2006; Carpenter et al., 2009). The implicit multi-scaling in the original Millennium Assessment conceptual framework was actually cross-scaling, considering that human wellbeing and biodiversity typically manifest themselves locally, but ecosystem services are often delivered at a larger scale, and indirect drivers and direct drivers mostly operate at even larger scales (Carpenter et al., 2006). Wisely choosing the scales associated with the various levels in the hierarchy for each of nature, anthropogenic assets benefits, drivers, institutions, and good life (see section 2.1) clarifies the core scale of interest for each level.

It is desirable to identify interlinked scales, to map out how they nest within each other spatially or temporally and integrate them upfront in the assessment design. This requires a hierarchical design centred on the core scale of the assessment, which encompasses the other scales relevant to explain the condition and trends observed at that scale. Figure 2.2 illustrates the respective nesting of scales for ecological systems and institutions, whose interactions underpin the dynamics of socio-ecosystems. One may also consider how the dynamics at the core scale spread to other scales and potential feedback mechanisms. A full cross-scale assessment (Scholes et al., 2013) asks questions such as: 'what is the effect of this at larger (or smaller) scales?' and 'how is this affected by processes at larger or smaller scales?' It enables in particular to account for 'slow variables', which typically operate at larger scales, and are especially important in controlling resilience properties (Biggs et al., 2012).

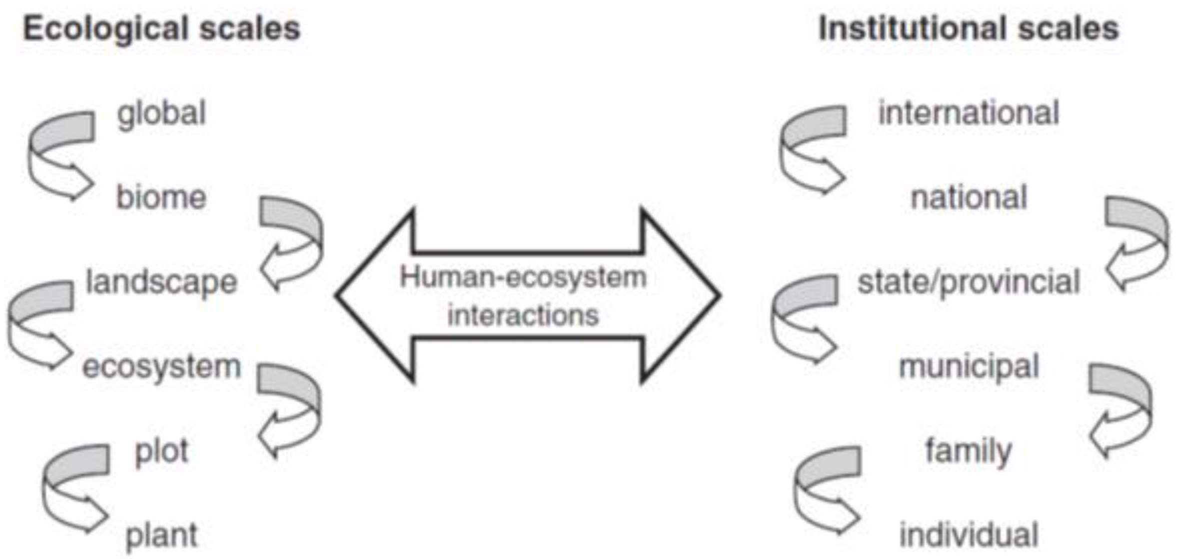

Figure 2.2. Nested ecological and institutional scales that determine human-ecosystem interactions and thereby flows of benefits from nature to societies (from Hein et al., 2006, adapted from Leemans, 2000)

Such structured multi-scale assessments are more likely to deliver clear and robust information for designing integrated response options, from local management approaches to sectorial policies. On the other hand, they are more demanding in terms of data needs, so that practical constraints mean not all biodiversity patterns or ecosystem services can be addressed at every assessment scale (MA, 2005). A judgement should be made about how much information is useful to the assessment's users.

Once a multi-scale assessment has been chosen, it is crucial to think carefully about common characteristics of the entire assessment area to allow comparison across scales or between assessments. A first step is to recognize and describe the socio-ecological context of the assessment (Redman, Grove, & Kuby, 2004; Seppelt et al., 2012) and explicitly think about the scale at which the assessment operates and can provide valid findings. A second step is to select a set of common biodiversity indicators and ecosystem services to assess in conceptually comparable ways across different scales or assessments. For instance, in the Southern African Millennium Ecosystem Assessment (SAfMA), which comprised separate assessments at three different spatial scales, each of these scales agreed to assess a common set of three services: cereal production, freshwater, and biodiversity (Biggs et al., 2004; van Jaarsveld et al., 2005). Each of the common services linked to food production and freshwater was assessed in terms of the difference between minimum per capita requirements and supply in each region, so that although these were assessed using completely different datasets and methods, they could be compared across scales (Biggs et al., 2004, van Jaarsveld et al., 2005). In addition to the common services, the assessment at each scale incorporated additional services of specific relevance or interest to the particular assessment region or scale, for instance medicinal plant use in local communities or air quality at the regional scale.

Cross-scale assessments will require upscaling and downscaling approaches. One of the greatest challenges is how to extrapolate or draw conclusions at large scales from estimates obtained at small scales, an approach called upscaling. Upscaling is in some cases quite straightforward, by aggregating with some weighting rule (for instance area occupied by terrestrial ecosystem; or number of people in a social system). In this instance, it is recommended to preserve both the averages and the distributional characteristics of data. Upscaling can for example enable the estimation of species richness in poorly sampled regions and taxa (Box 2.1), can be used to monitor biodiversity change across multiple scales, and can allow the inference of coarse-scale environmental or management changes from fine-scale observations and experiments. Downscaling, the opposite approach, is a promising way to extrapolate data from assessments conducted at different spatial scales. For example, downscaling can be applied when some parts of a large area are sampled, whereas others are not. Downscaling from the larger-scale study (sampled areas) to unsampled areas can provide reasonable estimates on whether a species is present or absent in the unsampled areas and these estimates can be projected as valid across the entire focal region. Disaggregating downwards is more tricky, as it is based on probabilistic estimates rather than deterministic ones, but is routinely done using some covariate for which a high-resolution coverage is available (such as altitude, for climate variables; Scholes, 2009). In some cases, scale translation is not at all straightforward, since the scaling rule may be non-linear, or the meaning or power of the variable may change between scales. For instance, transpiration is controlled by stomatal conductivity at the leaf scale, but by energy balance at the regional scale. These cases are interesting but relatively rare; they should be dealt with on a case-by-case basis using expert input.

Box 2.1. Upscaling and downscaling methods for estimating species diversity

Current upscaling approaches estimate the species-area relationship (SAR) for a larger geographical unit from small-scale measurements and then use the overall SAR to estimate total species richness at large scales. SARs arise partly because species composition will differ more among geographically more distant communities (similarity decay). The rate at which similarity declines with distance can be estimated from empirical samples, and this rate is closely associated with the slope of the SAR. Therefore, if we know the similarity decay and the species richness of samples collected at different distance classes, we can reasonably estimate species richness at larger scales. Several recent modelling approaches have been developed beyond this theoretical logic, and these models are now flexible enough to allow anthropogenic shifts in biodiversity scaling (e.g. the SAR will increase more slowly when the area is degraded) to be reflected in their results. A recent comparison of upscaling methods in the project SCALES (Kunin et al., 2012) suggested that the models with the best predictive accuracy are the ones that use incidence-based parametric richness estimator (Shen & He, 2008) or the analytic species accumulation (ASA) approach (Ugland et al., 2003).

Downscaling methods at present are confined to cases when information available at a large scale is used to predict the presence or absence (occupancy) of species at finer scales. A recent study (Azaele, Cornell & Kunin, 2012) showed that some methods can produce highly accurate estimates of fine-scale species occupancy, i.e., presence or absence of a species in a region, from large-scale patterns.

2.3. The types of assessment in IPBES and their scales

IPBES encompasses ***thematic assessments*** on specific questions such as pollination, land degradation, invasive alien species and sustainable use as well as ***methodological assessments*** on issues such as scenarios and valuation***.*** IPBES also conducts ***comprehensive assessments of biodiversity and ecosystem services***. These reflect issues at global, regional and subregional scales. Regional and subregional boundaries of such IPBES assessments do not necessarily follow the geopolitically defined UN regions that underpin the composition of membership in bodies under IPBES such as its Bureau and its Multidisciplinary Expert Panel (MEP). In defining such boundaries IPBES are exploring the following criteria, amongst others (Deliverable 2(b) scoping of regional assessments; IPBES/3/6):

(a) Biogeographic characteristics;
(b) Geographic proximity;
(c) Ecological and climatic similarities and barriers;
(d) Shared terrestrial and aquatic ecosystems and ecological features, such as migrating species;
(e) Interdependencies on ecosystem services, such as water catchments and food production;
(f) Social, economic, political, cultural, historical and linguistic similarities including existing regional mechanisms, institutions and processes.

Many ecosystem assessments are undertaken wither globally or at the spatial scales defined by administrative boundaries (i.e. regional, subregional, national and local). In these cases, the definition of the spatial scale is fixed for political reasons and it will influence the outputs and methodological approach of the assessment. It is important to reflect on the consequences of selecting administrative spatial scales to understand how this type of assessments might contribute to decision making and public policy processes at various levels (MA, 2005). Sometimes it is necessary to assess a specific ecosystem or ecological units. In these cases, the assessment would use different ecological spatial scales such as biogeographic regions (i.e. temperate forest), or a watershed (e.g. Amazonia). These ***focused assessments*** will be oriented towards the understanding of ecosystem processes that have the capacity to supply ecosystem services in a given area (Díaz et al., 2007) and can consider how trade-offs vary from ecosystems to benefits (Lavorel & Grigulis, 2012). Although the selection of ecological spatial units will generally ensure a better matching of the different spatial and temporal scales at which ecosystems operate, this is not necessarily the case for socio-economic systems, which have historically developed within and across ecological units and are better adjusted to cultural and/or administrative borders of regions.

Given the prerequisites described above beginning any assessment, it is essential to explicitly identify the scales for which the study is valid, because ultimately it will define the type of assessment (Figure 2.3).

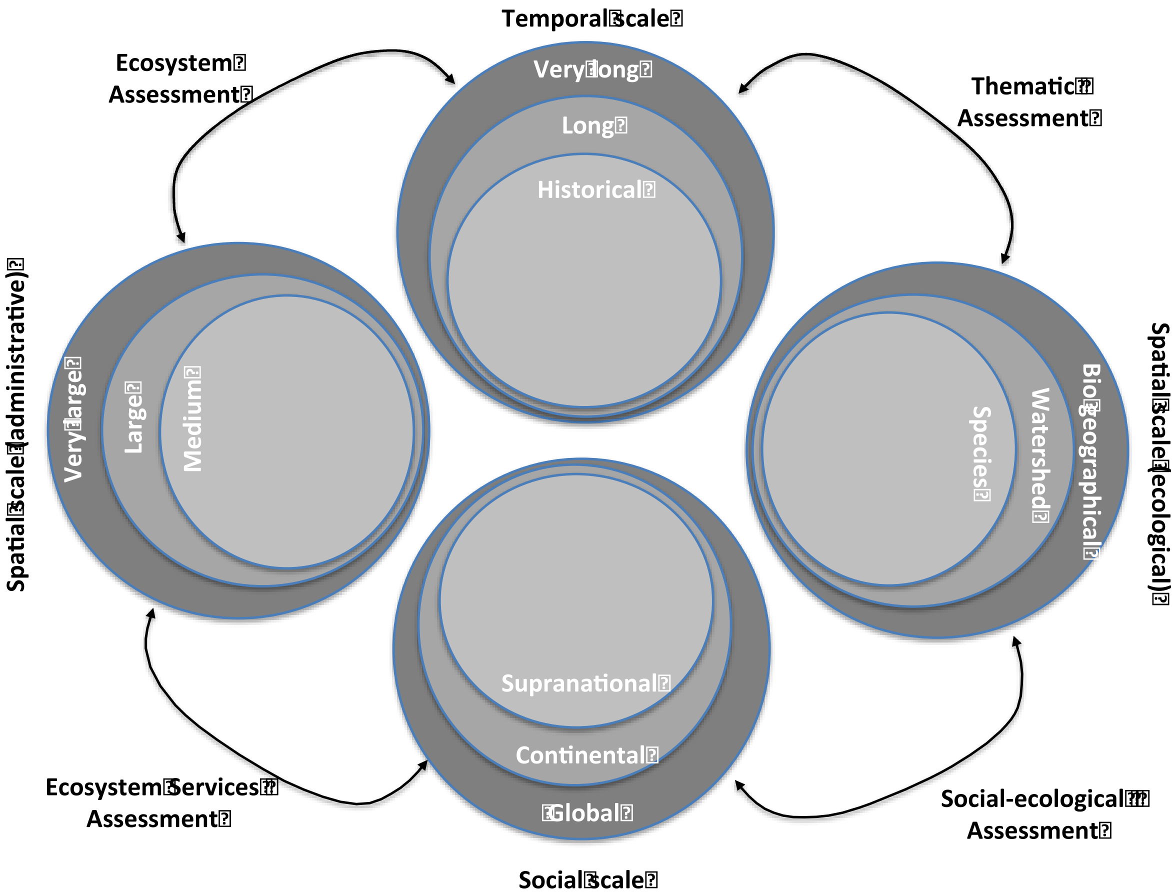

Figure 2.3. General relationships between the type of ecosystem assessments and the scales at which they are undertaken. Ecosystems assessment types in the figure present only a few examples with the purpose to show how social scales interact with ecosystems at different spatial and temporal scales (Inspired from Resilience Alliance, 2007 and Martín-López et al., 2009).

In the following the Guide highlights the key features for the different scales of assessment of IPBES: global, regional and subregional, considering also recommendations for national and local assessments.

2.3.1. Global scale

Global-scale assessments are, by definition, carried out at a very large spatial scale and ideally over very long temporal scales. Assessments applicable to large spatial scales however generally use spatially explicit data at low resolutions, which may hinder the detection of fine-scale patterns and processes. Even if data are collected at a fine level of detail, the aggregation of the findings at a larger scale means that local patterns and constraints may disappear (MA, 2005). Furthermore, large-scale assessments frequently use very large spatial and social/institutional scales but do not necessarily use long-term temporal scales. Thus there can be a potential mismatch between the ecologically relevant (long) time scale for large-scale processes and the small time scale of the assessment, which is often based on a snapshot of current biodiversity patterns and ecosystem services. An implication is that global scale assessments, in particular, may need to consider historical data in order to gain the deeper time perspective necessary for a robust understanding of some large-scale processes. Additionally, the relationships between large-scale processes means there will always be some unpredictability that makes it difficult to answer questions about future long-term processes and their interaction with behaviour on shorter time scales.

A global or regional ecosystem services assessment's methods will need to consider that most of the services are actually delivered at the local scale, although the results are often expressed over large scales such as nations. Thus, there is a need to aggregate information on local processes to the larger scale of the assessment. To deal with such issues the assessment would need to use some specific scaling rules, as for example up-scaling the ecosystem service demand (such as for cultural services) or down-scaling the impacts on ecosystems (such as by regionalizing the estimates of global climate change).

2.3.2. Regional and subregional scales

Regional and subregional scales differ from the global scale in several important aspects. The spatial scale for regional assessments is still relatively large (i.e., continental) and encompasses a wide range of environmental and biogeographical settings. Nevertheless, the regional scale offers an opportunity for a better understanding of the role that historical environmental and biogeographical factors played in shaping current patterns in biodiversity and ecosystem services than does the global level. For example, the impact of Ice Ages and the postglacial periods are now much better understood for some continents than for the entire globe. Thus, there is usually higher data availability and better opportunities for the use of temporal comparisons and longer time scales and for studying changes along temporal scales at the regional than at the global scale. At the institutional/social scale, assessment units will likely be more similar at the regional than at the global scale (c.f. regional political organisations such as the AU, EU, OAS etc.), although heterogeneities may still be an issue.

At the subregional scale, variation in the non-living environment including geography and climate is further reduced. The subregional assessment units share a common history and are likely to be environmentally and biogeographically more homogeneous than regions. Therefore, patterns in their biodiversity and ecosystem services are also likely to be more similar, for example, many of the subregional assessment units will correspond to the level of biomes in the biological organisation. These similarities make it likely that there is higher data availability for the assessments, or, when this is not the case, up- and downscaling methods and other techniques (e.g. species distribution modelling) will provide more reliable results and data for the assessments than at higher (regional, global) assessment scales. Assessments can thus be more detailed, and can build on national, subnational and local scales. There will also be higher similarity among assessment units along the social/institutional scales in subregions where countries share at least some of their socio-economic development and where countries have similar socio-economic systems. This scale offers the best opportunities for the integration of ILK and other knowledge systems.

2.3.3. National and subnational scales

Although IPBES assessments are intended to be carried out primarily at the global and regional, and, as necessary, at the subregional levels, IPBES also helps to catalyse support for subregional and national assessments, as appropriate (UNEP/IPBES.MI/2/9). In general, assessments of biodiversity and ecosystem services at the national scale are mainly based on the identification of indicators from available databases and through the use of expert judgment. In contrast, local case studies attempt to address trade-offs in ecosystem services at a finer level of detail using different methodologies, such as participatory assessment techniques based on the social perception of local actors, modelling of future scenarios, and biophysical evaluations of services and trends through local-scale indicators (Mouchet et al., 2014). On a national scale, most of the completed assessments have focused on explaining the relationship between the state of their ecosystem services and the direct causes of degradation. In many cases, other components such as indirect drivers of change or their implications for human wellbeing have been empirically excluded from the analysis because their relations with ecosystem services are not obvious, and time series data at the scale of assessment are often absent (Santos-Martín et al., 2013).

Local assessments are framed from the point of view of local stakeholders and therefore need to consider local constraints and processes as well as decisions and actions taken at that level (Resilience Alliance, 2007). However, to be effective, local assessments must adequately include relevant factors and determinants from larger scales in which they are embedded.

Moving towards national policies to implement actions at local scales for biodiversity management is a major challenge, since a national assessment can provide valuable insight at a broad scale that needs refinement to be relevant for a smaller domain. Whether it is possible to conduct a comparable assessment for local actions depends on (i) the application of explicit and compatible (or at least comparable) methods for the domain of interest, (ii) a good understanding of large-scale patterns and temporal trends of change in biodiversity and ecosystem services (Booney et al., 2009) and (iii) ensuring that information needed for the local analysis is adequate to solve the problems identified for multiple decision-making scales. To influence policies and their implementation at national scales, it is thus essential to combine broad assessments with finer-scale research to be able to attend to environmental problems at different levels of governance (Soberon & Sarukhan, 2010).

2.4 A roadmap for IPBES assessments across scales

The design of an ecosystem assessment should emerge from a collaborative process involving scientists, stakeholders and assessment users (MA 2005). User information needs, including information to guide policy making, should define the scope of the assessment. The selection of the scale or scales to be assessed should take into consideration data availability and/or the feasibility of obtaining new data, such as time, human resources, and monetary costs. This is particularly relevant in the design of multi-scale assessments as typically each new scale requires at least the doubling of resources needed. The roadmap below presents four main steps to be considered and re-iterated as necessary in order to identify the appropriate spatial, temporal and social/institutional scales for an assessment. Box 2.2 illustrates some of the challenges faced for some of the steps described here.

Step 1. Given the key questions and target stakeholders of the assessment, select appropriate scales for drivers, ecosystems, and institutions and governance

a) Use existing knowledge, publications, expert judgement to identify the core temporal and spatial scale for each of: biodiversity and ecosystems, nature’s benefits, drivers, institutions and governance, and quality of life.
b) Some of these scales might be prescribed by the nature of the assessment such as the extent (global, regional, sub-regional) for ecosystems and political jurisdiction, which can be supported by maps. The grain for these should still be identified beforehand based on existing knowledge and adjusted to data availability.
c) For drivers and institutions, carefully consider the multiple scales that are relevant for the focus of the assessment.
d) Try as far as possible to rationalise these into one or a few scales, with matching boundaries.

It is usually more practical to match ecological scales to administrative regions, than vice versa, since the decisions are based on the latter. However, from an ecological perspective ecologically defined assessment units may be more meaningful (e.g. watersheds, biomes).

e) Example: a regional assessment may comprise a mosaic of ecosystems distributed across several nations. The spatial extent of the region is prescribed for the assessment and defines that of biodiversity and ecosystems to be included. It is reasonable to first consider the resolution of data availability for biodiversity inventories and compare that to that of land use maps in order to identify the preferable grain for the quantification of ecosystem processes. If available historical biodiversity and land use data should be incorporated in order to document ecosystem trends and possible past legacies. Nature's benefit will be quantified for people living in the region (extent of the assessment), however it is also important to consider first how these benefits are distributed spatially across smaller traditional or administrative units where they translate into quality of life, and second whether benefits are derived to larger scales outside the region. Examples of the latter could be climate regulation or exported agricultural or forest commodities. The identification of drivers at the regional scale often starts with a land use map whose resolution determines the quantification of habitat extent and conversion (if time series are available) and of fragmentation. Survey data can provide maps of sources and extent of exotic species invasions, while climate change will be quantified from regional data sets and models whose resolution is often coarser than that of land use and biodiversity data.

Step 2: Decide if it is possible and necessary to carry out a multi-scale assessment

a) Use the above analysis (step 1) along with existing knowledge, publications and expert judgement to identify relevant adjacent temporal and spatial scales at which assessments should be carried out using a multi-scale nested approach (hierarchical design):

b) At sub-regional scale the assessment of biodiversity and ecosystem processes can be improved by first analysing watershed or landscape scales. At regional scale the overall analysis might proceed by up-scaling analyses of individual ecosystems.

c) Quality of life at regional scale might be best assessed by first analysing ecosystem benefits and their translation to quality of life for different cultural groups. Here, the identification of the relevant units for analyses might benefit from the knowledge of cultural landscapes and by integrating ILK on their definition.

d) As for step 1, for each of the smaller scales to be considered ecological and administrative or cultural boundaries need to be matched as best as possible so as to define the units of smaller scale assessment.

e) Example: a multi-scale assessment for a geographically diverse region could be designed based on the map of main ecosystems. Combining this with a map of cultural groups could be used to identify one option for the smaller scale of assessment. In case the resulting boundaries encompass several nations or autonomous administrative regions, sub-dividing these may be meaningful for the adequate assessment of anthropogenic assets and quality of life.

f) Evaluate benefits vs. difficulties (including data availability) and costs of a multi-scale assessment.

Step 3. If using a multi-scale assessment, this consists in first conducting the assessment at each of the selected lower scales (e.g. different ecosystem types of cultural areas) and second upscaling the resulting information

This implies the following additional elements:

a) To allow for comparison across scales or between assessments it is crucial to think carefully about common characteristics of the assessment area, in addition to focusing on unique or special features of the region. A first step is therefore to recognize and describe the socio-ecological context of the assessment (Redman, Grove, & Kuby, 2004; Seppelt et al., 2012)

b) Identify a core set of variables for each of biodiversity, benefits and drivers that should be documented at each spatial scale.

c) Use an expert thinking process (including scientists and stakeholders) to identify which ecological and social processes may operate cross-scale, and design a way of collecting information to understand and model such processes.

d) Depending on the important ecological processes of response to drivers and effects on benefits identify appropriate up-scaling methods of biodiversity and ecosystem functioning. Likewise for social processes identify up-scaling methods for benefits and quality of life.

e) Still take special care to consider benefits and impacts on quality of life beyond boundaries of the higher assessment scale considering off-site or downstream effects.

Step 4. Discuss with stakeholders your scale-related decisions, preferably by an iterative process (i.e. go back to step 1 if necessary)

It is important to note that if you involve additional scales (space or time) the stakeholder group may need to be adjusted to incorporate new stakeholders

Box 2.2. GEO Amazonia: challenges for an ecosystem multi scale assessment

GEO Amazonia was the first integrated environmental assessment for the region that took an ecosystem approach with the goal to contribute to policymaking and development planning. The assessment focused on biodiversity, forest, hydrological resources, aquatic ecosystems, agro-productive ecosystems and human settlements (UNEP 2009). The assessment reinforces the perception that the Amazonia is a region of great contrasts, not only considering physical- geographical aspects and its megadiversity, but also socio-culturally, economically, politically and institutionally.

This challenging project was organised by the United Nations Environmental Program (UNEP) and the Amazonian Treaty for Cooperation (ATCO). The technical coordination and execution of the process was led by Universidad del Pacífico (Lima-Perú). The countries involved in the GEO Amazonia process were those that belong to ATCO: Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela.

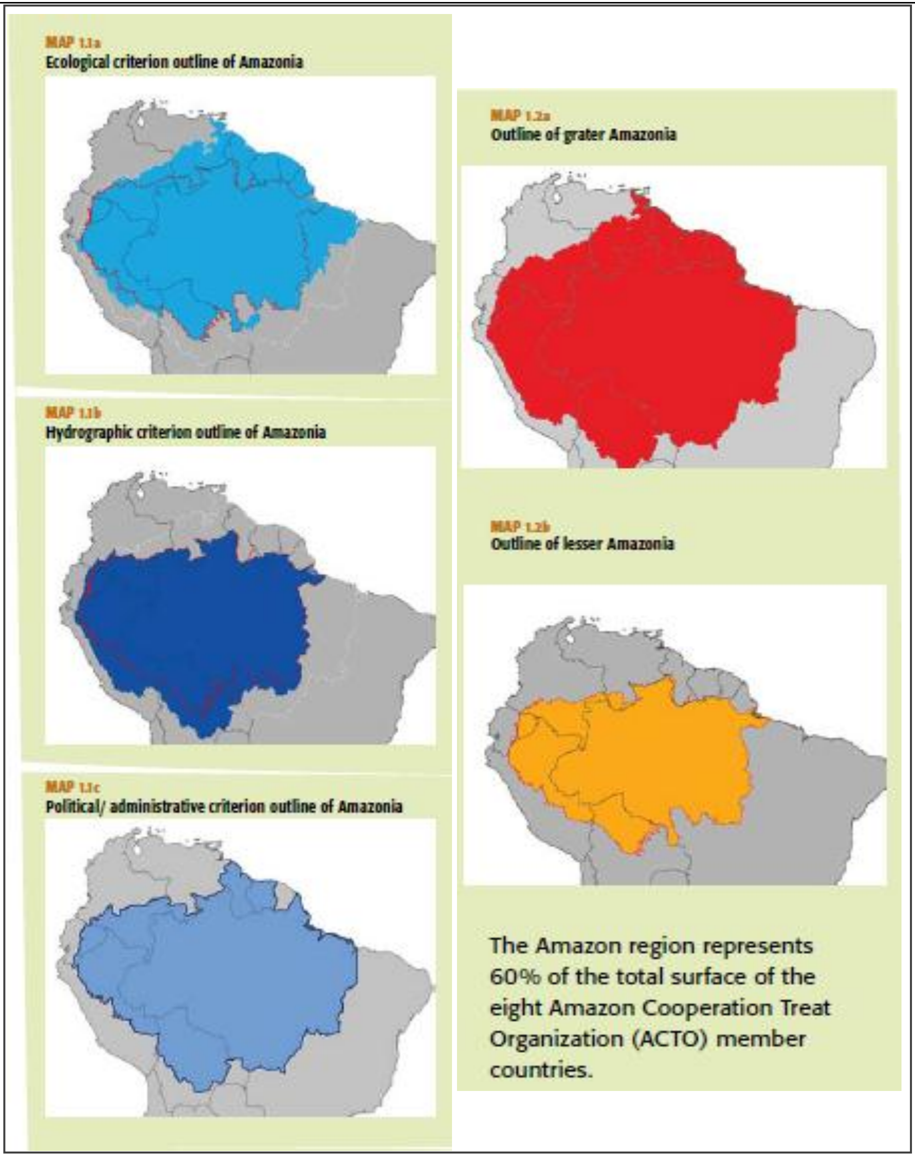

Figure. Ecological (Map 1.1), hydrographic (Map 1.2) and political/administrative (1.3) criteria used to reach an agreement amongst parties on the definition of the greater (Map 1.2ª) and the lesser Amazonia (Map 1.2b).

The GEO Amazonia process faced different challenges: to agree on the boundary of the Amazonia region; to establish criteria for selecting particular important issues with regional relevance, and handling country differences in data availability, among others. In the first case, three criteria were used to define the boundaries: ecological, hydrographic and political-administrative (Figure). These criteria were used to define a Major Amazonia and a Minor Amazonia. Major Amazonia is the maximum area based on at least one of the criteria. Minor Amazonia is the minimum area generated by the three criteria combined (Table). The Amazonian countries considered this approach appropriate.

Table. Amazonia area for ATCO countries based on ecological, hydrographic and political-administrative criteria

Amazonia	Total area	Conservation area	
	Km^2	**Km^2**	**%**
Major Amazonia	8,187,965	1,713,494	20.9
Minor Amazonia	5,147,970	1,159,387	22.5
World	134,914,000	13,626,314	10.1

Source: UNEP (2009)

The other challenge was to select specific examples that were relevant at the sub-national level, as well as the regional level. This selection was based on scientific information and experts' contributions. To do this, GEO Amazonia organized a group of researchers, Amazonia experts and policy makers to identify key examples of environmental degradation and ecosystem services conservation in Amazonia. It was very important to balance the representation of countries, given their great differences in size. Finally, differences in data availability, time frames and methodologies between countries limited the comparative analysis.

Despite the complexity involved, the preparation of GEO Amazonia was well managed because we shared a comprehensive, logical and easily understood framework. The framework is based on analysing the pressures and driving forces that affect the state of the main ecosystems. The key questions that organized the integrated environmental assessment were:

- What is happening with the environment in the Amazonia and why?
- What are the impacts of the environmental degradation on the human well-being?
- What actions are being taken to address the driving forces that affect the environment as well as the impacts on human well-being?
- What are the perspectives from and emerging issues in Amazonia?
- What are the proposals to drive a sustainable development in the Amazonia?

Like other GEO processes, GEO Amazonia is based on stakeholder participation, and is interdisciplinary and multi-sectorial. The development of GEO Amazonia took two years and finished with the publication of the report in three languages (Spanish, English and Portuguese). More than 150 scientists, researchers and policy makers from the Amazonian countries were part of the process.

2.5. Key resources

A current overview of scale issues in ecology and conservation is presented in Henle et al. (2014). A general introduction in scale issues and a useful dictionary for the meaning of scale-related terms is provided at the SCALETOOL portal (http://scales.ckff.si/scaletool). A seminal work on mismatches between ecological and societal scales is Cumming et al. (2006), while classic references for the hierarchical organisation of biodiversity is Noss (1990) and for environmental heterogeneity Kolasa & Pickett (1991). A worked example for both a multi-scale regional and a subregional assessment is provided by the South African Millennium Ecosystem Assessment (Scholes & Biggs, 2004; van Jaarsveld et al., 2005). Hein et al. (2006) provides a framework for the scaling of ecosystem services.

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Section II: Applying the IPBES Assessment Processes

This section is a guide to applying the IPBES Assessment Process. The overall structure for the IPBES Assessment Process has been agreed in Plenary and is set out in the IPBES Rules of Procedure (IPBES 2/17). The following chapters summarise this process in an accessible format and include further information to enhance this process, such as the use of uncertainty terms.

Chapter 3: The IPBES assessment process

3.1 Introduction

The IPBES plenary plans to make regular and timely assessments of knowledge on biodiversity and ecosystem services and their interlinkages. These assessments should include comprehensive global, regional and, as necessary, sub-regional assessments and thematic issues at appropriate scales and new topics identified by science and as decided upon by the plenary.

IPBES/2/17 states that assessment reports should be published assessments of scientific, technical and socio-economic issues that take into account different approaches, visions and knowledge systems. There are four types of assessment (See Introduction): global, regional, thematic and methodological. They are to be composed of two or more sections including a summary for policymakers, an optional technical summary, individual chapters, and executive summary.

A full ecosystem assessment should generally comprise of four stages: exploratory; design; implementation; and communication and outreach (Figure 3.1). Throughout the process, there should be continuous communication, capacity building and stakeholder engagement strategies. This section of the report discusses the process for undertaking an assessment, from its conception and initial scoping through to the presentation of the assessments findings.

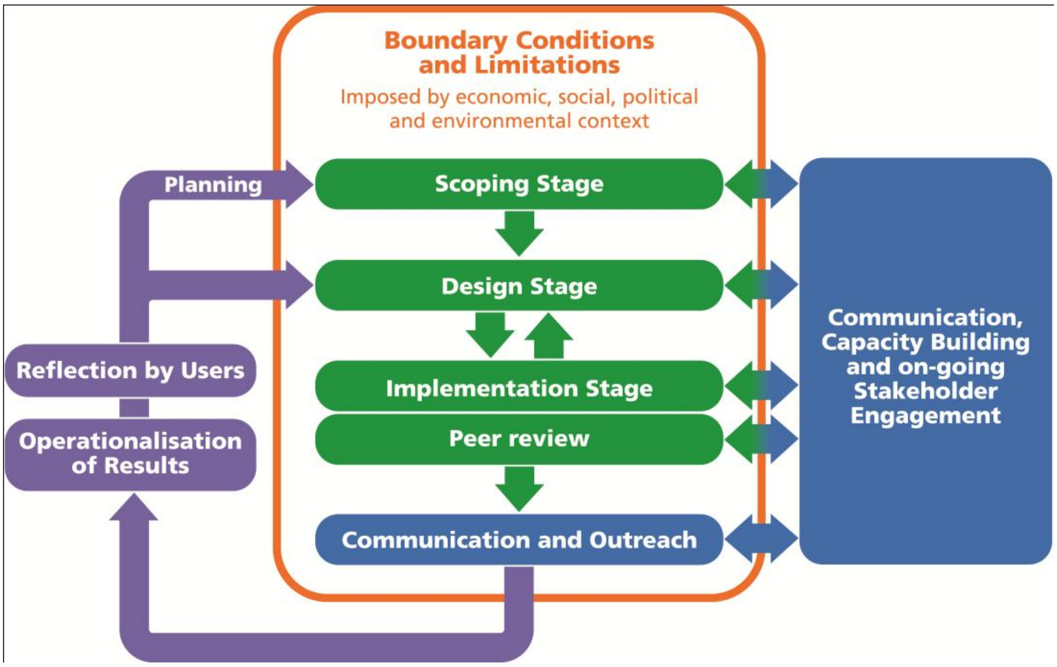

Figure 3.1. The ecosystem assessment process. Source: adapted from Ash et al. 2010.

3.2 The Exploratory Stage

The exploratory stage or scoping stage of an assessment investigates how and why an ecosystem assessment might be undertaken and generally has three main components:

1. Determining the need for an assessment
2. Defining the key questions the assessment will be designed to answer
3. Initial examination of potential design constraints

It can be helpful to convene a scoping study a technical and user planning group to address these issues and clarify the direction and applicability of applicability of assessment outputs (Box 3.1). The scoping process aims to define the scope and objectives of an assessment and evaluate the necessary information, human and financial requirements to achieve that objective. The scoping process should also consider the type and availability of knowledge, including local and indigenous knowledge (ILK) that is required to address the policy questions that have been identified. The scoping study should consider how this knowledge will be accessed and by whom. Identification of knowledge gaps is an important part of the assessment process that should also be considered during the scoping process.

Box 3.1 Scoping study for a National Ecosystem Assessment in Germany

In 2014, an interdisciplinary team at the Helmholtz Centre for Environmental Research (UFZ), in collaboration with external scientists, undertook a scoping study to investigate implementation options for a National Assessment of Ecosystems and their Services for the Economy and Society in Germany (NEA-DE).

The study identified the needs of potential assessment stakeholders and addressed the political questions around the validity of outputs from a NEA-DE. Further conclusions to arise from this study include:

- identification of the social, political and economic context that NEA-DE could contribute to;
- objectives and potential research questions of a NEA-DE;
- modular implementation concept for the NEA-DE; and
- analysis of current data availability for a NEA-DE.

Two possible implementation concepts were presented: a complete assessment; or a more scaled down, focused assessment. The project team is planning a strategic workshop to take this information forward and develop a conceptual framework.

Source: Albert et al. 2014

3.2.1 Scoping studies under IPBES

The first stage in the IPBES assessment process is for requests, inputs and suggestions to be submitted to the IPBES Secretariat consistent with decision IPBES/1/3.These inputs and suggestions are then considered by the Multidisciplinary Expert Panel (MEP) and the Bureau[3].

The procedure for the scoping process of an IPBES assessment is shown in Figure 3.2. As part of the initial evaluation and prioritisation process, the MEP and Bureau will undertake an initial scoping of an assessment, including examining feasibility and estimated costs. This initial scoping study may also contain pre-scoping material, usually provided by the body making the original request for the assessment. Using

[3] See paragraph 7 and 9 of decision IPBES/1/3

this information the MEP, in conjunction with the Bureau, will prepare a report containing a prioritised list of requested assessments to be submitted to the Plenary. The report will contain an analysis of the scientific and policy relevance of the requests, including the implication of the requests for the Platform's work programme and resources requirements. The Plenary has two options: fast-track or detailed scoping. A fast-track assessment can go ahead with the detailed scoping study and proceeds to implementation without the need to further consider the outcomes of the scoping exercise. In other cases, the Plenary will request a detailed scoping before agreeing an assessment following recommendation by the MEP and the Bureau.

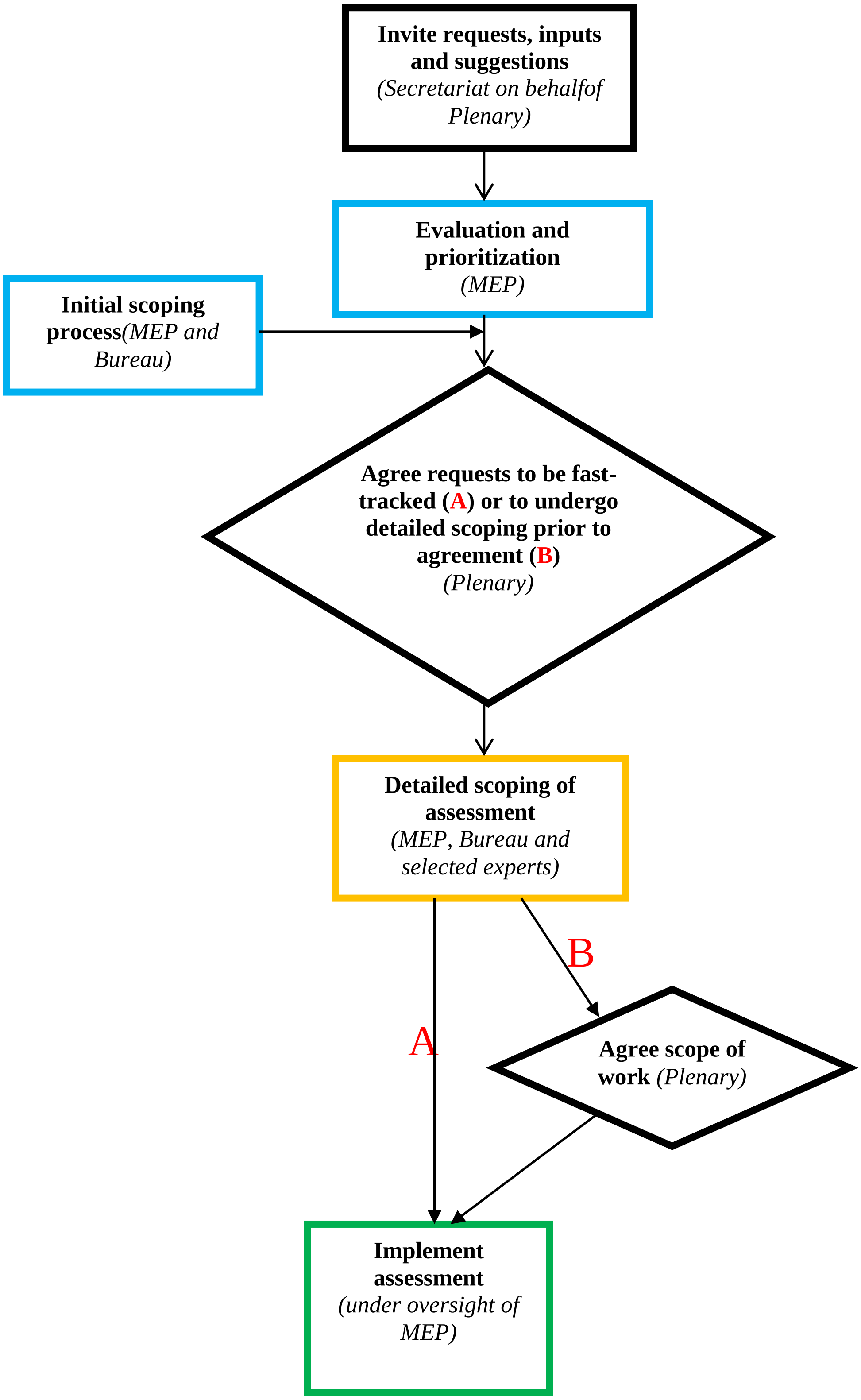

Figure 3.2 IPBES assessment scoping process (blue outline = Exploratory stage; orange outline = Design stage; green outline = Implementation stage). Source: adapted from IPBES/2/9.

The detailed scoping study will be conducted by experts selected from nominations from Governments and invited relevant stakeholders and will be overseen by the MEP and Bureau.

Following the scoping stage, and assuming acceptance by the Plenary, the Plenary will then formally request the MEP to proceed with an assessment. The detailed scoping report that was produced as part of the scoping stage is then sent to members of the Platform for review and comment over a four-week period and made available on the Platform website. Based on the results of the detailed scoping exercise and comments received from members of the Platform and other stakeholders, the MEP and the Bureau then decide whether to proceed with the assessment, working under the assumption that it could be conducted within the budget and timetable approved by the Plenary.

3.2 The Design Stage

A work plan with clearly defined timelines and milestones makes it easier to monitor progress. Setting out a clear work plan can minimise problems by allowing for conflict resolution, providing a mechanism to monitor progress and enabling integration of the work into a single product.

The design stage explores the key features of the assessment including:

1. Governance Structure (who and how)
2. Conceptual Framework (assessment aims; see Chapter 1)
3. Scale (temporal/spatial; see Chapter 2)
4. Knowledge Sources (scientific, traditional; see Section 4)

Defining who will be involved in an assessment, and what their respective roles and functions will be, is critical for ensuring user engagement, raising funds, and overseeing assessment progress. Effective governance provides leadership and can ensure the relevance, legitimacy and credibility of the assessment process and its findings. The governance structure is dependent upon the size and scope of the assessment at hand, and can be made up of representatives from key audience groups such as community leaders, scientists and scientific institutions, technical experts, political leaders and other stakeholders (see Box 3.2).

Box 3.2 Key audience groups

The scoping phase should identify key audience groups. Early and consistent stakeholder engagement will help those conducting the assessment understand stakeholders' needs and priorities and so help to shape the production of relevant assessment outputs. The type and scale of the assessment will determine these key audience groups, however time and budget constraints may also influence the ultimate decision on where to target communication of the key messages. There may be a need to utilise different media for diverse audiences, e.g. articles, leaflets or workshops, and the increased costs of producing these varying outputs may be a limiting factor in achieving far-reaching dissemination across multiple audience groups.

Common audiences for assessment information include:

- Governments (various levels and various departments)
- Planners
- Politicians
- Researchers and analysts

- Non-governmental organizations
- General public
- Schools and universities
- Industries and business
- Women's groups
- Indigenous peoples' groups
- Media

Source: Ash et al., 2010

3.2.1 Who's who in an IPBES assessment

The Rules of Procedure[4] set out the function and nomination process for the different roles with in an IPBES assessment. From the nominations received The MEP will select the report co-chairs, coordinating lead authors, lead authors and review editors from nominations it receives, using the selection criteria set out in Box 3.3. The proportion of stakeholder-nominated experts should not exceed twenty percent[5]. The functions of these roles is summarised in Table 3.1.

Box 3.3 Selection of report co-chairs, coordinating lead authors, lead authors and review editors

The composition of the group of coordinating lead authors and lead authors for a given chapter, report or its summary should reflect the range of scientific, technical and socio-economic views and expertise; geographical representation, with appropriate representation of experts from developing and developed countries and countries with economies in transition; the diversity of knowledge systems that exist; and gender balance. The Multidisciplinary Expert Panel will inform the Plenary on the selection process and the extent to which the above-mentioned considerations were achieved therein, and on the persons appointed to the positions of report co-chairs, coordinating lead authors, lead authors and review editors for the various chapters. Every effort should be made to engage experts from the relevant region on the author teams for chapters that deal with specific regions, but experts from other regions can be engaged when they can provide an important contribution to the assessment.

The coordinating lead authors and lead authors selected by the Multidisciplinary Expert Panel may enlist other experts as contributing authors to assist with the work.

Source: IPBES/2/17

[4] IPBES2/3
[5] IPBES/2/17

Table 3.1 Summary of the different roles within an IPBES Assessment process

Role	Function	Nomination Process
Assessment co-chair	An assessments co-chair's role is to assume responsibility for overseeing the preparation of an assessment report or synthesis report and ensuring that the report is completed to a high standard.	Governments, the scientific community and other stakeholders are able to nominate appropriate experts for the roles of Co-chairs, CLAs and LAs in response to requests from the Chair of IPBES. In addition to a call for nominations Members of the Multidisciplinary Expert Panel and the Bureau will contribute, as necessary, to identifying relevant experts to ensure appropriate representation from developing and developed countries and countries with economies in transition as well as an appropriate diversity of expertise and disciplines, gender balance and representation from ILK holders. Such nominations will be compiled in lists that are made available to all Platform members and other stakeholders and maintained by the Platform secretariat. Experts with the most relevant knowledge, expertise and experience may only be chosen once an assessment topic has been fully scoped. Every effort should be made to engage experts from the relevant region on the author teams for chapters that deal with specific regions, but experts from countries outside the region should be engaged when they can provide an important contribution to the assessment. The nomination process will follow these steps: 1. Nominees will be invited to fill out an Application form and attach their Curricula Vitae through the dedicated web portal
Coordinating Lead Authors (CLAs)	A coordinating lead author's role within an assessment is to assume overall responsibility for coordinating the major sections and/or chapters of an assessment report. Coordinating lead authors are lead authors who, in addition to their responsibilities of a lead author, have the responsibility of ensuring that the major sections and/or chapters of a report are completed to a high standard and are collated and delivered to the report co-chairs in a timely manner and conform to any overall standards of style set for the document. Coordinating lead authors also play a leading role in ensuring that any cross-cutting scientific, technical or socio-economic issues of significance to more than one section of a report are addressed in a complete and coherent manner and reflect the latest information available.	
Lead Authors (LAs)	The role of a lead author is to assume the responsibility of producing designated sections or parts of chapters that respond to the work programme of the Platform on the basis of the best scientific, technical and socio-economic information available.	

Role	Function	Nomination Process
	Lead authors typically work in small groups that together are responsible for ensuring that the various components of their sections are put together on time, are of a uniformly high quality and conform to any overall standards of style set for the document. The essence of the lead authors' role is to synthesize material drawn from the available literature, fully-justified unpublished sources, contributing author's stakeholders and experts where appropriate.	(www.ipbes.net/applicationform.html) 2. The Application Form will automatically be sent to the Nominating Government or Organisation (Nominator) indicated by the Nominees with an email which will provide a link to a Nomination Form inviting the Nominators to approve and submit their nominations. 3. Nominators and Nominees will receive an acknowledgement
Contributing Authors (CAs)	A contributing author's role is to prepare technical information in the form of text, graphs or data for inclusion by the lead authors in the relevant section or part of a chapter. Input from a wide range of contributors is key to the success of Platform assessments. Contributions are sometimes solicited by lead authors but spontaneous contributions also encouraged. Contributions should be supported, as far as possible, with references from the peer reviewed and internationally available literature.	The coordinating lead authors and lead authors selected by the MEP may enlist other experts as contributing authors to assist with the work.
Review Editors (REs)	Review Editors carry out the following activities: (i) to assist the Multidisciplinary Expert Panel in identifying reviewers for the expert review process, (ii) ensure that all substantive expert and government review comments are afforded appropriate consideration, (iii) advise lead authors on how to handle contentious or controversial issues and (iv) ensure that genuine controversies are adequately reflected in the text of the report concerned. Responsibility for the final text of the report remains with the relevant CLAs. In general, there will be two review editors per chapter, including its executive summary. Review editors are not actively engaged in drafting reports and may not serve as reviewers for text that they have been involved in writing. Review editors may be drawn from among members of the Multidisciplinary Expert Panel, the Bureau or other experts as agreed by the Panel.	REs are nominated through the same process as authors.

Role	Function	Nomination Process
	Review editors must submit a written report to the Multidisciplinary Expert Panel and, where appropriate, will be requested to attend a meeting convened by the Multidisciplinary Expert Panel to communicate their findings from the review process and to assist in finalizing summaries for policymakers and, as necessary, synthesis reports. The names of all review editors will be acknowledged in the reports.	
Expert Reviewers	Expert reviewers are to comment on the accuracy and completeness of the scientific technical and socio-economic content and the overall balance between the scientific, technical and socio-economic aspects of the drafts according to their knowledge and experience.	Expert reviewers are identified by the MEP
Technical Support Unit (TSU)	Although the IPBES Secretariat is mandated to provide technical support to the expert working groups, it is probable that the technical support required will outstrip the capacity available. A number of solutions to this have been proposed including the creation of expert group specific technical support units: whose task is to coordinate and support the activities of working groups and task forces. Dedicated technical support units under the oversight of the Secretariat to coordinate and administer specific activities of expert groups, networks etc. Actual functions would vary depending on activities being undertaken by the body being supported. The IPCC runs under such a distributed model for technical support to its assessment working groups.	One possible mechanism for managing technical support may be through strategic partnerships which aim to use the expertise and experience of other organizations where this is relevant to supporting delivery of the work programme, in anticipation that this will provide a cost-effective approach if implemented in an appropriate manner.

3.3 The Implementation Stage

This is the technical stage of the assessment, which undertakes preliminary assessments of each of the focus areas identified in the scoping study. Work undertaken at this stage can include consideration of:

1. The **status and trends** of priority ecosystems and services and the associated drivers of change
2. **Scenarios** – development of descriptive story lines to illustrate the consequences of different plausible kinds of change in drivers, ecosystems and their services and human well-being (see Chapter 6)
3. **Valuation** of services – present and future; monetary and non-monetary
4. Analysing **response options** – i.e. Examining past and current actions that have been taken to enhance contribution of ecosystem services to human well-being

For most assessments, the key output will be a report detailing the methodological processes and technical findings of the assessment. However, in some cases the production of a series of tailored reports may be necessary in order to communicate effectively to all intended audience groups.

The first draft of this report should be prepared by the report co-chairs, coordinating lead authors and lead authors, with the secretariat maintaining communication between the authors and experts on assessment themes and expected timeframe. Lead authors must work on the basis of contributions submitted by experts. Peer-reviewed and publically available literature should underpin these contributions and any unpublished materials, including indigenous and local knowledge, must be cited accordingly (see Chapter 7). Assessment authors should be mindful of the language used in the preparation of the first draft and the range of scientific, technical and socio-economic evidence should be presented clearly and concisely (Box 3.4).

Box 3.4. Some useful writing suggestions for assessment reports

These suggestions are based on comments received during the Millennium Ecosystem Assessment peer review process.

• Discuss the problems and actions first. Any necessary background can come later, in an appendix or in references to other sources.

• Focus on definable measures and actions and avoid the passive voice. For example, policy professional are likely to ignore statements like "there are reasons to believe some trends can be slowed or even reversed". If there are some opportunities for reversal, state precisely what we believe they are, as best we know.

• Statements like "...might have enormous ramifications for health and productivity...," while they seem to the scientist to be strong because of the word "enormous" are actually politically impotent because of the word "might." If data were used in the assessment, what do they say about what "is" happening? What can we recommend, based on best knowledge, about what actions would be effective?

• Statements like "There is a long history of concern over the environmental effects of fishing in coastal habitats, but the vast scope of ecological degradation is only recently becoming apparent (citation)" is a case where something strong could be said, but it is weakened by putting the emphasis on the late arrival of this information and knowledge "becoming apparent." It does not matter so much when the degradation was discovered, what matters is that it was. Cite the source and say "fishing practices are causing wide-spread destruction."

• Do not use value-laden, flowery, or colloquial language (e.g. “sleeping dragon,” “elephant in the room,” etc.).

• Statements like “we do not yet have clear guidelines for achieving responsible, effective management of natural resources” could result in a legitimate policy response of “OK, so we’ll wait until we do.” Instead, the statement could be changed to recommend what needs to be done, such as “if clear guidelines were developed, then...”

Source: Ash et al., 2010

3.3.1 Developing an IPBES Assessment report

Assessment reports and synthesis reports prepared for the Platform require the report co-chairs, coordinating lead authors, lead authors, reviewers and review editors to produce “technically and scientifically balanced assessments” (IPBES 2/3). Following the relevant scoping study or studies, approval process, and selection of experts and authors, there are a number of steps to be carried out in the preparation of the Platform assessment report(s).These steps are dependent upon the type of assessment being undertaken (Table 3.2).

Table 3.2. Steps in preparation of Platform assessment report(s) following acceptance of the Scoping document by Plenary

Step	Standard–thematic or methodological assessments	Fast Track–thematic or methodological assessments	Regional, subregional or global assessments
1	The report co-chairs, coordinating lead authors and lead authors prepare the first draft of the report	The report co-chairs, coordinating lead authors and lead authors prepare first drafts of the report and the summary for policymakers	The report co-chairs, coordinating lead authors and lead authors prepare the first draft of the report
2	The first draft of the report is peer reviewed by experts in an open and transparent process	The first drafts of the report and the summary for policymakers are reviewed by Governments and experts in an open and transparent process	The first draft of the report is peer reviewed by experts in an open and transparent process. The review of regional and subregional reports will emphasize the use of expertise from, as well as relevant to, the geographic region under consideration
3	The report co-chairs, coordinating lead authors and lead authors prepare the second draft of the report and the first draft of the summary for policymakers under the guidance of the review editors and the Multidisciplinary Expert Panel	The report co-chairs, coordinating lead authors and lead authors revise the first drafts of the report and the summary for policymakers with the guidance of the review editors and the Multidisciplinary Expert Panel	The report co-chairs, coordinating lead authors and lead authors prepare the second draft of the report and the first draft of the summary for policymakers under the guidance of the review editors and the Multidisciplinary Expert Panel

Step	Standard–thematic or methodological assessments	Fast Track–thematic or methodological assessments	Regional, subregional or global assessments
4	The second draft of the report and the first draft of the summary for policymakers are reviewed concurrently by both Governments and experts in an open and transparent process	The summary for policymakers is translated into the six official languages of the United Nations and prior to distribution is checked for accuracy by the experts involved in the Assessments	The second draft of the report and the first draft of the summary for policymakers are reviewed concurrently by both Governments and experts in an open and transparent process
5	The report co-chairs, coordinating lead authors and lead authors prepare final drafts of the report and the summary for policymakers under the guidance of the review editors and the Multidisciplinary Expert Panel	The final drafts of the report and the summary for policymakers are sent to Governments for final review and made available on the Platform website	The report co-chairs, coordinating lead authors and lead authors prepare final drafts of the report and the summary for policymakers under the guidance of the review editors and the Multidisciplinary Expert Panel
6	The summary for policymakers is translated into the six official languages of the United Nations and prior to distribution is checked for accuracy by the experts involved in the assessments	Plenary reviews and may accept the report and approve the summary for policymakers.	The summary for policymakers is translated into the six official languages of the United Nations and prior to distribution is checked for accuracy by the experts involved in the assessments
7	The final drafts of the report and the summary for policymakers are sent to Governments for final review and made available on the Platform website		The final drafts of the report and the summary for policymakers are sent to Governments for final review and made available on the Platform website
8	Governments are strongly encouraged to submit written comments to the secretariat at least two weeks prior to any session of the Plenary		Governments are strongly encouraged to submit written comments to the secretariat at least two weeks prior to any session of the Plenary
9	The Plenary reviews and may accept the report and approve the summary for policymakers.		The Plenary reviews and may accept the report and approve the summary for policymakers.

3.3.2 Peer review process

The peer-review stage is a vital element in the assessment process, and should be given careful consideration from the outset. Comprehensive review processes can (as indicated in TEEB, 2013):

- provide guidance
- ensure robustness
- provide a fresh perspective
- augment results

- add legitimacy
- help to ensure greater buy-in to the findings

The selection of suitable peer-reviewers should not be restricted to scientists and assessment practitioners, but involve a range of assessment users. This will contribute further to stakeholder engagement while providing a broader set of comments through which to enhance the assessment's perceived legitimacy (Ash et al., 2010).

The logistical side of peer review can be complicated so you need to allocate adequate time and resources for this process during the design stage. It is advised that one or two members of the assessment team are designated as a central contact point in order to deal with administrative tasks, such as the distribution of assessment materials and collation of review comments. Select peer-reviewers as early as possible and tell them: when the assessment outputs will be available; what the format and size of outputs will be (e.g. number of chapters and/or pages); what sections they are expected to comment on; and deadlines for submission of comments. This will allow them to prepare their own time schedules and maximize their engagement in the process.

It is crucial that peer-reviewers are given clear guidance, including:

- a background to the assessment;
- the timeline for peer-review;
- what reviewers are expected to comment on e.g.
    - the overall direction and content of the report
    - methods and analysis
    - overarching conclusions
    - whether there is any additional material that should be considered for inclusion;
- how to submit comments (i.e. email, post or online);
- how the reviewer will be acknowledged in the report (if applicable);
- how their comments will be addressed by the respective authors; and
- when outputs are expected to be disseminated.

A review template can be provided to all peer-reviewers to make it easier to collate comments submitted (see Table 3.3). When preparing the documents for peer review, consider including section, page and line numbers so that these can be recorded by the reviewer in the review template.

Table 3.3. Example of a review template

Section number	**Page number**	**Line number**	**Comment**
1	*2*	*3*	*xxxxx*

3.3.2.1 IPBES peer review process

The MEP and Bureau will assist the authors in ensuring the reports are peer-reviewed in accordance with the present procedures (IPBES2/3). This includes ensuring adherence to the three governing principles of

Platform report peer-review: the provision of preeminent expert advice; ensuring comprehensive independent representation; and following a transparent and open process (Figure 3.3).

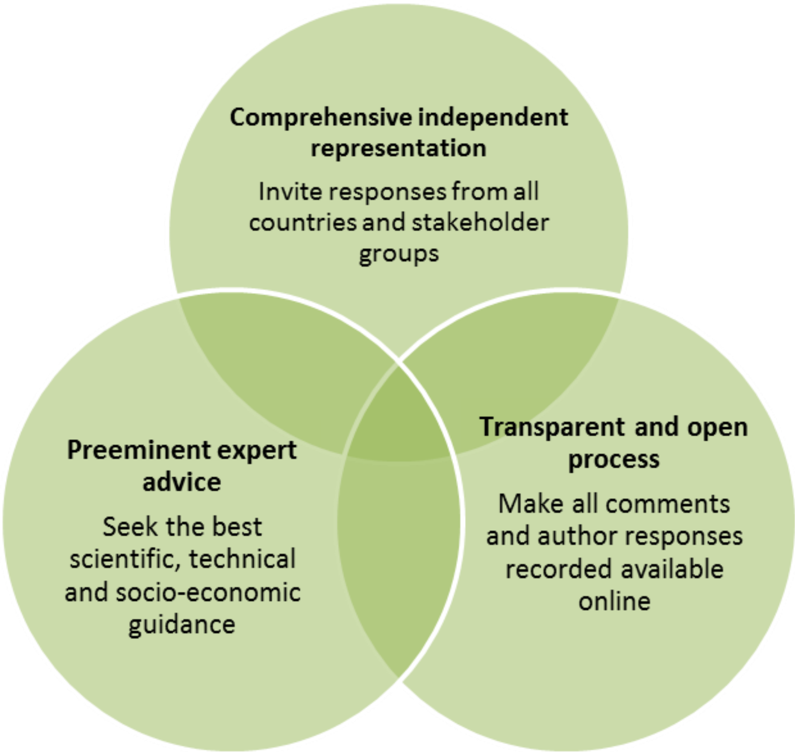

Figure 3.3.Three principles of Platform report review processes

The review process for Platform reports normally consists of three stages, which should be coordinated in a timely manner according to the type of assessment undertaken (IPBES2/3):

1. Review by experts(first review);
2. Review by Governments and experts(second review);
3. Review by Governments of summaries for policymakers and/or synthesis reports.

All written review comments by experts and Governments will be made available on the Platform website during the review process. The draft Platform reports and author responses to review comments will be made available as soon as possible following the finalization of the report.

First review (by experts)

The MEP circulates the first draft of a report for review, through the secretariat,.

Governments should be notified of the start of the first review process. The first draft of a report should be sent by the secretariat to government-designated national focal points for information purposes. A full list of reviewers should be made available on the Platform's website.

On request, the secretariat should make available any material that is referenced in the document being reviewed that is not available in the international published literature.

Expert reviewers should provide the comments to the appropriate lead authors through the secretariat.

Second review (by Governments &experts)

The Platform secretariat should distribute the second draft of the report and the first draft of the summary for policymakers to Governments through the government-designated national focal points, the Bureau of the Plenary, the Multidisciplinary Expert Panel and the report co-chairs, coordinating lead authors, lead authors, contributing authors and expert reviewers.

Government focal points should be notified of the start of the second review process some six to eight weeks in advance. Governments should send one integrated set of comments for each report to the secretariat through their designated national focal points. Experts should send their comments to the secretariat.

3.3.3 Preparing the final draft report

Report co-chairs, coordinating lead authors and lead authors, in consultation with the review editors, should prepare a final draft for submission to the Plenary. The final draft should reflect comments made by Governments and experts. If necessary, the MEP working with authors, review editors and reviewers can try to resolve areas of major differences of opinion.

Reports should describe different, possibly controversial, scientific, technical and socio-economic views on a given subject, particularly if they are relevant to the policy debate. The final draft of a report should credit all report co-chairs, coordinating lead authors, lead authors, contributing authors, reviewers and review editors and other contributors, as appropriate, by name and affiliation, at the end of the report.

3.3.3.1 Summary for Policy makers

Summaries for policymakers for global, regional, subregional and thematic and methodological assessments should be subject to simultaneous review by Governments and experts. Written comments by Governments on the revised draft should be submitted to the secretariat through the government-designated national focal points before final approval by the Plenary. Regional summaries for policymakers should, as a preliminary step, be approved by their respective regional members of the Platform prior to further review and approval by the Plenary.

Responsibility for preparing first drafts and revised drafts of summaries for policymakers lies with the report co-chairs and an appropriate representation of coordinating lead authors and lead authors, overseen by the Multidisciplinary Expert Panel and the Bureau. The summaries for policymakers should be prepared concurrently with the main reports.

The first review of a summary for policymakers will take place during the same period as the review of the second draft of a report by Governments and experts in an open and transparent manner.

The final draft of a summary for policymakers will be circulated for a final round of comments by Governments in preparation for the session of the Plenary at which it will be considered for approval.

Approval of a summary for policymakers signifies that it is consistent with the factual material contained in the full scientific, technical and socio-economic assessment accepted by the Plenary.

Report co-chairs and coordinating lead authors should be present at sessions of the Plenary at which the relevant summary for policymakers is to be considered in order to ensure that changes made by the Plenary to the summary are consistent with the findings in the main report. The summaries for policymakers should be formally and prominently described as a report of IPBES.

3.3.3.2 Language and translation

We advise that translation be considered as early in the process as possible. Experience from the MA showed that translation of the final outputs into the official UN languages proved to be more complicated than expected. Translation processes proved to be time-consuming as multiple reviews of translated texts were necessary to ensure quality (Ash et al., 2010).

The working language of IPBES assessment meetings will normally be English. Subregional and regional assessment reports may be produced in the most relevant of the six official languages of the United Nations. All summaries for policymakers presented to the Plenary will be made available in the six official languages of the United Nations and checked for accuracy prior to distribution by the experts involved in the assessments.

3.3.3.3 Key messages and key findings

While the full assessment reports are useful reference documents, it is important to synthesise this information into targeted key messages for interested parties who may have little time to fully engage. Often, these 'Key messages' are confused with the 'Key findings' of an assessment and are therefore do not adequately convey the content and conclusions in a way that will resonate with key audiences. Key findings are defined as the facts and information drawn directly from the technical chapters, while key messages are a "strategic culling of the points most relevant to each audience, presented in a way that promotes the credibility of the findings" (Ash et al., 2010; Table 3.4).

Table 3.4. Example of the key findings and key messages of the UKNEA (2011)

Key Findings	Key messages
The economic, human health and social benefits that we derive from ecosystem services are critically important to human well-being and the UK economy, and each should be considered when evaluating the implications of changes in ecosystems and their services.	The natural world, its biodiversity and its constituent ecosystems are critically important to our well-being and economic prosperity, but are consistently undervalued in conventional economic analyses and decision-making.
The landscape of the UK has changed markedly during the last 60 years with the expansion of Enclosed Farmlands, Woodlands and Urban areas, and the contraction and fragmentation of Semi-natural Grasslands, upland and lowland Heaths, Freshwater wetlands and Coastal Margin habitats.	Ecosystems and ecosystem services, and the ways people benefit from them, have changed markedly in the past 60 years, driven by changes in society.

Key Findings	Key messages
• The expansion of Woodlands has contributed to both improved climate regulation, through greater carbon sequestration, and air quality, while at the same time increased timber supply. More recent changes in forest policy and woodland management have enhanced general amenity value and wild species diversity. • Expansion of Urban areas has degraded regulating services for climate, hazards, soil and water quality, and noise. • Fragmentation and deterioration of wetlands, and in particular these parathion of rivers from their floodplains, has compromised hazard (flood) regulation and many other ecosystem services.	The UK's ecosystems are currently delivering some services well, but others are still in long-term decline.
Contemporary society is less sustainable than it could be. Responding to the pressures to provide food, water and energy security, while at the same time conserving biodiversity and adapting to rapid environmental change, will require getting the valuation right, creating functioning markets for ecosystem services, improving the use of our resources and adopting new ways of managing those resources.	The UK population will continue to grow, and its demands and expectations continue to evolve. This is likely to increase pressures on ecosystem services in a future where climate change will have an accelerating impact both here and in the world at large.
In future, the management of ecosystem services will need to be resilient and adaptive to societal (e.g. demographic), environmental (e.g. climate change) and land use (e.g. increased use of bio-energy) changes. Therefore the underlying indirect and direct drivers of change must be considered.	Actions taken and decisions made now will have consequences far into the future for ecosystems, ecosystem services and human well-being. It is important that these are understood, so that we can make the best possible choices, not just for society now but also for future generations.
The transition to a more sustainable use of ecosystems and their services can be facilitated by taking a more integrated, rather than conventional sectoral, approach to their management, recognizing that some difficult trade-offs will have to be made between individual ecosystem services.	A move to sustainable development will require an appropriate mixture of regulations, technology, financial investment and education, as well as changes in individual and societal behavior and adoption of a more integrated, rather than conventional sectoral, approach to ecosystem management.

3.3.3.4 Addressing possible errors and complaints

The review processes described above should ensure that errors are eliminated well before the publication of Platform reports and technical papers. However, if a reader of an accepted Platform report, approved summary for policymakers or finalized technical paper finds a possible error (e.g., a miscalculation or the omission of critically important information) or has a complaint relating to a report or technical paper (e.g., a claim to authorship, an issue of possible plagiarism or of falsification of data) the issue should be brought to the attention of the secretariat, which will implement the process for error correction or complaint resolution as set out in decision IPBES 2/3.

3.3.3.5 Conflicts of interest

Highly participatory processes, such as the conducting of ecosystem assessments, will always carry a risk of conflicts of interest among stakeholders. The assessment team, and various governance groups, should be prepared to deal with these issues pro-actively in order to minimize any interruptions to the process. Ash et al. (2010) suggest that some ways of dealing with these issues could be to:

- Establish by consensus clear, but flexible, rules of participation;
- Have an agenda and clear objectives for each meeting that is convened;
- Promote communication among members in between meetings; and
- If the governing body is a large one, create a committee to deal with operative issues between meetings.

3.3.4 Acceptance of reports by the plenary

Reports presented at sessions of the Plenary are the full scientific, technical and socio-economic assessment reports. The subject matter of these reports shall conform to the terms of reference and to the work plan approved by the Plenary or the MEP as requested. Reports presented to the Plenary will have undergone review by Governments and experts. The purpose of these reviews is to ensure that the reports present a comprehensive and balanced view of the subjects they cover. While the large volume and technical detail of this material places practical limitations upon the extent to which changes to the reports can be made at sessions of the Plenary, “acceptance” signifies the view of the Plenary that this purpose has been achieved. The content of the chapters is the responsibility of the coordinating lead authors and is subject to Plenary ‘acceptance’. Other than grammatical or minor editorial changes, after ‘acceptance’ by the Plenary only changes required to ensure consistency with the summary for policymakers shall be accepted. Such changes shall be identified by the lead author in writing and submitted to the Plenary at the time it is asked to approve the summary for policymakers.

Reports accepted by the Plenary should be formally and prominently described on the front and other introductory covers as a report accepted by IPBES.

3.3.4.1 Approval and adoption of synthesis reports by the Plenary

Synthesis reports integrate materials contained in the assessment reports. They should be written in a non-technical style suitable for policymakers and address a broad range of policy-relevant questions as approved by the Plenary. A synthesis report comprises two sections, (a) summary for policymakers, and (b) full report.

There are five steps, as outlined in IPBES 2/3, to the approval and adoption of synthesis reports by the Plenary:

Step1: The full report (30–50 pages) and the summary for policymakers (5–10 pages) of the synthesis report are prepared by the writing team.

Step2: The full report and the summary for policymakers of the synthesis report undergo simultaneous review by Governments, experts and other stakeholders.

Step3: The full report and the summary for policymakers of the synthesis report are revised by the report co-chairs and lead authors with the assistance of the review editors.

Step4: The revised drafts of the full report and the summary for policymakers of the synthesis report are submitted to Governments and observer organizations eight weeks before a session of the Plenary.

Step5: The full report and the summary for policymakers of the synthesis report are submitted for discussion by the Plenary:

1. At its session, the Plenary will provisionally approve the summary for policymakers on a line-by-line basis.

2. The Plenary will then review and adopt the full report of the synthesis report on a section-by-section basis in the following manner:

   - When changes in the full report of the synthesis report are required, either for the purpose of conforming to the summary for policymakers or to ensure consistency with the underlying assessment reports, the Plenary and the authors will note where such changes are required to ensure consistency in tone and content.

   - The authors of the full report or the synthesis report will then make the required changes, which will be presented for consideration by the Plenary for review and possible adoption of the revised sections on a section-by-section basis. If further inconsistencies are identified by the Plenary, the full report or the synthesis report will be further refined by its authors with the assistance of the review editors for subsequent review on a section-by-section basis and possible adoption by the Plenary.

3. The Plenary will, as appropriate, adopt the final text of the full report of the synthesis report and approve the summary for policymakers.

The synthesis report consisting of the full report and the summary for policymakers should be formally and prominently described as a report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.

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Chapter 4. Using Uncertainty Terms

4.1 What are uncertainty terms?

The credibility of an assessment process is closely linked to how it addresses what is not known in addition to how it addresses what is known (MA, 2005). Adopting a consistent approach for assessing, characterising and reporting uncertainties is important for the clarity and utility of an assessment's outputs. It can also aid communication between the research community and decision-makers (MA, 2003). There are many sources of uncertainty in an assessment's findings. For example, they can be due to an incomplete understanding of the interactions and dynamics within ecosystems, or data gaps or errors in the data (Ash et al., 2010). Errors in the structure of a model or the inappropriateness/lack of confidence in a model's underlying assumptions are further examples (Moss & Schneider, 2000).

There are two approaches to presenting certainty (or uncertainty) in assessments. The choice between them depends on the information concerned. The approaches are:

1) Qualitative assessment of uncertainty using the estimates of agreement and evidence (e.g. type, amount, quality and consistency). For qualitative statements, an agreed set of phrases can be used.

2) Quantitative assessment of statistical uncertainty using estimates of likelihood (probability) that a well-defined outcome has occurred or will occur in the future. This approach should only be done in cases where some quantitative estimate of uncertainty can be made. A statistical approach (Box 4.1), using confidence limits in tables, graphs or text, can be used together with a set of special 'reserved words' (Ash et al., 2010).

See Section 4 for more details and MA (2003), which outlines steps to undertake an uncertainty analysis when the amount of information available is relatively rich.

One outcome of an assessment is to reveal knowledge gaps and identifying uncertainties is part of this process. An important function of assessments is to determine future research priorities, which can then be considered by the IPBES Task Force on Data and Knowledge.

Box 4.1: Philosophical approaches to estimating uncertainty

There are two broad philosophical approaches to estimating uncertainty using statistics (Ash et al., 2010):

1) Frequentist framework–This is the basis for most standard statistics where uncertainties are derived as a result of hypothetical repetitions of the data collection process (i.e. multiple independent samples are taken).

2) Bayesian framework –Uncertainties are derived from the laws of probability.

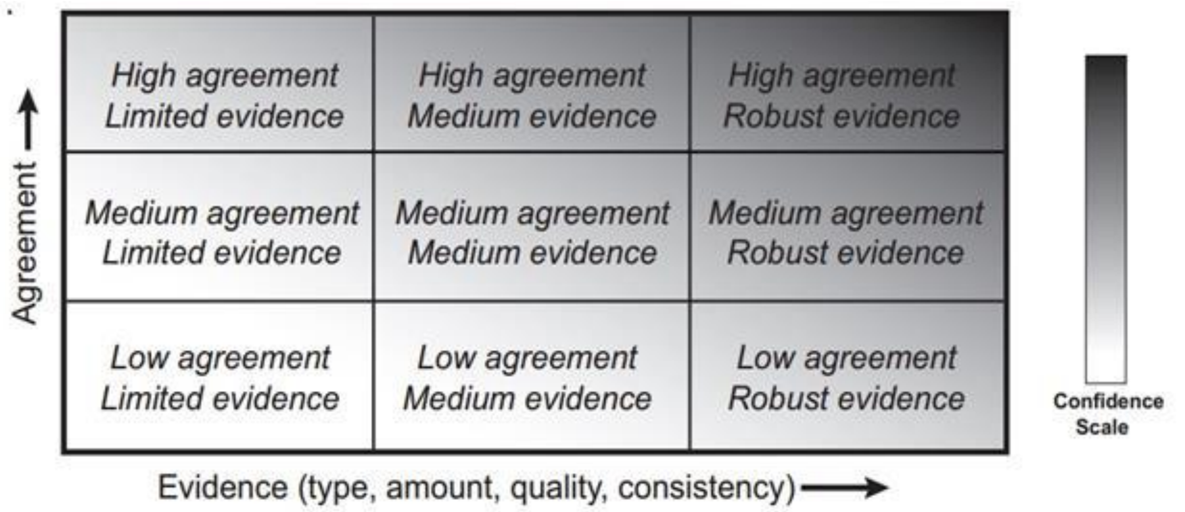
There is no consensus in the literature on which approach is most appropriate (Vallverdú, 2008). The two approaches will often result in the same estimate and which one is used generally comes down to practicality or preference (Ash et al., 2010).

4.2 How to use uncertainty terms within an IPBES assessment

IPBES assessments will be handling uncertainty using an approach, based on the two complementary models described below, to be agreed and finalised early 2015.

Handling certainty (and uncertainty) within an IPBES assessment will involve using:

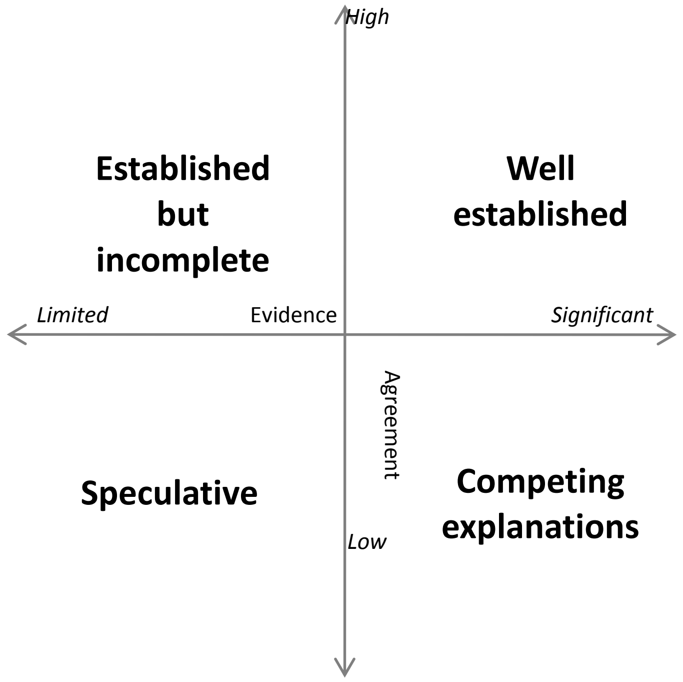
1. A set of qualitative uncertainty terms. These terms can be derived from the nine-box model as set out in the IPCC Assessment Report 5 guidance (Mastrandrea et al., 2010) and currently being used by the IPBES Pollination Assessment. This model allows for a more detailed qualification of agreement and evidence and provides a finer grained perspective. If a simplified version is desired then the four-box model will be appropriate (derived from the Mastrandrea et all., 2010 & UK NEA 2011)
2. A likelihood scale, which will be used (where possible) to complement the qualitative uncertainty terms (a-g in Figure 4.1).



__The nine-boxed model__ showing a combination of evidence and agreement statements and their relationship to confidence. The confidence scale (right bar) increases towards the top-right corner meaning that, generally, evidence is more robust where there are multiple, independent lines of high-quality evidence.

__The four-boxed model__ qualitative assessment of uncertainty using the following terms:

1. *Well established*: high agreement based on significant evidence
2. *Established but incomplete evidence*: high agreement based on limited evidence
3. *Competing explanations*: low agreement, albeit with significant evidence
4. *Speculative*: low agreement based on limited evidence



Plus (where possible) regardless of which model set our above was used a quantitative assessment of uncertainty using the following *__likelihood scale:__*

a. *Virtually certain*: >99% probability of occurrence

b. *Very likely*: >90% probability

c. *Likely*: >66% probability

d. *About as likely as not*: >33-66% probability

e. *Unlikely* : <33% probability

f. *Very unlikely*: <10% probability

g. *Exceptionally unlikely*: <1% probability

Figure 4.1: Uncertainty in IPBES assessments using uncertainty terms via a nine-box or four-box model together with, where possible, a likelihood scale. Source: Based on the UK National Ecosystem Assessment (2011) and the IPCC Assessment Report 5 guidance (Mastrandrea et al. 2010). Note: The MEP in consultation with the Bureau and based on the experiences of the two fast track assessments will make a recommendations.

Estimates of certainty are derived from the collective judgment of authors, observational evidence, modelling results and/or theory examined for this assessment. The uncertainty language should be used appropriately and consistently in the key findings of each chapter. Box 4.2 provides examples of when uncertainty language should and should not be used.

Box 4.2: When should uncertainty language be used?

- In statements that are of most relevance to policy decisions.
- When the finding that is reported is based on the judgment of a group of experts rather than the reporting of a 'fact'.
- In general when reporting on trends in data it is not necessary to include uncertainty terms, unless the interpretation of the data depended on the judgment of a group of experts. However, when a range is presented the level of uncertainty would typically be reflected (e.g. 100-200 hectares vs. 152 hectares).

Source: Ash et al. (2010)

Box 4.3 gives examples of how to incorporate uncertainty terms, in the form of footnotes or embedded within the sentence. Footnotes can be easier to use as they allow greater flexibility in writing key findings. Uncertainty can also be presented in graphical form using radar plots or snowflake charts that signify increasing confidence as it increases in size. See Moss & Schneider (2000) for further discussions on graphical approaches to communicating uncertainty.

Box 4.3: Example key findings and the uncertainty terms used	
"**Biodiversity underpins all ecosystem services.** Biodiversity plays a wide range of functional roles in ecosystems and, therefore, in the processes that underpin ecosystem services[1]. Examples range from the roles bacteria and fungi play in nutrient cycles which are fundamental processes in all ecosystems, to particular animal groups, such as birds and mammals, which are culturally important to many people. Ecosystem functions are more stable through time in experimental ecosystems with relatively high levels of biodiversity[2]; and there are comparable effects in natural ecosystems[c]. Taken together, this evidence shows that, in general terms, the level and stability of ecosystem services tend to improve with increasing biodiversity." Source: Norris et al. (2011)	[1] well established [2] established but incomplete evidence [c] likely
"There is a growing use of 'green care' in many contexts in the UK, including therapeutic horticulture, animal-assisted therapy, ecotherapy, green exercise therapies and wilderness therapy[2]. Green care produces health, social and educational benefits, but these have not yet been widely evaluated[3]." Source: Pretty et al. (2011)	[2] established but incomplete evidence [3] competing explanations
"Many organisms create living habitats such as reefs and seagrass meadows. These can provide essential feeding, breeding and nursery space that can be particularly important for commercial fish species[1, a]. Such habitats play a critical role in species interactions and the regulation of population dynamics, and are a prerequisite for the provision of many goods and services[c]. Fishing at the seabed with trawl nets and dredging fishing gears severely	[1] well established [a] virtually certain [b] very likely

damages living reefs and deep sea corals, which are very slow-growing and, consequently, take a long time to recover[a]. Boat anchoring, propeller scarring and channel dredging can damage shallow water and intertidal habitats[c]. However, building coastal defences and offshore structures, such as wind turbines, oil platforms and reefs, provides artificial habitats which can have positive impacts, particularly for species usually associated with rocky environments[b]." Source: Austin & Malcom et al. (2011)	[c] likely
"Adaptation is becoming embedded in some planning processes, with more limited implementation of responses (*high confidence*). Engineered and technological options are commonly implemented adaptive responses, often integrated within existing programs such as disaster risk management and water management. There is increasing recognition of the value of social, institutional, and ecosystem-based measures and of the extent of constraints to adaptation. Adaptation options adopted to date continue to emphasize incremental adjustments and cobenefits and are starting to emphasize flexibility and learning (*medium evidence, medium agreement*). Most assessments of adaptation have been restricted to impacts, vulnerability, and adaptation planning, with very few assessing the processes of implementation or the effects of adaptation actions (*medium evidence, high agreement*)." Source: IPCC (2014)	

4.3 Key Resources

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Section III: Use of Methodologies in Assessments

This section is a guide to the use of methodologies in IPBES assessments. This section does not contain all the possible methods which can be or should be employed when undertaking an IPBES assessment at any scale. The chapters included here summaries of methods which have been requested by the Plenary for further assessment and have their own comprehensive guides.

There are a number of other methods, approaches and tools which are essential to undertaking an assessment. For example: systematic reviews form an important step in gathering evidence[6]. Other methods and tools which might be used within an assessment process include trade-off analysis, risk assessments, ecosystem services mapping, participatory approaches, and multi-criteria analysis.

Chapter 5: Values

5.1 Introduction

This chapter provides the key messages from the preliminary guide regarding diverse conceptualization of multiple values of nature and its benefits, including biodiversity and ecosystem functions and services. The purpose of the preliminary guide is to ensure consistency in approach across IPBES assessments of biodiversity and ecosystem functions and services undertaken in accordance with the IPBES Conceptual Framework.

The IPBES conceptual framework acknowledges the different paradigms and world views that guide human expressions of value. Value is a term for human preferences and judgment for ecosystem functions and services. Values, which are multiple and plural, may be formed and elicited within different cultural, social and institutional frameworks - all with the purpose of social and economic knowledge informing policy decisions. Figure 5.1 provides the schematic of the guide. For further reading, please refer to the preliminary guide as presented in IPBES/3/INF/7.

[6] www.cebc.bangor.ac.uk/Documents/CEBC%20Systematic%20Review%20Guidelines%20Version%202.0.pdf

Figure 1: Schematic of the guide regarding diverse conceptualization of multiple values of nature and its benefits, including biodiversity and ecosystem functions and services

5.2 Major concepts of values

1. The word values can mean very different things. The values associated with nature, nature's benefit to people, and a good quality of life can refer to the importance people recognize or attribute to them, or it can refer to their measurement. Values in this context can refer to values centered on nature in and of itself, and to values centered around human ends. Valuations and assessments should take into account the worldviews that are associated with the categorization of biodiversity and ecosystem services, and of nature, nature's benefits to people, and good quality of life.
2. Values are multiple and plural. Values are formed and developed within different worldviews as held by individuals or populations. They are diverse because they arise according to people's interactions with their biophysical environments, as well as their socio-cultural and political context, and the institutions that facilitate their articulation.
3. Values change. Values attributed to nature, nature's benefits to people and a good quality of life change through time, across spatial scales and among forms of social organization (e.g. arrangements and institutions from the local to the global level).
4. All values are not always transparently or explicitly taken into account. While some values are present and informing decision-making. The transparent and explicit articulation of these values can depend on various factors such as (i) distribution of costs and benefits of different decisions

among stakeholders; (ii) whether and how these stakeholders are included in decision-making; and (iii) the power asymmetries that occur among them and among the institutions that mediate such interactions. Some values, such as those held by indigenous peoples and local communities and those that are context specific, are particularly relevant.

5. Assessing which values are likely to be impacted in any decision relative to nature and its benefits is a complex but crucial task to perform. To assist this process, an inclusive and extensive checklist of the different types of values that can be attributed to nature, nature's benefit to people, and a good quality of life can be used (preferably in a participatory and iterative way) to help identify and assess which values may be impacted within a particular decision context.

5.3 Valuation methodologies

1. An IPBES protocol for valuation and assessment processes is proposed. Conducting a valuation or valuation assessment according to the IPBES protocol may facilitate comparability of results, and transparency and accountability in the process and resulting decisions.
2. Valuation methods are diverse. They include biophysical and ecological, cultural and social, economic, public health, and holistic, indigenous, and local knowledge-based types of methods.
3. Methods for assessing, integrating and bridging different valuation approaches are diverse. These include deliberation, multicriteria analysis, integrative modelling, and narrative analysis. All aim to reflect the plurality of values expressed by different valuation methods. Integration or bridging of diverse valuation approaches is not always appropriate.
4. Six major considerations should guide valuation and valuation assessments: (a) What types of values are considered? (b) Which world views are incorporated? (c) What are the spatial, temporal and social organization scales at which values are expressed? (d) Who is involved, and how, at each stage of the valuation process? (e) How is the broader social context taken into account? (f) Practical considerations including availability and need for resources, knowledge, information and data.
5. Valuation should incorporate both the current state of nature and potential changes. An assessment of anthropocentric values should consider the current state and potential changes in nature, nature's benefits to people, and good quality of life. For the intrinsic values of nature (non- anthropocentric values), assessing state and changes in nature's benefits to people and good quality of life is irrelevant.
6. A valuation or assessment process includes communicating the results to the public and decision-makers. The level and type of social engagement during the process, as well as the manner in which the results of the valuation and assessment are communicated affects decision-making and can even affect the assessed values themselves.

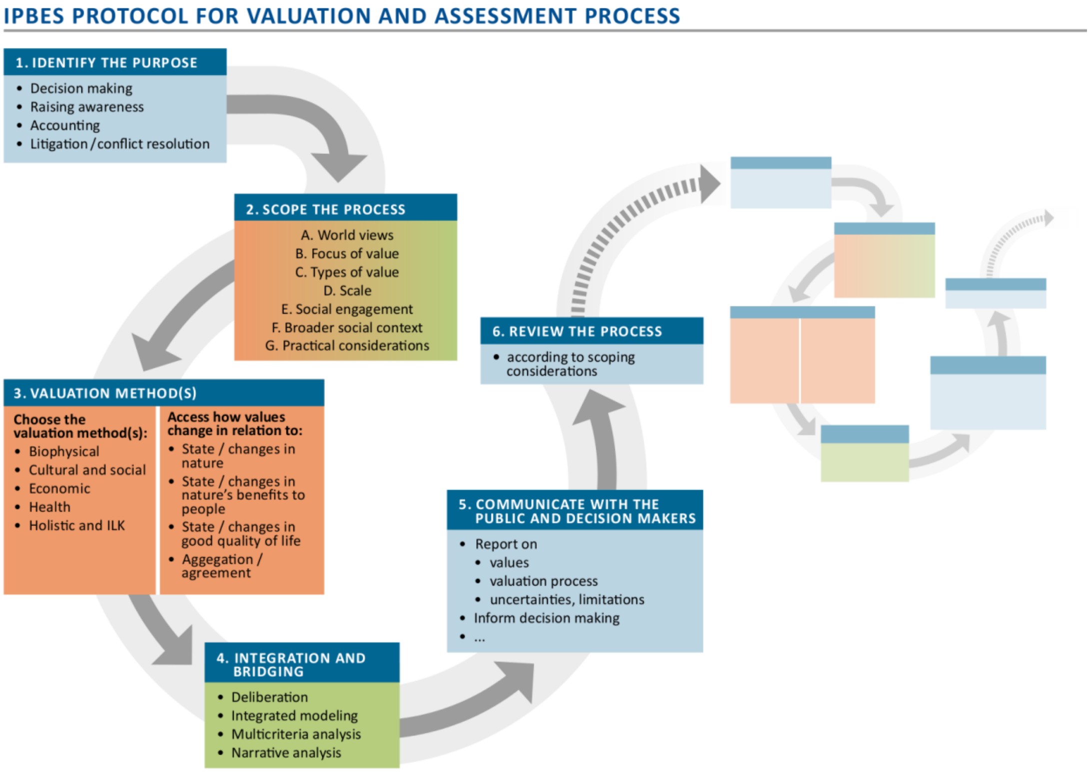

Figure 5.2. IPBES protocol for valuation and assessment process

5.4 Data and knowledge needs

1. Data and knowledge needs for a valuation study can vary substantially. Data and knowledge needs will be affected by the valuation's spatial, temporal and social organization scales. –The scoping study will determine the appropriate choice of the method(s) to be applied, which in turn determines data and knowledge requirements. Where possible, multiple data, knowledge sources including indigenous and traditional local knowledge systems, and information systems should be consulted and utilised.
2. Not all data and knowledge are readily available or accessible. Holistic and integrated valuation exercises require an extensive amount of data and knowledge. However, this varies across scales of analysis as does the accessibility of this data and knowledge. Existing data, knowledge and information sources on nature, nature's benefits to people and good quality of life including biodiversity and ecosystem services are available to a limited extent at local, regional and global levels, but remain inadequate to capture the multiple values defined in Chapter 2 and the different knowledge systems and peoples' worldviews impacted.
3. Data and knowledge generation requires multi-disciplinary approaches. As data and knowledge related to socio-cultural aspects are often collective, oral and un-written, different sources must be considered (e.g. narratives, images, folk art forms and other oral and visual traditions etc.). Multi-disciplinary teams that include ILK holders and practitioners are required to carry out valuations and assessments but it is preferred that ILK holders must express their views about values by themselves.

5.5 Integrating into IPBES activities

1. Application of the tools and methodologies to IPBES activities requires special attention to the context of the assessment. Assessment teams usually work under very tight schedules and mainly rely on existing studies and knowledge to compile the assessments and derive overall conclusions.

Under these conditions it becomes particularly challenging to adequately represent different worldviews and conceptualizations of values and there is no silver bullet to doing so.

2. Assessment processes need to consider all possible types of values and acknowledge the diversity of worldviews. A first important step for any assessment consists of identifying which values might be at stake and thus relevant for a given topic of assessment. This implies to consider all 'key targets of valuation' for each 'type of value' and then specify and select which are applicable, for most cases not all of them will be applicable.
3. It is important to reflect on the gaps in the current literature and in the existing assessments. Assessments commonly include market values andincreasingly address other economic values where adequate information and methods are readily available, but cultural and health values as well as values held by indigenous people and local communities are often not adequately covered. It is neither necessary nor usually feasible to include all types of values in depth, many may not be applicable/relevant for each assessment, others may have to be left out due to scarce resources. Being transparent about which values were included and for what reasons others were left out increases the usefulness of the assessment.
4. Assessments need to pay attention to scalar dynamics when assessing valuation results and particularly when attempting to aggregate or integrate values. Studies of values address different purposes and scales (temporal, spatial and level of social organization) and values change across these scales.For example, indigenous peoples are often minorities in their countries and their often quite specific relationships to biodiversity, involving several value dimensions, would get averaged out in a simple aggregation process.

5.6 Capacity building

1. Three priority areas for capacity building have been identified, (a) the capacity for generating data and information; (b) the capacity to carry out evaluation/assessment; (c) the capacity to influence policy and decision making.
2. Increase the visibility of and access to existing knowledge, including 'grey literature' and indigenous and local knowledge where appropriate, e.g. by identifying existing sources of information, engaging with different types of expertise, and facilitating interlinkages between existing data repositories and networks of practitioners.
3. Increase the valuation and assessment capacity, especially at regional, national and local levels, through better inclusion of knowledge holders and policy makers, and training opportunities for interdisciplinary and transdisciplinary competencies.
4. Increase visibility and impact at policy and governance levels, through improved communication between scientific and policy communities, training on how to use assessment results and development of stakeholder networks for information sharing and fund-raising.
5. Identification and use of existing platforms and resources should remain a priority, in order to avoid fragmentation and duplication of efforts. In particular, this refers to formal and informal science-policy mechanisms and communities of practice established at subnational, national, regional or interregional level.

5.7 Policy support tools

1. There is a wide range of policy tools, methodologies and instruments that can be used in different socio-political contexts in decision-making at a range of spatial scales. The different contexts include geographic or jurisdictional, ecological, social, economic, cultural and others.
2. Seven categories of policy tools and methodologies have been identified. These are are approaches and techniques that can inform and assist policymaking and implementation at a range of spatial scales to protect and promote nature, nature's benefits to people and a good quality of life. These

incldude (i) assembling data and knowledge; (ii) assessments and evaluation; (iii) public discussion, involvement and participatory processes; (iv) selection and design of policy instruments; (v) implementation, outreach and enforcement; (vi) capacity building; and (vii) social learning, innovation and adaptive governance. Intercultural dialogue or the dialogue among different stakeholders is important to be considered in all the categories.

3. Policy instruments to effect change in order to address identified challenges e.g. biodiversity loss and degradation of ecosystem services can be viewed in a variety of contexts, including, policy and market failure, institutional weaknesses, and the rights of people and nature.
4. There are four major categories of policy instruments, which should be considered according to national circumstances and priorities, separately or in combination: (i) economic and financial-based; (ii) rights-based; (iii) institutional and legal; (iv) social and cultural; and (iv) standards and planning.
5. Assessment results are often underutilized in policy-making, due in part to the lack of interaction,effective communication and trust between policy makers and researchers. Numerous interventions and products can be assembled and communicated more effectively to provide appropriate information and support to the policy maker.

Chapter 6: Role of scenarios and models in assessment and decision making

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6.1 Overview

Modelling offers a means of formalizing and quantifying interactions between several major elements of the IPBES analytical conceptual framework, thereby providing an objective and highly flexible foundation for responding to assessment and decision-making needs across multiple spatial scales (Figure 6.1).

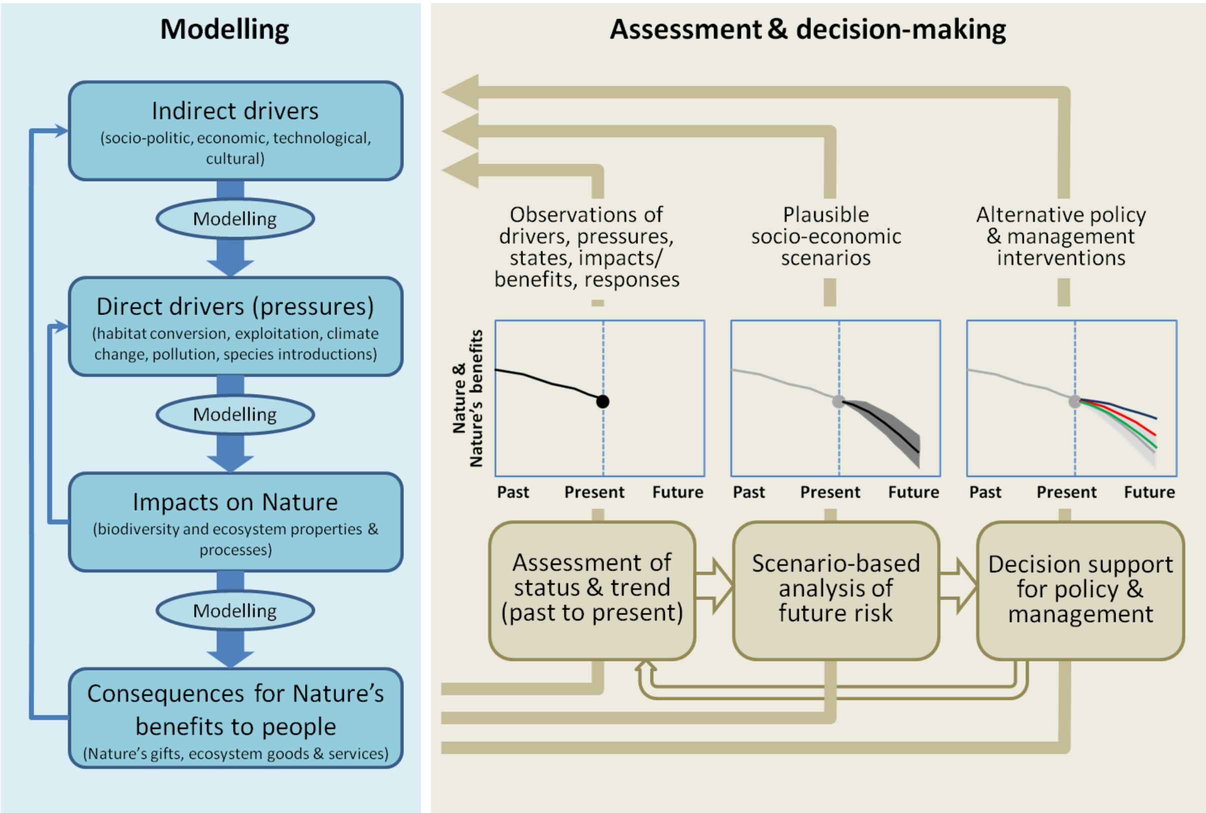

Figure 6.1. Interactions between modelling and assessment and decision-making. The left side of the diagram depicts the elements of the IPBES conceptual framework (blue filled boxes) that can be linked through modelling (large arrows indicate the most common chain of modelling, while narrow arrows indicate feedbacks). The right side of the diagram depicts three broad areas of application in assessment and decision-making (tan filled boxes, and graphs showing typical model outputs). The solid arrows on the right side indicate the flow of information (inputs) to modelling from a given assessment or decision-making activity, and the flow of model outputs back to the assessment. The open arrows indicate interactions between the three areas of application.

Modelling the links between any two elements of the IPBES framework allows us to use changes in one element (whether observed or projected) to estimate, or project, resulting changes in the other. Most of the modelling approaches considered by the Methodological Assessment of Scenarios and Modelling (IPBES Deliverable 3c) focus on three particular linkages within the IPBES framework (left side of Figure 6.1):

- effects of changes in indirect drivers (e.g. socio- economic, technological and cultural factors) on direct drivers of change in (e.g. habitat conversion, over-exploitation, climate change, pollution, species introductions) biodiversity and ecosystems;
- impacts of changes in direct drivers – both negative and positive – on Nature, including various dimensions and levels of biodiversity, and ecosystem properties and processes; and
- consequences of changes in biodiversity and ecosystems for the benefits that people derive from Nature including, but not limited to, ecosystem goods and services.

Many types of models can be used to describe and explore the above linkages. Depending on the particular needs of any given application, models will often vary markedly in:

- *Geographical extent and resolution* – ranging from global models operating at relatively coarse spatial resolutions, through to finer-scaled regional, sub-regional and local (e.g. farm-level) models.
- *Scope of considered drivers and biodiversity/ecosystem values* – ranging from models focusing very specifically on the effects of one, or a small number of drivers (e.g. habitat conversion, climate change), on particular biological entities (e.g. individual species; Feeley & Silman, 2010), through to whole-ecosystem models dealing with a broad array of ecosystem properties and processes (Fulton, 2010), or integrated assessment models (IAMs) attempting to model entire coupled social-economic-ecological systems (Harfoot et al., 2014a).
- *Source, and form, of information defining modelled relationships* – ranging from simple semi-quantitative approaches to capturing, and representing, stakeholder knowledge (e.g. using participatory techniques; Walz et al., 2007, Priess & Hauck, 2014), through to correlative (statistical) analysis of empirical data (e.g. species distribution modeling; Elith & Leathwick, 2009), or more mechanistic approaches based on established scientific understanding, and mathematical formulation, of relevant underlying processes (e.g. meta-population modeling; Gordon et al., 2012), mechanistic models of ecosystem function (Harfoot et al., 2014b).

As depicted on the right side of Figure 6.1, modelling can inform three broad areas of assessment and decision-making (Cook et al., 2014). These three areas are strongly linked and interdependent so it is best to think of the models informing them as serving complementary needs within an overarching adaptive policy (or management) cycle. Using models to help assess status and trends (past to present) in Nature, and its benefits to people, provides the foundation for modelling potential future changes, and therefore risks, under plausible socio-economic scenarios. Scenario analysis then, in turn, provides the basis for modelling the effect that alternative policy and/or management interventions are expected to have on future outcomes, thereby directly supporting decision-making. Lastly, the policy/management cycle is completed through the use of ongoing status-and-trend assessment to evaluate outcomes of implemented policy and management actions, and to progressively refine the rigor of underpinning models over time.

These three broad areas of application are now described in more detail.

6.2 Assessment of status and trends (past to present)

IPBES assessments help to identify problems and set agendas at global, regional and sub-regional scales – especially when linked to analyses of future risk (see Figure 6.2 below). One widely adopted approach to status-and-trend assessment is the DPSIR (drivers-pressures-states-impacts/benefits-responses) approach (Feld et al., 2010; Sparks et al., 2011). Several elements of the IPBES conceptual framework align reasonably well with major categories of indicators in this approach. Modelling can add considerable value to assessments of status and trends in two important ways:

- *Filling gaps in data (observations) needed to underpin key indicators.* Data are much easier and/or less costly to obtain for some elements of the IPBES conceptual framework than for others. For example, advances in remote sensing have made it possible to track temporal changes in a number of direct drivers (pressures), including habitat conversion and climate change, at relatively fine spatial resolutions across extensive regions. On the other hand, most components of biodiversity, particularly at the species and genetic levels, are not detectable through remote sensing, and changes in their state can be observed only through direct field survey. Such data therefore tend to be sparsely, and unevenly, distributed across both space and time. Modelling offers a cost-effective means of filling gaps in this coverage by using remotely sensed, and therefore geographically complete, information on drivers to estimate changes in the state of biodiversity (past to present) expected across unsurveyed areas (calibrated, where possible, using observed relationships between remotely-mapped drivers and directly observed impacts on biodiversity at better-surveyed locations)(Ferrier, 2011). Using modelling to fill gaps in information can play an equally valuable role in assessing status and trends in Nature's benefits to people – e.g. by estimating changes in the supply of ecosystem services from remotely-sensed land cover classes and structural or functional ecosystem attributes (biomass, net primary production etc.; Tallis et al., 2012; Andrew, Wulder & Nelson, 2014).

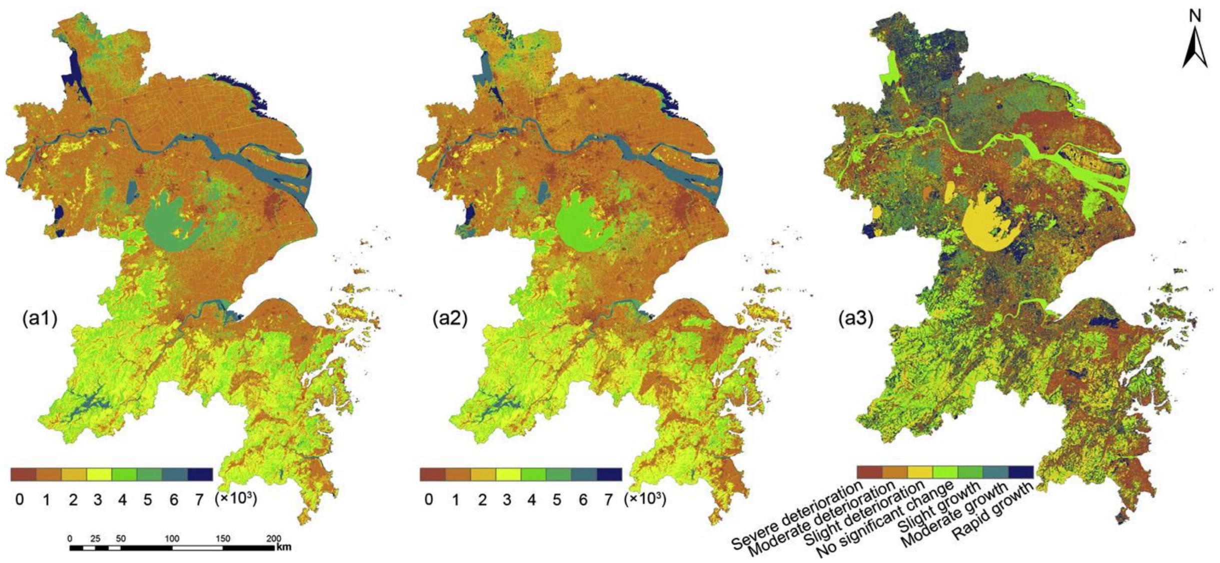

Figure 6.2: Example application of modelling to status-and-trend assessment – change in natural capital (from ecosystem services related to carbon sequestration, grain production and water supply) in the Yangtze River Delta, 2000–2010, derived from model-based analysis of remote sensing data. (a1) natural capital in 2000; (a2) natural capital in 2010; and (a3) spatial change in natural capital in 2000–2010. (Xu et al., 2014)

- *Integrating multiple pressure-state-response elements into composite indicators.* Applications of the DPSIR framework, or similar approaches to status-and-trend assessment, typically generate multiple indicators (Butchart et al., 2010; Sparks et al., 2011). These are distinguished not only by their focus on different high-level components of this framework (e.g. pressure indicators versus state indicators versus response indicators) but also by differences in the focus of indicators within each component – e.g. indicators of habitat-conversion pressures versus species-introduction pressures; or indicators of habitat-protection (reservation) responses versus introduced-species-control responses. To provide a better sense of the overall status of, and trends in, the condition or "health" of the system these individual indicators are sometimes aggregated to produce one, or a small number of, composite indicators or indices (Halpern et al., 2012). Aggregation will often be most readily achieved through some form of simple arithmetic manipulation (e.g. as a scaled and/or weighted average of individual values) (Butchart et al., 2010). However, such an approach may fail to adequately address the often complex, non-additive, and highly dynamic, nature of interactions between multiple pressure, state and response elements in real-world systems. Modelling offers an alternative means of integrating data, and indicators, describing past-to-present changes across multiple system elements (represented in the IPBES conceptual framework), to generate composite indicators that better account for complexities and dynamics in the interaction of these elements (Vackar et al., 2012; Pereira et al., 2013; Tett et al., 2013).

6.3 Scenario-based analysis of future developments

The role of modelling in this second broad area of application is intermediate between, and therefore bridges, the roles played in status-and-trend assessment (application 1 above) and in decision support (application 3 below). While often sharing with status-and-trend assessment the general purpose of informing problem identification and agenda setting, scenario analysis shifts the focus of assessment from changes that are known to have already occurred to changes that might occur into the future. Using modelling to project possible changes beyond the present provides a powerful means of assessing future risks and opportunities for biodiversity, ecosystem properties and processes, and Nature's benefits to people, and therefore the need for action (Pereira et al., 2010). Scenario analysis explores possible future developments of human society and the potential consequences of these developments. The IPCC defines scenarios (at the global scale) to be *"… coherent, internally consistent and plausible descriptions of a possible future state of the world … they are not a forecast and this is an important attribute; rather, each scenario is one alternative image of how the future can unfold"* (IPCC-SRES, 2000).

Any future projection involves high levels of uncertainty, particularly around indirect socio-political, economic, technological and cultural drivers of change in biodiversity and ecosystems. Scenario-based analyses of future risk typically attempt to accommodate these uncertainties by exploring a range of plausible socio-economic scenarios, each based on a different set of assumptions about future trajectories in key factors (e.g. population, income, technology development). Many such scenarios have been developed, and applied extensively and successfully, by other major global assessments prior to the establishment of IPBES. The most prominent of these are the global scenarios developed by the climate science community, including the IPCC's Special Report on Emission Scenarios (SRES) from 2000, and the more recently adopted scenario framework comprising two elements: Representative Concentration Pathways (RCPs) describing different trajectories for emissions and concentrations of atmospheric constituents affecting the climate system over time; and Shared Socio-economic Pathways (SSPs) providing narrative descriptions and quantifications of plausible developments of socio-economic variables characterizing challenges to climate-change mitigation and adaptation (van Vuuren & Carter, 2014). The Millennium Ecosystem Assessment (MA) set another prominent precedent, from more of an ecosystem-service perspective, with its construction of global storyline scenarios representing different combinations of possible paths for world development, and reactive versus proactive approaches to ecosystem management (Cork et al., 2006). More recently, increasing effort is being directed towards developing socio-economic scenarios at regional or national scales, tailored specifically to the needs of biodiversity and ecosystem-service assessment – e.g. the ALARM project in Europe (Spangenberg et al., 2012), and the Australian National Outlook initiative (Bryan, Nolan & Harwood, 2014). The trend towards application of scenario analysis at more local scales is also being accompanied by increasing adoption of participatory approaches to the development of scenarios, tapping directly into local stakeholder knowledge of how the system of interest works (Walz et al., 2007; Priess & Hauck, 2014).

Commonly, the first step in assessing the implications of socio-economic scenarios for Nature and its benefits is to model the effect that these scenarios are expected to have on direct drivers of biodiversity and ecosystem change (linking the top two elements on the left-hand side of Figure 6.3) under each of the scenarios. For example, one might model spatially- and temporally-explicit changes in climate, or land use (Hurtt et al., 2011). An additional level of modelling is then used to project, in turn, the impact that these changes (in direct drivers) are expected to have on biodiversity and ecosystem properties and processes, and resulting consequences for benefits to people (linking the bottom three elements on the left-hand side of 3). In addition to more qualitative modelling approaches (e.g. arising through participatory scenario development), quantitative techniques commonly used to model, and thereby project, impacts of direct drivers on biodiversity and ecosystems include:

- species distribution modelling (Elith & Leathwick, 2009);
- population and meta-population modelling (Gordon et al., 2012);
- dose-response modelling (Alkemade et al., 2009);
- macroecological (e.g. species-area) and meta-community modelling (Mokany et al., 2012);
- trait-based modeling (Lamarque et al., 2014), and
- process-based ecosystem modelling (e.g. marine trophic models, dynamic vegetation models; Fulton, 2010; Hartig, et al., 2012).

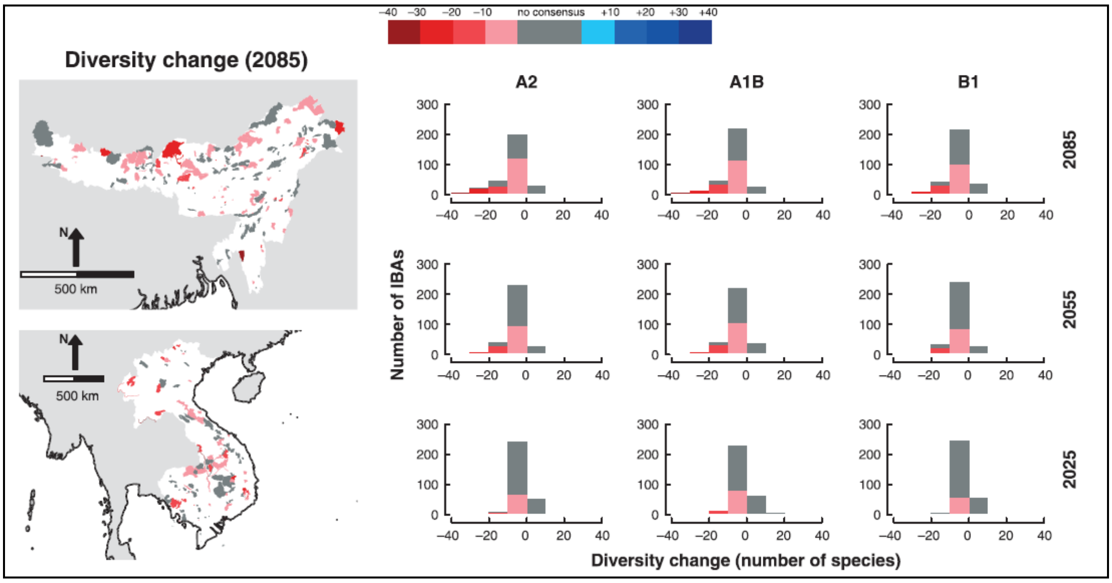

Figure 6.3. Example of scenario-based risk analysis employing species distribution modelling – projected impacts of climate change on species richness in Important Bird Areas (IBAs) in the Eastern Himalaya (top left) and the Lower Mekong (bottom left). The maps show projected changes in the number of

species of conservation concern. Future climates in coloured IBAs are 'extremely likely' to be suitable for fewer species (red) or more species (blue). The histograms show the distribution of changes in species richness for the IBAs across combinations of 30-year time periods (rows) and SRES scenarios (columns). Source: Bagchi et al., 2013.

Scenario-based risk analysis can set the scene for subsequent decision support (application 3 below) by exploring, and assessing potential impacts of, a broad range of socio-economic futures. An example could be through provision of valuable information on the relative importance of different drivers in shaping future risks to biodiversity and ecosystems, and the amount of change that might be required in important drivers to reduce these risks to an acceptable level.

6.4 Decision support for policy and management

This third, and arguably most crucial application of modelling, extends the use of scenario analysis (application 2 above) by projecting the effect that alternative, and explicitly defined, policy and/or management interventions (actions) are expected to have on future outcomes for biodiversity, ecosystem properties and processes, and Nature's benefits to people. The type and scale of interventions potentially considered by this approach can vary greatly, thereby allowing applicability across a wide range of decision-making contexts. For example, the intervention options requiring assessment might be aimed at addressing either indirect drivers (e.g. reduction of fossil-fuel use to slow the rate of climate change) or direct drivers (e.g. habitat protection or restoration to counter the impacts of habitat loss). These options may also involve either the formulation of whole policies (e.g. regulation of vegetation clearing) or programs (e.g. establishment of an environmental-stewardship funding scheme) across entire countries or other jurisdictions, or the implementation of specific spatially-explicit management actions (e.g. reservation of a particular patch of forest; or introduced-species control within a particular estuary).

Where the interventions of interest are aimed primarily at addressing indirect drivers, and/or involve high-level policy formulation, established approaches to scenario-based risk analysis (application 2 above) may need only modest extension to effectively support decision-making. The same models used to evaluative the consequences of a plausible range of futures in analysis of risks and opportunities – i.e. so-called "exploratory scenarios" – are now applied to "normative scenarios", purposely tailored to assess the extent to which different policy interventions might move the system of interest in a desired direction (van Vuuren et al, 2012). Depending on the context, such modelling may also be required to consider options from a "backcasting", rather than a forecasting, perspective by finding combinations of policy and/or management interventions that can deliver an agreed future end-point for Nature, or its benefits to people – e.g. as applied recently in the Rio+20 scenarios (PBL 2012; see Figure 6.4).

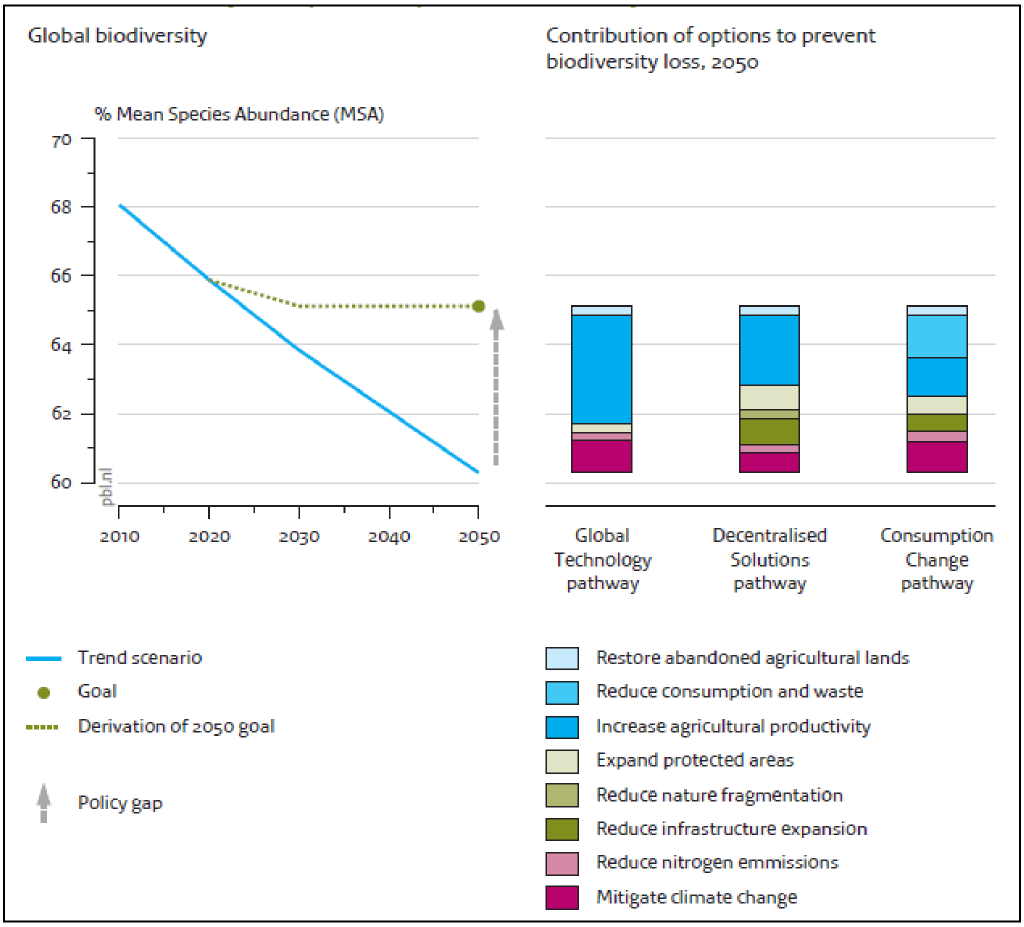

Figure 6.4: Example of decision support employing scenarios that are designed achieve future global targets on climate change, biodiversity and human development (also known as "backcasting"). Biodiversity targets set by the Convention on Biological Diversity have been interpreted in terms of the biodiversity indicator Mean Species Abundance (MSA). GLOBIO modelling was then used to evaluate whether these targets could be achieved via the three development pathways. The analysis showed that to achieve these targets, it would take a large effort for each pathway and a combination of policies, including extension of protected area network, sustainable intensification of agriculture, climate mitigation and changes in life style. Source: PBL, 2012.

Where the interventions under consideration are more specific, the basic idea of informing decision-making by modelling the expected consequences (for biodiversity or ecosystems) of alternative actions, is already well established across a number of methodological paradigms, or frameworks – e.g. Structured Decision Making (Addison et al., 2013), and Management Strategy Evaluation (Mapstone et al., 2008). Depending on the decision-making context, these frameworks typically call upon modelling to either: 1) assess a discrete set of policy or management options (arising, for example, from a participatory planning process); or 2) consider all possible options for achieving a specified goal, thereby identifying the “best” solution, subject to any relevant constraints (e.g. cost of implementation), through some form of optimization. Assessment and decision-making often need to focus on multiple rather than single criteria, e.g. multiple dimensions of biodiversity and ecosystem services (e.g. provisioning services, or climate regulation). This will require the use of multiple models and/or models that can produce projections for multiple criteria; the examination of trade-offs in outputs for alternative scenarios; the use of aggregation methods such as multi-criteria decision analysis or other participatory methods for decision support.

Participatory approaches – including the use of agent-based modelling to capture stakeholder knowledge and learning – are, again, playing an increasingly important role in the development and application of scenarios for decision support. These approaches can be applied either in place of, or in combination with, more quantitative techniques such as those described above (Castella, Trung & Boissau, 2005; Sandker et al., 2010).

6.5 Specific recommendations for regional, global and thematic assessments

Some assessments have primarily relied on analyses of tailor-made socio-economics scenarios (e.g., MA, 2005; GEO4, 2007; UK NEA, 2011), while others have almost exclusively been based on assessment of published material (e.g., GBO3, 2010). We recommend a mixture of these approaches where possible; i.e., that assessments include relevant published work and, where available, analyses that have been developed to match IPBES assessment objectives. Several of the IPBES task forces will encourage the development of tailor-made scenarios and models by working in close collaboration with the scientific community. The recently released Global Biodiversity Outlook 4 (GBO4, 2014) is one example of an assessment which combines analyses of published and bespoke scenarios and models. The evaluation of a wide range of scenarios and models has some drawbacks, one of the most important being that it complicates comparisons of scenarios and models. However, basing IPBES assessments on a wide range of published material will have the great benefit of allowing exploration of a much greater diversity of models and scenarios. Examples of the use of a broad range of scenarios and models in assessments can be found in several of the most recent IPCC chapters on climate change impacts (IPCC AR4 WG2, 2014) and in the technical reports that are the basis of the Global Biodiversity Outlooks 3 & 4 (GBO3, 2010; GBO4, 2014).

This reliance of IPBES assessments on a wide range of published material and, when available, bespoke scenarios and models have a number of important consequences:

- Assessment authors need to access, synthesize and assess a very large number of scenarios and modeling studies. This is particularly true for the regional and global assessments, although less so for the thematic assessments. Sorting through the literature on models and scenarios is challenging, so one of the main objectives of the methodological assessment on scenarios and models and subsequent activities of the follow-up task force is to provide guidance on how to search for, interpret, synthesize and assess published work.
- Considerable attention needs to be paid to the capacity of authors to find, interpret and assess scenarios and models. Many IPBES authors will be less familiar with scenarios and models than with analyses of data on status and trends. This means that attention must be paid to the backgrounds of assessment authors, and that assessments should include a reasonable number of authors with experience in interpreting scenarios and models. Over the longer term, efforts within the capacity building components of IPBES will be required to encourage the development of a broader capacity to develop, use and interpret scenarios and models among scientists and decision makers.
- Assessment authors will need to evaluate scenarios and models that cover a wide range of temporal scales (see also Chapter 2). Many previous assessments have focused on scenarios and models examining future risk in the 2050-2100 time horizon (e.g., IPCC AR5 WG2, 2014; MA, 2005; UK NEA, 2011). As outlined above, scenarios and models for analysis of status and trends, shorter time horizons, or without explicit reference to time horizon (e.g., many management scenarios) are abundant in the literature. In many cases, these scenarios and models are easier for policy makers and other stakeholders to incorporate in their decision making than those that

explore distant future time horizons, and therefore, should play an important role in IPBES assessment activities.

- Particular attention must also be paid to using appropriate spatial extent and resolution (see also Chapter 2). The IPBES global assessment will, by its very nature, rely heavily on global scale scenarios and models. However, regional and local scale scenarios and models can be extremely useful in helping to inform and enrich analyses at global scales. IPBES regional assessments will logically rely more heavily on regional and local scenarios and models; however, evaluating how these compare and contrast with global scenarios and models will aide considerably in making cross-regional comparisons. Thematic assessments are likely to exploit scenarios and models across a broad spectrum of spatial scales. In all cases, it should be kept in mind that many decision makers need scenarios and models at relatively fine spatial resolution.
- Scenarios and models vary substantially in the degree of uncertainty associated with their projections. Some have been extensively validated and widely used in decision-making. Many others have undergone little or no validation, and in some cases may suffer from serious flaws. Because the IPBES assessments will not rely on a single set of scenarios or modeling framework, it will be up to assessment authors to evaluate the sources and levels of uncertainty associated with projections. The methodological assessment of scenarios and models will provide guidance on evaluating quality, as well as on methods for assessing uncertainty (e.g., comparison of projections of several types of models; Pereira et al., 2010).
- The choice of indicators used for scenarios and models is a key element in 1) linking them to assessments of status and trends, 2) making sure that they are policy relevant and 3) carrying out comparisons across regions and sub-regions in the regional assessment activities. Discussions concerning the choice of indicators need to be carried out in advance of assessment activities, and authors of assessments, particularly the regional assessments, need to dialog across sub-regions and regions to harmonize use of indicators to the maximum extent feasible.
- Previous global and regional assessments have paid little or no attention to the role of indigenous and local knowledge (ILK) in scenarios and models. The rapid growth of participatory methods in scenario and model development (see above) has opened the door to greater inclusion of ILK. The methodological assessment of scenarios and models will include specific guidance on the inclusion of ILK.
- The incorporation of scenarios and models in the overall structure of assessments has varied greatly. Some assessments have grouped most of the evaluation of scenarios and models to specifically dedicated chapters (e.g., MA, 2005; GBO3, 2010; UK NEA, 2011), while others have woven the evaluation of scenarios and models much more broadly into chapters (IPCC AR5 WG2, 2014; GBO4, 2014). The use of specifically dedicated chapters makes good sense for assessments that are primarily based on analyses of tailor-made socio-economic scenarios. Weaving scenarios and models more widely into chapters makes good sense when relying on a broad evaluation of published material. The authors of this chapter strongly encourage IPBES experts to consider a combination of these approaches when developing the overall structure of assessments during scoping and when writing assessments. For example, this would mean grouping analyses of scenarios and models when this is helpful for providing a synthetic overview of future projections of a wide range of indicators, while also using scenarios and models throughout chapters to provide a coherent vision of past, present and possible future dynamics of individual indicators. An example of this combined approach is the Global Biodiversity Outlook 4 (GBO4, 2014) in which past, present and future dynamics of a wide range of indictors were assessed for each of the

twenty Aichi targets, and then the overall picture emerging from these scenarios and models was synthesized in a dedicated chapter.

IPBES will stimulate the development of new scenarios and models that target IPBES objectives through its interactions with the scientific and policy communities. The timing of the assessments should make the development of tailor-made scenarios and models a reasonable objective for the global assessment, but the earlier completion dates of the regional and currently planned thematic assessments may make it more difficult to integrate work specifically addressing IPBES objectives. The experts involved in the methodological assessment of scenarios and models will work closely with the Data, Information and Knowledge task force, and with the authors of assessments to ensure a coherent approach to dialoging with the scientific community and incorporating new scenarios work in assessments.

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Chapter 7 Indigenous and Local Knowledge

At the second meeting of the Plenary of IPBES, it was agreed to establish an IPBES task force to address issues related to bringing indigenous and local knowledge systems (ILK) into IPBES assessments and other processes. This task force was specifically mandated to develop procedures and approaches for ILK in IPBES. It is expected that the task force will prepare preliminary procedures and approaches for ILK in IPBES for the third session of the Plenary (January 2015), and the final procedures and approaches for the fourth meeting of the Plenary. When finalised, it is anticipated that the Guide for Assessments will reflect how these ILK procedures and approaches could be best used by assessment practitioners.

Section IV: Identifying and Addressing Data, Information and Knowledge Resources and Gaps

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The IPBES assessment process aims to, across several scales, evaluate status and trends regarding the knowledge on biodiversity and ecosystem services (BES), their interlinkages, the impact of biodiversity and ecosystem services on human well-being and the effectiveness of responses (IPBES-2/5). Such assessments are critically dependent on a multitude of data types and sources from a variety of domains and scales. These support the development of information, including metrics and indicators, which in turn support knowledge generation, assessments and policy support tools, three of the four main IPBES functions (Chapter 1). The characterization of knowledge needs, the identification of qualifying data and information to address them, and their mobilization, analysis and interpretation are the core goals of these assessments. A larger intended outcome is the increasing closure of knowledge and associated data/information gaps as the assessment process progresses.

Data, information and knowledge in IPBES

Data, Information, and Knowledge represent the key empirical underpinning of IPBES functions. Our operational definitions of these terms are as follows (Figure 8.1):

- **Data** represents raw observations or measurements of states or drivers, which may be qualitative or quantitative. Data can feed into assessment via direct aggregation or models, or through the derivation of information products. Data may be subdivided along thematic, geographical, taxonomic lines or by knowledge system. The ways that data can be used and interpreted depends on their scale, resolution, quality and how representative they are. 'Metadata' provides standardized descriptors of data that are required to characterise, manage and exchange data.
- **Information** includes "processed data", which might be metrics, indicators, trends or model parameter estimates derived from aggregating, integrating and analysing other data. Indicators are defined information products that can be used to characterize biodiversity or ecosystem states or drivers. 'Essential' Climate or Biodiversity Variables may represent raw data or information. Information of this sort can is particularly useful in developing policy-support tools and support assessments. IPBES assessments will often rely on the analysis or aggregation of information for deriving knowledge. Metadata about this information, 'Meta-information', characterizes its scope (e.g. spatial/temporal, taxonomic), uncertainty, and potential biases in relation to assessment scope or knowledge target.
- **Knowledge** stands for understanding gained through experience, reasoning, interpretation, perception, intuition and learning, which is developed as result of using and processing information. It empowers people to take action and supports decision-making. Knowledge made available in IPBES assessments may be derived directly from data (e.g. via models) or from the analysis or aggregation of information. In their production, IPBES assessments will both use and generate knowledge.

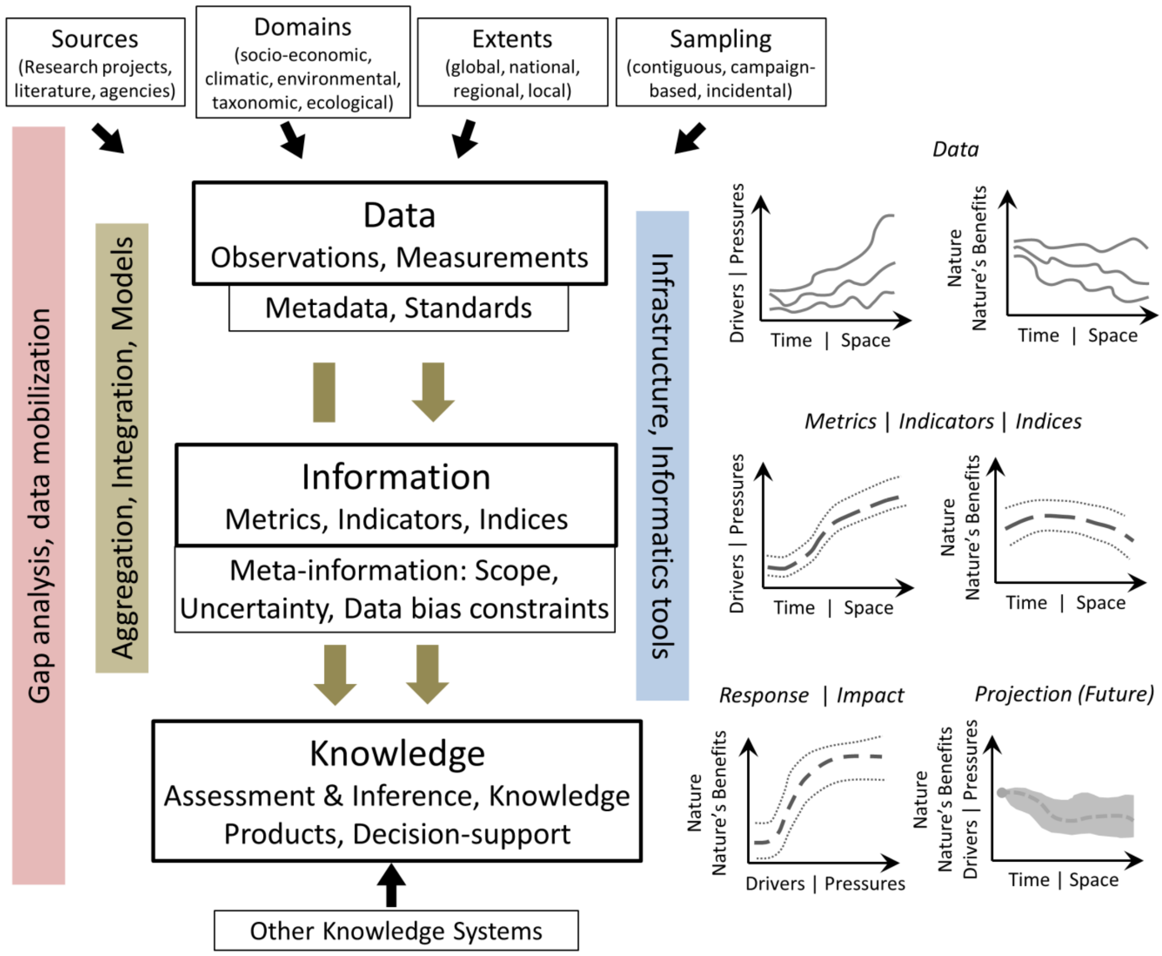

Figure 8.1: Conceptual connection among data, information, and knowledge in IPBES. Figures on right illustrate how raw data on temporal or spatial variation in drivers, pressures, and nature may be combined to establish information about them, such as in the form of metrics, indicators or indices. Data or information contribute to knowledge about causal associations between drivers and response (or impact), which may then be used for projection.

Chapter 8: Data

8.1 The hierarchy of data, information and knowledge

Data is turned into information and then into knowledge. This process can be thought of as a hierarchy, with each step building on the last. New knowledge is derived by aggregating information from several data sources. Knowledge serves as the means to understand an issue related to a specific subject[7]. As a systematic enterprise, science necessarily needs to organize knowledge to answer specific queries and build hypotheses that may be tested to generate the necessary knowledge (Figure 8.1).

This hierarchy demonstrates the organization of unique data units or data sets in a common structure, that become the building blocks of information and when put together in certain configurations provide new knowledge that can be used for decision making/developing policy instruments and guide better governance at all levels.

[7] http://www.ritholtz.com/blog/2010/12/hierarchy-of-visual-knowledge/

In the IPBES process, parties will assess the gaps in knowledge and generate queries about BES that will guide the development of new useful knowledge by collecting, analysing and synthesising sets of data.

A successful assessment depends on clearly crafted queries, thematically organized such that the necessary data, indicators, indices and metrics are aligned to inform the preparation of new knowledge. After identifying knowledge gaps, information gaps should also be clearly identified. Information gaps are to be identified in terms of sets of indicators, where data sets are needed to evaluate the indicators based upon the observation of BES in the status, changes, trends, etc.

Successful IPBES assessments are expected to provide knowledge about the state of Nature and Nature's benefits, the state of indirect and direct drivers impacting them, and the type and consequences of these impacts at global, regional, and sub-regional level. In the IPBES conceptual framework, Nature is represented by the properties and processes of biodiversity and ecosystems and Nature's benefits are represented by the goods and services those properties and processes provide. Indirect drivers are socio-political, economic, technological or cultural conditions associated with human life. Direct drivers (pressures) include habitat conversion, exploitation, human-forced climate change, pollution and species introductions.

Ideally, assessments would provide an understanding of the causal links between the effects of drivers or pressures and Nature or Nature's Benefits (Díaz et al. 2006, Dawson et al. 2011). Sometimes, such links will be firm and supported by experimental evidence. But usually, given large scope of the assessments, any links are likely to be statistical and model-based. The model's parameters are derived from information or raw data about the way that drivers, pressures, Nature, or Nature's Benefits vary in space and time. Once established at sufficient scale and resolution, such models can make predictions about the state of biodiversity and ecosystems in particular places and support projection of future states for different scenarios and decision support (Pereira et al. 2010; also see Section 3).

In addition to model-based assessments, some assessments are likely to be more descriptive. These synthesise quantitative or qualitative information about the variation in Drivers, Pressures, Nature, or Nature's Benefits in space and time. This information in turn is built on basic spatiotemporal data, i.e. observations or measurements. These data are aggregated, integrated or modelled to give information such as indicators or other metrics or they can directly help generate knowledge. Data will come from many sources and domains. It will be captured over different scales, at different resolutions and with different sampling methods. We expect an iterative process of identifying assessment knowledge, information, and data needs and gaps, which in turn will drive subsequent analysis and mobilization of additional data.

8.2 Data types

There has been a remarkable and continued growth in data that is of an appropriate spatial resolution (local) and extent (global) (Figure 3.1, Framework) to inform information and knowledge relevant to IPBES. Vital types of spatiotemporal data for biodiversity and ecosystem properties and services, and their drivers include:

- satellite and airborne remote sensing (Turner et al. 2003, Estes et al. 2010, Schimel et al. 2013, Andrew et al. 2014)
- in situ sensor-based data (Wikelski et al. 2007, O'Connell et al. 2010, Blumstein et al. 2011, Heidemann et al. 2012)
- attempts to quantify select ecosystem services (Boyd & Banzhaf 2007, Brauman et al. 2007)

- species interaction network data and ecological trait compilations (Brose et al. 2006, Kattge et al. 2011, Wilman et al. 2014)
- museum collections (Graham et al. 2004, Suarez & Tsutsui 2004)
- formal biodiversity survey efforts (Roemmich & McGowan 1995, Harrison et al. 1997, Settele et al. 2008)
- citizen science contributions (Dickinson et al. 2010, Hochachka et al. 2012)
- project-driven data collection campaigns

The data and information that are relevant to IPBES changes as new products are derived from remote sensing and different types of data from different domains are integrated globally. Even for a single IPBES component and variable family (say, land cover), such information may vary from raw data (e.g. non-ground truthed satellite imagery) to highly derived and processed or modelled summary metrics (e.g. forest structure). It may be geographically sporadic (e.g. widely spread plot measurements or species observations) or fully continuous (e.g. remote sensing-based layers). While the spatial scope would usually be near global, the temporal scope may be limited, and both spatial and temporal grain may vary from very fine (e.g. 30m, daily) to coarse (hundreds of kilometers, decadal). Existing or envisioned web-based infrastructure may facilitate access or provide easy to use compilations addressing multiple data types (O'Leary & Kaufman 2011, Jetz et al. 2012, Scholes et al. 2012). Existing indicator or other efforts may already have translated data into information. But in some cases new informatics tools and infrastructure to analyze and synthesize these data may be required.

8.3 Data and information sources: general guidance

Both raw data and derived data products need to be high quality to ensure that IPBES assessments are successful, accepted by stakeholders, updated and can be further synthesised. All assessments and associated products should be based on data that are:

i) fully referenced and for which all contributions are fully acknowledged and recognized;

ii) sufficiently documented and that adhere to domain-specific metadata standards; and

iii) archived and accessible to IPBES experts and, wherever possible, the public.

A useful function would be to be able to combine and disaggregate data across scales, among regions and among the different IPBES science domains. For this to be possible, it is vital that data follow clear standards that facilitate interoperability and are readily electronically accessible. Datasets that follow the same procedures and approaches will most readily enable cross-regional comparisons and synthesis. Broad guidance on a number of general aspects of data and information handling will be provided through Platform deliverable 4(b) "Information and data management plan" (Decision IPBES-2/5) provided by the Task Force on Knowledge and Data.

8.4 Data and information sources: global

A powerful way for IPBES regional and sub-regional assessments to efficiently enable aggregation and ensure comparability is to use the same core datasets across multiple or all regions. Such key global datasets serve a significant role for allowing (sub-) regional assessments to replicate and standardize efforts, simplify documentation requirements, and facilitate global synthesis.

- Providers and sources of near-global data products (Figure 8.2) include:
- International organizations (e.g. World Bank, FAO, UNEP-WCMC, IUCN);
- National agencies with international scope (e.g. NASA, ESA);

- Internationally active non-governmental organizations (e.g. WCS, WWF, TNC);
- Globally active research institutes and initiatives (WRI, GBIF, MOL, BIP); and
- Academic research groups that work on global questions.

8.5 Data and information sources: regional

Regional and sub-regional assessments may be able to tap into geographically restricted data and information of greater relevance, quality, spatial resolution, accessibility, taxonomic or temporal scope than are available globally. In exceptional cases, data of near-global scope that is used elsewhere may not be adequate for a given region, due to high uncertainties or limited representativeness. A good example of this is climate change forecast data which relies on local station data to increase their regional accuracy.

Providers and sources of regional to sub-regional data products include the following, all with national or regional remit:

- Governmental ministries and agencies;
- Regionally focused institutes;
- Active non-governmental organizations that have regional and landscape scale focus (e.g. WCS);
- Regionally focused initiatives, projects and research groups.

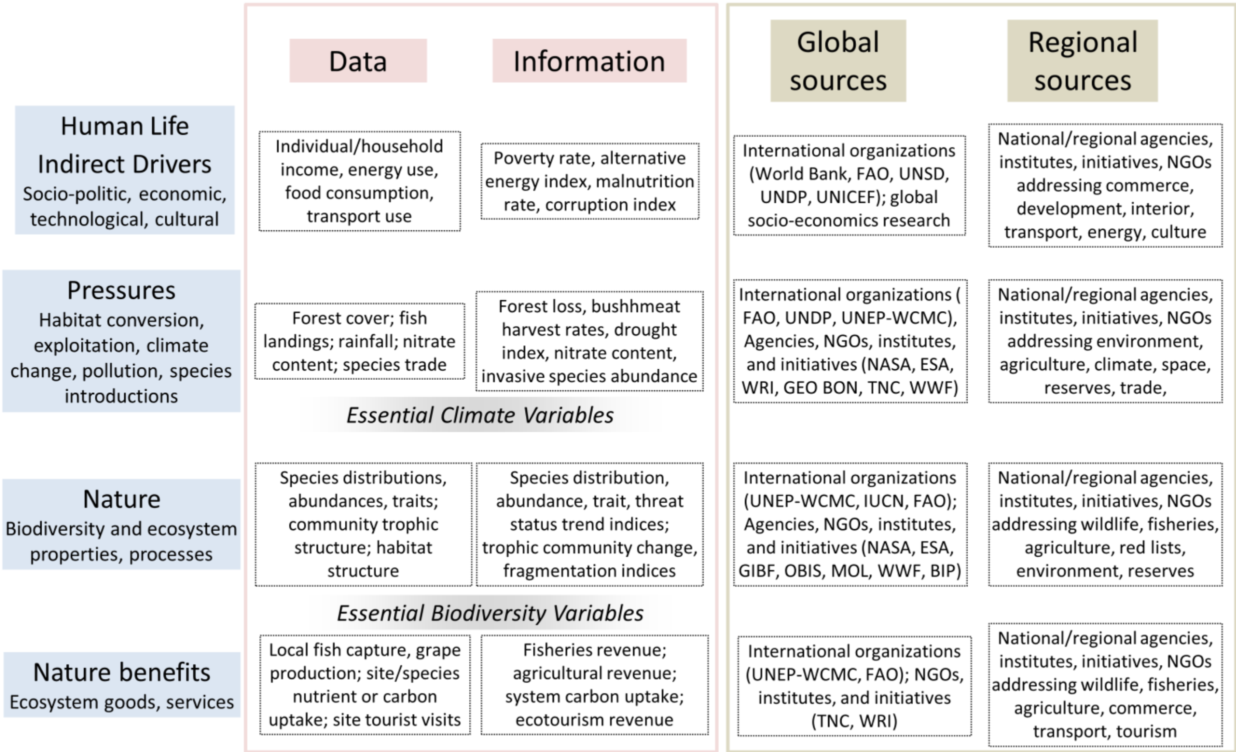

Figure 8.2. Example data and information addressing the different IPBES foci and potential sources at global and regional level. 'Essential' Climate or Biodiversity Variables (Pereira et al. 2013) may represent either data or information (e.g. indicators), or both.

It would be useful for all IPBES assessments if there were a compilation that identified global and regional datasets and information and recommended which are best-suited for IPBES needs. Such a compilation would make it easier to standardise and integrate assessments and could usefully contain URLs, access information, meta-data and meta–information, and usage recommendation. It would need careful, regular review and updating.

For select sub-groups of variables (e.g. biodiversity indicators, see below) initial steps have been taken towards this sort of compilation. A general, online IBPES knowledge, information, and data discovery and access platform is envisioned, provided and continuously updated by the Task Force on Data and Knowledge between 2015 and 2018, with the help of its Technical Support Unit, hosted by the South Korean National Institute of Environment (NIE). The web platform should support the discovery and sharing of information necessary for the assessments.

8.6 Regional and Sub-regional data and expertise

Not all data used by IPBES will be common to all assessments, but data that are unique to a particular region may still be valuable to the wider IPBES process, should meet minimum quality standards and be made widely available. Individual assessments are likely to use data sources not available globally or not used by other assessments. They may identify new data needs for the region in question, or need data at resolutions that cannot be obtained at global scales. They may give rise to novel data of unique regional relevance, including expert-based quality-control of existing datasets, or additional data-points. These new or improved datasets may offer valuable information beyond the focal region and new opportunities for comparison and aggregation. They will need to fulfill minimum quality thresholds (e.g. being peer-reviewed, fully documented, accessible; see below) to ensure a comparable level of scientific rigor among assessments. Assessment groups should consult with the Task Force on Data and Knowledge and its Technical Support Unit on how best to include new regional data in the planned larger architecture so that the data are easy to find and access for everyone (Figure 8.1).

8.7 Data standards

Standards and protocols for data and metadata are essential to help make it easier to access and use them, particularly as the data are generated by a community of globally distributed stakeholders. Data that comply with a standard have the same format and meaning (syntax and semantics) and so can be integrated with other data, for example in data portals, and data will be more easily accessed and widely used, allowing analyses that can be more robust. Metadata captures information characterizing the scope and context of collected data that is vital for its re-use and integration with other datasets.

The IPBES Task Force on Data and Knowledge recommends adopting internationally accepted data standards regarding all types of data that pertain to Biodiversity and Ecosystem Services in a broad sense, which may include species, ecological, agricultural, socio-economic, and climatic data, among others. Many biodiversity data standards (e.g. for point occurrence data) have been developed by the community of biodiversity informatics, under the umbrella of the Biodiversity Data Standards (see for example, www.tdwg.org). However, standards for many biodiversity and ecosystem data types are still lacking.

However, there are many initiatives and systems related to IPBES data that are not interoperable. Assessments are encouraged to pursue data interoperability in an open distributed computing environment, by adopting concepts and techniques such as service-oriented computing. Providing access to standardized data by means of state-of-the-art distributed computing interfaces should be encouraged.

8.8 Data uncertainty and quality

Data and derived information on biodiversity and ecosystem services is subject to observation errors, may have sample size and measurement limitations, and is often constrained in scope. Supporting effective decision-making and policy relies on careful and clear delineation and communication of these limitations. Failing to quantify and document the uncertainty around observations, derived metrics or indicators and predictions has the potential to result in false conclusions or unwarranted action, e.g. regarding trends or prioritization.

1. At a first level, issues surrounding the quality of available raw data are a key factor limiting the quality of analyses and decisions derived from them. In addition to preventive or corrective action, data quality should be assessed and reported in order to inform downstream uses. We recommend IPBES incentivize actions that contribute to a culture of data quality in BES, encompassing development of methods, standards, tools and guidelines for data quality assessment, prevention and correction, data quality policies, and capacity building.
2. The results of the aggregation and analysis of data have inherent uncertainty determined by factors including size and independence of samples, model type, and other methodological aspects. We recommend that IPBES-relevant reporting of results always include domain-typical metrics of statistical confidence in derived metrics, indicators, predictions, and projections. These need to carefully address all sources of potential uncertainty, e.g. in climate, biodiversity and socioeconomic variables. They are expected to reduce uncertainty through careful methodology, dealing with structural uncertainty and to characterize the degree of certainty/uncertainty in their findings.
3. The range and scope of biodiversity and ecosystem service data that is available for metrics and analyses often only imperfectly represents the scope of assessment or policy support goals. Usually, data is systematically scarcer for certain regions, taxa, functions and services. Such biases have the potential to distort IPBES-relevant results, indicators and, by extension, knowledge, in a way not captured by traditional statistical metrics. We recommend that IPBES activities carefully and quantitatively evaluate the congruence between the scope of available information and that of IPBES assessment and reporting targets. We recommend dedicated scientific and capacity building activities that help document and assess limits to the representativeness of available data for IPBES and the resulting constraints on relevant metrics and inference, and inform efforts for gap filling.

8.9 Data storage and archiving

Long term storage and archiving digital data requires the appropriate infrastructure, resources and tools. Most digital storage media have short lifetimes of only a few years. An archive ensures that data is preserved and maintained in file formats that are most likely to be useable in the future. Data may need to be converted to latest available archiving tools to keep up to date with latest archiving technologies.

Data archiving is the preferred option as most archives serve the dual purpose of data preservation and dissemination. Their archives usually have a search utility and are often indexed by the major web search engines, thus increasing the chances of other researchers using and crediting your datasets and publications. Archiving datasets also means the dataset owner does not need to maintain a website and can specify a wide range of access controls. Assessment groups should consult with the Task Force on Data and Knowledge Technical Support Unit for advice and support.

Chapter 9: Knowledge Gaps

9.1 Acknowledging the Variability of Knowledge Systems

There are various knowledge systems that support of biodiversity conservation, ecosystem services and sustainable use. The concept of Traditional Knowledge systems for biodiversity conservation "recognizes that the well-being of human society is closely related to the well-being of natural ecosystems. The intellectual resources on which sustainability science is building on needs to take into account the knowledge of local people as well. We need, therefore, to foster a sustainability science that draws on the collective intellectual resources of both formal sciences, and local systems of knowledge (often referred as ethnoscience) (Pandey, 2001[8])."

Societies have survived the pre-scientific era with traditional systems of management, the success of which are demonstrated in the biodiversity that we have today. These traditional systems have been motivated by self-interest to sustain access to such resources. The persistence of traditional knowledge embodies the adaptation of humans to the changes to their environments and is valuable input to effective biodiversity conservation (Berkes, Folke & Gadgil, 1995).

Dynamic sets of conservation knowledge and practices reside in indigenous and local communities who are aware of local plant and animal varieties as well as the character of their landscapes: knowledge that they use to conserve and manage biodiversity. One interdisciplinary initiative, developed by UNESCO, is the Local and Indigenous Knowledge Systems (LINKS) program**me**, which works to secure an active and equitable role for local communities in resource management, strengthens knowledge transmission across and within generations, and explores pathways to balance community-based knowledge with global knowledge in formal and non-formal education. All of these activities contribute to the equitable and sustainable use and management of biodiversity (UNESCO, 2014).

One example is the Satoyama initiative, a movement developed to evaluate degraded ecosystems and promote their revival through "multi-functional land use systems in which agricultural practices and natural resource management techniques are used to optimize the benefits derived from local ecosystems" (UNU, 2009).

9.2 Classification of ecosystems, ecosystem services and taxonomic

The major challenge regarding data, information and knowledge is to use classifications which make assessments compatible. This is extremely important for the baseline information, like classification of habitats and taxa, and the services they provide.

9.3 Roadmap to identify DIK resources and gaps

1. Get organised on tasks, logistics, responsibilities, available resources (money, staff, experts, software, etc).
2. Stakeholder analysis, where stakeholders are DIK owners/managers, that is to map what DIK are (i) exist and (ii) available. Some data are privately owned, or known by indigenous people, and cannot be used in the timeframe of the assessment). Stakeholders include academic people from natural and social science, and indigenous people and people with traditional ecological knowledge.

[8] http://www.infinityfoundation.com/mandala/t_es/t_es_pande_conserve.htm

3. Evaluate how DIK fits to the given assessment. For example, data on bee presence/country may not satisfy a subregional assessment, which needs more fine scale data, e.g. at scale of presence/10x10 km grid. Or, the upscaling of local traditional knowledge to regional or global level may be questionable.
4. Ensure that DIK can be available on the longterm (archiving) for transparency and repeatability.
5. Identify various gaps:
    a. data not exist
    b. data exist but not available
    c. data available, but do not fit well to the given assessment
6. Identify possibilities and strategies to fill the gaps:
    a. for the purpose of the given assessment, if this is possible
    b. prioritise gaps for the decision makers and donors in the region of the assessment

9.4 How assessment processes can identify knowledge gaps

The Task Force on Data, Information and Knowledge (TF DIK) produced a data, information and knowledge (DIK) strategy. The strategy highlights, among others, the need for critical evaluation of existing DIK, identifies DIK gaps, biases and representativeness, and provides broad directions to address these gaps. At current, the coverage of data or information needs is simply unknown. There are, however several ways to reveal DIK gaps from various thematic, sub-regional, regional and global assessment processes.

9.5 Engage a gap assessment process (acquire information from other gap assessments conducted)

First, however, the compilation of the gaps has to be undertaken, followed by a prioritization exercise based on feasibility is needed. Prioritization should include what gaps have to be related to the conceptual framework, the work programme and the four key functions of IPBES. In terms of scale, priorities have to be of regional or global relevance and also relevant to policy-making at the national level.

Assessments can identify DIK gaps of different types: limited access DIK (e.g. in non UN language, grey literature, etc), and non-existing DIK. These need different approaches, and the consideration of different knowledge systems (academic, indigenous, traditional, citizen-science). Below, we list ways for addressing DIK gaps.

Conduct Knowledge dialogues / forum with strategic partners and other stakeholders. The IPBES Task Force on Knowledge, Information and Data recommends that engaging **knowledge dialogues** between and among stakeholders including “multilateral environmental agreements, United Nations bodies and networks of scientists and knowledge holders, to fill gaps and build on their work while avoiding duplication”. UNESCO offered, as a form of non-financial assistance, “to organize and run regular knowledge dialogues of the IPBES Knowledge & Data Task Force by engaging key scientific organizations, policymakers and funding organizations in interchanges aimed at mobilizing the relevant knowledge needed to be assessed so as to address the requests received by the Platform”. Expected outcomes of such *knowledge dialogues* are:

- generate “advice on strategic partnerships that could help to deliver improved access to data, information and knowledge, and facilitate other activities that have the same effect”

- "Collaborate with existing initiatives, to fill gaps and build upon their work while avoiding duplication, including with networks of scientists and knowledge holders" [IPBES operating principle 1]
- "Recognise and respect the contribution of indigenous and local knowledge to the conservation and sustainable use of biodiversity and ecosystems" [IPBES operating principle 4] and assist the IPBES Knowledge & Data Task Force to liaise with other IPBES task forces, namely the Task Force on ILK and with the proposed Capacity Building activities
- Contribute directly and substantially to deliverable 1d of the IPBES Work Programme 2014 – 2018 ("Catalyze efforts to generate new knowledge and data in order to address priority knowledge and data needs for policymakers)
- Direct Requests

Request the IPBES membership, including observers to provide information on the location / presence of biodiversity (BD) and Ecosystem Services (ES) - related information. Consistent with the principle of inclusiveness, assessments may cover a wide range of species, ecosystems and their interactions, ecosystem services, the collection of which may include the participation of a wide range of stakeholder-sources (academic, local, and indigenous communities, among others) Sources may be accessed from:

- Data and information used to prepare reports submitted by member states in compliance to the reporting requirements of multilateral environmental agreements (MEAs) that they have signed on to Regional
- Assessments such as the Ecologically or Biologically significant marine areas
  - In Nagoya, in October 2010, the 193 Members States of the Convention on Biological Diversity requested Member States to further enhance globally networked scientific efforts, such as OBIS, to continue to update a comprehensive and accessible global database of all forms of life in the sea, and further assess and map the distribution and abundance of species in the sea. They also explicitly called upon IOC to further facilitate availability and inter-operability of the best available marine and coastal biodiversity data sets and information across global, regional and national scales.
  - The CBD secretariat is organizing a series of regional workshops to identify the most **Ecologically or Biologically Significant marine Areas** (EBSAs). OBIS is used as one of the major sources for data on the diversity and distribution of marine biodiversity, such as marine mammals, reptiles, IUCN red list species, but also shallow and deepwater biodiversity. On this slide you see a biodiversity index map provided for the identification of EBSAs in the Caribbean region.

Engage IPBES strategic partners and existing networks (including global and regional societies, expert groups) to facilitate data collection in region or countries. It is suggested that these focal points could act as facilitators and act as a communication vehicle between IPBES and their national community, so that IPBES gaps are communicated at national and sub-national level, and data and knowledge identified. This idea would rely on the existence of a strong network of national platforms or focal points for IPBES which does not currently exist.

In addressing the gaps, an analysis of their characteristics is necessary in terms of scale, thematic and geography in relation to the given assessment. The feasibility of overcoming the identified gaps need to be evaluated, considering resources (financial, expertise) and time scale (complying with the timeline of deliverables). Non-existing data, for example, are not suitable to address for an ongoing assessment, but it can be highlighted as a priority DIK gap.

The IPBES Task Force on Data and Knowledge may by the end of 2015 deliver on a:

- Strategy on DIK, including liaison with other IPBES deliverables (task forces and expert groups)

Data and knowledge underpins the content of discussions on all four agreed functions of IPBES (knowledge generation, assessment, policy support tools and capacity building), but most important for providing reliable assessments of biodiversity and ecosystem services to inform policy.

- Mechanism/process for identifying knowledge needs/gaps (guideline)
    - Processes for scoping groups to report to TF including needs on type of knowledge data metrics to undertake assessment
    - Processes for identification of existing data, knowledge and metrics such as knowledge dialogue/forum with partners
    - Process for assessment groups to report TF gaps in Knowledge & Data & Information
    - Overview of pressing data and knowledge needs

How to respond to such gaps with the IPBES context / Addressing knowledge and data needs The TF on Data and Knowledge may deliver on the following by the end of 2015

- **Review** of existing readily available data and systems, and limitations of access to these data
- **Roadmap** towards overcoming limitations of access in collaboration with other components of IPBES
- A **paper that is a call** to the global community from this group to make data available – with key examples (publishers, funders, key data sets)

Addressing Knowledge and data gaps / How to generate new knowledge

By the end of 2015, the TF on Data and Knowledge will deliver on the:

- Analysis of gaps from existing assessment report in different levels such as regional, subregional, global.
- Process to address knowledge, data and metrics gaps
- Strategy on Knowledge and Data Generation
- Paper call to the global community to fill data and knowledge needs that we identify as priorities
- Report on knowledge and data gaps and needs

Paper call to the global community to fill data and knowledge needs that we identify as priorities

Issues related to the lack of biodiversity and ecosystem services data may largely be related to delays in or in the non-publication of such or to the general inaccessibility of primary biodiversity data. In response to this gap, IPBES may encourage data publication through online Journals and expedite the process with incentives. Chavan & Penev (2011) recommend “recognition through conventional scholarly publication of enriched metadata, which should ensure rapid discovery of 'fit-for-use' biodiversity data resource”.

Chapter 10: Biodiversity and Ecosystem Service Indicators

10.1 Introducing indicators of biodiversity and ecosystem services

Indicators are defined as values or signs that unambiguously reflect the status, cause or outcome of an object or process and are an important tool in the assessment of biodiversity and ecosystem services (Ash et al. 2010). Biodiversity and ecosystem service indicators serve multiple purposes which can broadly be categorized into three key functions: (1) tracking performance; (2) monitoring the consequences of alternative policies; and (3) scientific exploration (Failing & Gregory 2003). Assessments mostly use them for the first two purposes, which are the focus of this section.

Data such as observations and measurements (Figure 8.1) are used as the basis for deriving indicators e.g. bird count observations collected and compared over time show a trend which can be an indicator of the success of conservation actions for a specific group of species. Sometimes several measurements can be combined in a particular way to derive an index. For example, the Red List Index for birds shows changes in threat status over time obtained through a specific formula. These indices make up an important set of indicators due to their ability to communicate complex objects or processes in a way that is easy to understand. They include some very popular social and ecological indicators like the Human Development Index, the Living Planet Index and many others. It is important that indices can be disaggregated and traced back to their component measures (see Ash et al. 2010).

The domain of biodiversity and ecosystem service assessment is very large, encompassing many attributes and measurements related to a wide variety of policies. This breadth could result in the use of long lists of measures and indicators. However, using a clear process from data collection through to communication can identify a few carefully designed datasets that populate a large and consistently evolving set of metrics and indicators for use across many aspects of science and policy. This large set of metrics and indicators can in turn be refined into a smaller set of composite indices which can be used to inform high level policy and decisions. We emphasize the importance of effective and efficient data collection and index design, while allowing for innovation and exploration in the analysis and development of metrics and indicators (Tallis et al. 2012).

Indicators can vary substantially in terms of their data requirements, calculation, typology and eventual outputs. However, they all have one thing in common: they are focused on answering a specific question. These questions can be scientific, policy-driven or arising from civil society and decision-maker interest. Focusing on the question being asked of the assessment and its indicators, can help simplify the enormous complexity of datasets, indicators, frameworks and approaches available (Box 10.1).

Box 10.1: Questions used to direct the Millennium Ecosystem Assessment and the development of indicators and metrics used in the global and sub-global assessments.

1. How have ecosystems changed?
2. How have ecosystem services and their uses changed?
3. How have ecosystem changes affected human well-being and poverty alleviation?
4. What are the critical factors causing ecosystem change?

5. How might ecosystems and their services change in the future under various plausible scenarios
6. What can be learned about the consequences of ecosystem change?
7. What is known about time scales, inertia, and the risk of nonlinear changes in ecosystems?
8. What options exist to manage ecosystem sustainably?
9. What are the most important uncertainties hindering decision-making concerning ecosystems?

10.2. The role of indicators in assessments

Across sectors and disciplines, indicators inform data collection and collation (see Chapter 8); they are useful tools for communicating the results of assessments (see Chapter 12) and are a popular policy support tool (see Chapter 11) used at multiple scales in tracking performance, exploring progress to policy targets, and understanding the consequences of particular decisions, interventions or even future scenarios (see Chapter 6). Indicators are able to present information so that it can be easily communicated and intuitively understood, allowing policy- and decision-makers to base their decisions on evidence (Layke et al. 2012).

One of the major roles played by indicators is in monitoring and communicating progress to policy targets, for example, the CBD Biodiversity 2010 Target and Aichi Targets. Butchart et al. (2010) reviewed global progress towards the CBD 2010 target and, using 31 indicators, highlighted that in general targets were not being met, although large challenges were identified in the development of appropriate indicators (see Mace & Baillie 2007; Mace et al. 2010). More recently, discussions around post-2015 Millennium Development Goals have also begun to focus on the topic of biodiversity and ecosystem service indicators for measuring progress to development goals (Griggs et al. 2013; Sachs et al. 2009).

More generally, biodiversity and ecosystem service indicators are frequently used to answer questions that society, researchers or policy makers ask about biodiversity and ecosystem service on topics such as ecosystem change and its consequences, the costs and benefits of a particular intervention, the value of biodiversity to a community, or the status of a particular ecosystem or species etc. This is likely the role that indicators will play in most assessments (e.g. Box 10.1) – where the questions asked of the assessment will inform the design and development of the necessary indicators to be used.

10.3. What makes a good indicator?

As no single indicator can provide information on all of an assessment's policy relevant aspects, assessments rely on sets of indicators. The chosen set ideally includes only a relatively small number of individual indicators representative of the relevant issue. The size of the set needs to balance out the costs and complexity of communicating a large number of indicators, with the potential of a small and simple set to ignore important aspects of the issue being assessed. Beyond making sure the indicators are appropriate for answering the questions posed of the assessment, there are several publications that list multiple criteria to consider when selecting and developing indicators (e.g. Ash et al. 2010; Layke et al. 2012; Mace & Baillie 2007). In summary, individual indicators should be policy relevant, scientifically sound, simple and easy to understand, practical and affordable, sensitive to relevant changes, suitable for aggregation and disaggregation, and useable for projections of future scenarios (Box 10.2, Ash et al. 2010). Of these criteria, perhaps the most pertinent to this guideline is the need to make the indicators relevant to the purpose. This not only requires setting clear goals and targets in the indicator development process, but also a thorough understanding of the target audience and their needs (Mace & Baillie 2007).

Box 10.2. Principles for choosing indicators

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.

7. Useable for projections of future scenarios
Indicators that allow cause-effect relationships to be quantified and projected forward allow for scenario analyses. This can enable evaluation of alternative policy options or management strategies.

Source: Ash et al.2010.

In addition to these general characteristics, indicators and metrics need to have an appropriate temporal and geographical coverage (see Chapter 2), and ideally be spatially explicit. Making indicators spatially explicit not only allows people to examine the spatial and temporal dynamics of biodiversity and ecosystem services, but also helps make assumptions explicit, and identifies important gaps and needs for further information. The benefits of ecosystems and biodiversity are often used away from where they are produced, so a spatially explicit approach is essential to capture effects across scales and to fully evaluate the importance of ecosystem services and the impacts of related policy actions.

10.4. Indicator frameworks and approaches

There are several frameworks which can help guide the design and development of indicators for assessments. The Drivers-Pressures-State-Impact-Response (DPSIR) framework is a popular indicator framework often used in State of Environment reporting. This framework distinguishes between driving forces of environmental change, pressures on the environment, state of the environment, impacts on population, economy, ecosystems and response of society. Several authors have evolved this framework to more specifically link with conceptual frameworks of biodiversity and ecosystem services (e.g. Reyers et al. 2013; Rounsevell, Dawson & Harrison 2010) which may help assessments in using the IPBES Conceptual Framework to direct indicator development.

In addition to these frameworks to guide indicator selection, it is important to explore which attributes, features or components of biodiversity and ecosystem services need to be measured to develop indicators that are fit for purpose. This is preferable to relying on existing data and indicators which has resulted in our current inability to develop indicators relevant to policy targets (Mace & Baillie 2007). Below we introduce some of the major components of biodiversity and ecosystem services and provide some examples of indicators within each.

10.4.1 Developing indicators of biodiversity

Biodiversity is a multi-faceted, multi-attribute concept of a hierarchy of genes, species and ecosystems, with structural, functional and compositional aspects within each hierarchical level.
Change in biodiversity is also multi-faceted and can include loss of quantity (abundance, distribution), quality (ecosystem degradation) or variability (diversity of species or genes) within all levels and aspects. As Mace, Norris, & Fitter (2012) highlight, different facets of change will have different implications for different ecosystem services, for example changes in functional and structural variability in species will have broad-ranging impacts on most services, while changes in the quantity and distribution of populations and ecosystems will be important for many provisioning and regulating services. In developing indicators of biodiversity it is important to explore the appropriate attributes of biodiversity requiring measurement, namely diversity, quantity and condition, rather than just using the more common indicators like species richness or ecosystem extent. A fourth category useful in developing indicators, drawn from the DPSIR framework, is one that measures pressures exerted on the biodiversity. Table 10.1 illustrates how these attributes can be useful in identifying different indicators for development.

Table 10.1: Categories of biodiversity indicators and some examples of indicators from each category for use in assessments (extracted from TEEB, 2010)

Measures of diversity	Species diversity, richness and endemism Beta-diversity (turnover of species) Phylogenetic diversity Genetic diversity Functional diversity
Measures of quantity	Extent and geographic distribution of species and ecosystems Abundance/population size Biomass/Net Primary Production (NPP)
Measures of condition	Threatened species/ecosystems Red List Index (RLI) Ecosystem connectivity/fragmentation (Fractal dimension, Core Area Index, Connectivity, Patch Cohesion) Ecosystem degradation Trophic integrity (Marine Trophic Integrity - MTI) Changes in disturbance regimes (human induced ecosystem failure, changes in fire frequency and intensity) Population integrity/abundance measures (Mean Species Abundance - MSA, Biodiversity Intactness Index -BII, Natural Capital Index- NCI)
Measures of pressures	Land cover change Climate change Pollution and eutrophication (Nutrient level assessment) Human footprint indicators (e.g. Human Appropriated Net Primary Productivity - HANPP, Living Planet Index -LPI, ecological debt) Levels of use (harvesting, abstraction) Alien invasive species

10.4.2 Developing indicators of ecosystem services

The chain linking biodiversity to its final impacts on society has recently been divided into separate components or steps to structure its assessment (Tallis et al., 2012; Chapter 1). Table 10.2 outlines these components of ecosystem services and provides some examples of possible indicators useful for each stage. Nature´s benefits to society are produced by species, ecological processes and their interactions with social systems and human management of ecosystems. These factors determine the *supply* (arrow 4 in the CF), that is, the potential flow of benefits from nature to people. The next step is the contact between this flow of benefits and the final beneficiaries of the ecosystem service, determined by the location of beneficiaries, their needs and perceptions, and how regulations or governance determine access to services. These factors determine the *delivery* (arrow 8 in the CF) of nature's benefits to society. The next step captures the consequences these benefits have for the wellbeing of individual stakeholders and society at large. Factors such as the other anthropogenic assets (from the CF) determine nature's *contribution to well-being* through ecosystem services. The final step captures the way in which such benefits are accounted for or valued by different stakeholders, including individuals, social groups or societies at large, when taking into account different perspectives, preferences, and social values or norms. These factors determine the *value* of ecosystem services. Value is commonly captured by monetary indicators, but reflects a much wider field of exploration in economics and includes a varied set of possible indicators in development (see Chapter 5).

This step-wise approach is helpful in making clear which components of ecosystems and social systems require monitoring and assessment in order to understand the impacts that ecosystems have on people. The application of this approach need not be done in the order as outlined in Table 10.2, nor do all steps or components need assessment in all contexts. The appropriate approach will depend on the context, questions being asked of the assessment and data available (see Chapter 3). In addition the approach, while linear in application, is part of a larger complex system of interactions and feedbacks between social systems, ecosystems and social-ecological systems (see Chapter 1).

Table 10.2: Examples of ecosystem service indicators capturing the series of ecosystem and social system components necessary to reflect the links between ecosystems and society. Source: GEO BON Ecosystem Services Working group.

Type of services	Ecosystem Service Component			
			Good quality of life	
	Nature	Benefits	Contributions to well- being	Value
Provisioning	Amount of biomass available for fodder (pasture or forage, Tons) Biomass or abundance of important species	Total production of all commercial crops (Tons), Caloric or micronutrient content of fish landings (grams) Volume of harvested wood (m3)	% caloric or micronutrient intake contributed by crops, % income or number of jobs contributed by aquaculture Basic needs satisfied via ecosystem good or service	Market value of all livestock products (US$) Marginal contribution of irrigation to crop market value Change in malnutrition rate due to wild harvest food
Regulating	Amount of carbon absorbed by vegetation from the atmosphere (Tons of C) Mass of nutrients, organic matter, sediments, or toxic organisms or compounds removed (Kg), changes in temperature, pH Pollinator abundances and pollination rates	Water conditions (e.g. nutrient content, presence of harmful bacteria) in relation to standards for different water users at or above withdrawal point Marginal contribution of soils to agricultural, forestry and biofuel production Area of avoided flood damaged due to regulation by vegetation and soils (ha)	% of population with reduced negative impacts (e.g. from floods, wind, drought) Number of people protected from infrastructure loss, flooding and erosion from coastal protection Marginal contribution of pest control to food or biofuel production	Market value of carbon uptake (US$) Avoided water treatment costs (US$) Avoided economic loss by flood regulation from vegetation and soils (US$)
Cultural	Area that provides aesthetic views Area that is suitable for nature-based tourism Abundance of plants	Nature based tourism visitation rates, collection rates of plants used for ritual practices	Marginal contributions to income or well-being of visitors and to local inhabitants derived from aesthetic views, attendance at ritual events, frequency of cultural activities	Economic revenues derived from visits to aesthetic areas, marginal contribution to real estate prices by nature-based tourism (US$), strength of cultural identity

10.4.3 Indicators of trade-offs and synergies of biodiversity and ecosystem services

Resource management has often focused on increasing the delivery of a single service (very often food) at the expense of the decline (e.g. impacts on water quality) of other services. While indicators of these trade-offs have not been systematically developed, some common approaches have been used and can serve as indicators. Examples of these approaches include indicators of pair-wise relationships, bundles of services and evenness of services. Indicators of pair-wise relationships often use correlation analysis or similar statistics to indicate positive (synergistic) or negative (trade-off) between pairs of services (Raudsepp-Hearne, Peterson & Bennett 2010). Indicators that reflect the bundles of services provided by an area can be used to reflect groups of services that appear together repeatedly through space and time. These groups can be identified using multivariate techniques (e.g. through schematic representations including flower or radar diagrams (e.g. Foley et al., 2005), or with matrices reflecting the state and magnitude of each service across a variety of systems or areas (e.g. MA, 2005). Furthermore, evenness in service delivery using measures such as Simpson's diversity index can be used to assess the relative magnitudes of a set of services in an area useful for depicting dominant services or even magnitudes across services. For several of these indicators, services can be measured in different metrics and differences across a particular study region can be calculated relative to maximum possible magnitude (e.g. Reyers et al., 2009). However, it is important that the same component (e.g. quantity or diversity, supply or value) is measured across all biodiversity and ecosystem services to allow bundles or trade-offs to be comparable. New methods are constantly evolving and should be explored for use by IPBES.

10.4.4 Ecosystem Service models

Models are increasingly being used to generate maps and indicators of supply, delivery, contributions to well-being and value of ecosystem services across space and time. Such models can be built from a variety of data sources, including remote sensing data, geographic information, field- based estimations, expert assessments and participatory mapping (Tallis et al. 2012). They can be useful in data-poor areas or in exploring impacts of future scenarios around specific decisions (see Chapter 6). There are an ever-increasing number of these models available for use in assessments. Below we introduce some of the more widely available and widely used modelling platforms, but note the constant growth of new models and approaches which should be included for use in IPBES (see review in Matrinez-Harms & Balvanera 2012).

The Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) platform is a free and open-source software tool aimed at informing and improving natural resource management and investment decisions (Tallis et al. 2013). It focuses on modeling how different social and ecological conditions modify the supply, delivery and value of individual ecosystem services. It also allows for the exploration of the relationships among multiple services. The Multiscale Integrated Models of Ecosystem Services (MIMES) platform focuses on spatial and temporal changes in ecosystem service values (Altman et al. In press). The models are developed in collaboration with stakeholders and emphasise the interactions among services and emerging trade-offs. The Lund-Potsdam-Jena managed Land Dynamic Global Vegetation and Water Balance Model (*LPJmL*) was developed to assess vegetation dynamics under climate change (Bondeau et al. 2007). The supply of services tightly linked to climate variation and vegetation dynamics (water, carbon, wood, woodfuel, agriculture) can be modelled with this platform globally or regionally, though with low resolution (50 km X 50 km grid cell size). The Artificial Intelligence for Ecosystem Services (ARIES) models track components of services (supply, demand-delivery, flow-link between areas of supply and those of delivery, depletion-balance between supply and demand, and value) of ecosystem services (Bagstad et al. 2013). Generic models built via Bayesian belief networks are adapted to specific applications at different spatial scales and for particular social-ecological contexts, and becomes increasingly easy to apply in data poor regions the more it is used.

10.5 Summary of current indicators

Indicators and metrics of biodiversity, ecosystem services and human wellbeing have proliferated over the past several years, largely in response to the setting of the CBD Targets, the Millennium Ecosystem Assessment and its sub-global activities, as well as recent work on post 2015 Millennium Development Goals agenda. An exhaustive review of all these indicators and measures is not intended here (see Butchart et al., 2010; TEEB, 2010; Layke et al., 2012 for in depth reviews); rather this section highlights what types of indicators and measures are available and reviews their relative strengths and weaknesses in an effort to guide the selection and development of appropriate indicators and measures. In general, existing reviews have found that complexities in current targets, the diversity of target audiences and their needs, the resources required to turn measures into effective indicators, and the reliance of most current measures and indicators on available data have posed substantial obstacles in the development of relevant and useful indicators.

10.5.1 Indicators of biodiversity and ecosystem functioning

An assessment by TEEB (2010) showed that there are a large number of measures and indicators available across geographic scales and regions for assessing biodiversity and ecosystem services. Much of the existing data and indicators were collected and developed for multiple purposes other than biodiversity and ecosystem service assessment, and are therefore not necessarily fit for assessing biodiversity and ecosystem change. In reviewing the list of indicators presented in Table 8.2, indicators of diversity were found to be well developed at a global level for some taxa e.g. mammals and amphibians, while at sub-global scales these are supplemented by measures and indicators of genetic and ecosystem diversity. However, measures of functional diversity, relevant to many ecosystem services, remain under-developed.

Indicators of quantity e.g. changes in ecosystem extent (e.g. forest area), in species abundances (e.g. number of waterbirds) or in biomass and productivity are relatively well developed at global and sub-global levels for ecosystems and species, as well as often easily associated with indicators of provisioning service levels (e.g. fish stocks). However, these indicators often focus only on a narrow range of species and ecosystems, and often do not include useful non-food plant and animal species.

Indicators of condition or quality e.g. habitat fragmentation, population integrity and extinction risk indicators (e.g. Biodiversity Intactness Index (BII), Red List Index (RLI)) are quite common and widely used in science and policy reporting. They have been applied at global and sub-global levels and are useful communication tools, but require careful disaggregation and interpretation. They are data and knowledge intensive in development.

Indicators of anthropogenic drivers are very common, often reflecting changes in the main drivers of biodiversity loss e.g. habitat loss and fragmentation, alien invasive species or pollution levels.

They are also often used to construct aggregated indices including Living Planet Index (LPI) and the Ecological Footprint. These indicators are very useful communication tools, but require careful thought in linking them to the relevant aspects of biodiversity change.

10.5.2 Indicators of benefits

Across ecosystem service categories, several reviews have found current indicators inadequate for characterizing the diversity and complexity of the benefits provided by ecosystem services (Table 2). Most current indicators focus on provisioning services, although emphasis is on delivery and market value, often ignoring wild food, capture fisheries, aquaculture and genetic resources. Indicators for regulating services are under development and include supply, delivery and often value measures. Spatially explicit models, remote sensing, national statistics and field estimations are available for some regulating services, but lack of data is a key constraint in their development. Cultural services are difficult to elicit, except for the case of ecotourism, as they are highly context dependent and depend on world visions and deep values. Measures of spiritual or religious values are absent and even for measures of tourism, recreation and aesthetic value, data availability is limited and the indicators often fare poorly in ability to convey information. Recent work by (Daniel et al. 2012) may provide some future options for the development of cultural service measures and indicators.

10.5.3 Indicators of Nature's Contribution to Human Wellbeing

Indicators of nature's contribution to human wellbeing translate the amount of good or service delivered to people into the significance for a person's welfare. Many indicators of human wellbeing exist, and have been the focus of decades of development and discussion. While many now reflect the diverse components of human wellbeing (MA, 2003) and provide information relevant to numerous decision contexts, few capture the specific role of nature (Daw et al. 2011).

For example, consider several of the indicators used by national governments to report on the Millennium Development Goals. This set of indicators will likely be a strong starting point for those used in developing indicators for the post-2015 Development Goals. These indicators are also used broadly by national governments to report on other international agreements and for internal decision making. One leading indicator is child malnutrition rate, used to track nutritional health. Nature may contribute to nutritional health through agricultural supporting services and wild-harvest provisioning services (e.g. fish, bushmeat). While child malnutrition rates may change in response to a changing natural resource base, they may also change as a result of diseases that affect nutritional health or in response to other drivers of food availability (policies, food aid programs, etc). As such, child malnutrition is not a useful indicator of nature's contribution to nutritional health. Similarly, poverty is often indicated as the number of people living on less than $1 per day. It has been shown that the poor are often disproportionately reliant on nature, and so nature may contribute significantly to increases in their income. A more direct indicator of this benefit from nature would be the proportion of people advanced over the poverty line by nature-based income. The employment to population ratio is a popular indicator of jobs, but captures all kinds of jobs, not just those supported by nature. To capture this ecosystem service, an indicator such as the nature-based employment to population ratio would be needed. In many development contexts, the proportion of the population with access to medical services is used as an indicator of overall health care provision. To isolate the provisioning ecosystem service provided by medicinal plants, we would need a different indicator such as the proportion of the population reliant on traditional medicine.

Few of the human wellbeing metrics and indicators regularly reported address the role of nature in achieving the captured human condition. Examples do exist, including the proportion of total water resources used, an indicator used in reporting on the Millennium Development Goals. Assessments can create indicators by creatively combining some existing data sets and doing targeted additional data collection to focus on the specific links between ecosystem services and human wellbeing.

Household surveys and national census information offer an avenue worth exploring for assessments (see Tallis et al. 2012).

10.5.4 Value Indicators (also see Chapter 5)

Indicators of nature's contribution to human wellbeing tell us how much better off people are because of benefits from the environment. They do not, however, tell us how much people value being better off in each case. Someone may receive more nutrition from wild-harvested food, but not find much value in that change if they were not hungry before, or see no difference in their health because of that change in food. Similarly, a farmer may enjoy higher crop yields because of native pollination, but not highly value that service because of other more dominant issues with wellbeing, such as a debilitating medical condition. A few farms down, a coffee farmer may not highly value increased yields from native pollination because of a saturated coffee market with low prices. We need a separate set of value indicators to reflect people's preferences for receiving different benefits in different contexts.

In a perfectly functioning market economy, people reveal this value by choosing how much to consume of each good or service on the basis of how much it contributes to their wellbeing relative to its price. In such a system, we could use observed market prices and quantities purchased to measure the value people hold for receiving ecosystem services. In our examples above, the first farmer would not spend money on fertilizer to increase yields because all income may be needed to pay for medical expenses. The second farmer would not pay for pollination (by renting domestic bee hives, etc.) because they would not have a viable market for improved yields. Most provisioning services are captured in markets and we can use market values as value indicators.

However, in the current global economic system, many ecosystem service values are not captured in existing markets. In the absence of market-derived values, other methods can be used to derive monetary indicators, such as people's willingness to pay for a given amount of an ecosystem good or service, or willingness to accept to give up an amount of good or service. Such indicators should be sure to reflect nature's contribution to the benefit people receive. For example, an indicator of people's willingness to pay to visit a tourism destination does not isolate the value that nature adds. Instead, it reflects the value of the whole tourism experience, from aesthetics to activities offered, to the quality of the food or accommodation, to the ease of access. In addition, value indicators should be related to a certain amount of service in a certain context. People seldom hold a constant value for a good or service. A familiar case is water scarcity, where people are willing to pay more for a given amount of water, (e.g. 1 litre) when water is scarce than when water is abundant. Similarly, people may express a higher willingness to pay for access to an important cultural site if it is the last of their social group's cultural sites than if it is one of hundreds already easily accessible.

Indicators of monetary value, regardless of method of determination (e.g. market, willingness to pay) are still insufficient to capture all values provided by ecosystem services. Many cultural values, spiritual values and existence values provide intangible experiences that are not captured well in any current valuation approaches. In these cases, stepping back the 'supply chain' of ecosystem services to human wellbeing indicators is a good interim alternative. While these indicators clearly lack important preference information, they at least place the importance of an ecosystem service in the context of a person's wellbeing.

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Section V: Enhancing the Utility of Assessments for Decision Makers and Practitioners

IPBES aims to encourage decision makers and other practitioners to use its assessment findings, as set out in its third function: “Promote the development and use of policy support tools and methodologies so that the results of assessments can be more effectively applied with a particular focus on policy support tools”.

This section describes ways of making assessment findings useful for decision-makers and practitioners. The first chapter focuses on policy support tools and methodologies. It draws on the work of the expert group for Deliverable 4c, including the guide and in particular the Catalogue of Policy Support Tools. The second chapter focuses on communication and stakeholder engagement. While there is a communication and stakeholder engagement plan for IPBES, it is recommended that assessments (particularly regional, national and local assessments), have their own plan to ensure that the assessment process is relevant, credible and legitimate to end users. This is a short chapter outlining key principles, and issues around communication and stakeholder engagement with reference to other key resources.

Chapter 11: Policy support tools and methodologies

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11.1 IPBES and policy support tools and methodologies

There is a wide range of policy support tools and methodologies available for different purposes, at various stages of the policy cycle. Despite the abundance of ecosystem service-related tools, there have been few systematic reviews or evaluations of ecosystem services tools that have determined their strengths, weaknesses, and applicability to various settings or that have simultaneously applied several tools to a common study area (Bagstad et al. 2013). Consequently, it is often difficult for decision-makers, at different scales, to access information on policy support tools and methodologies, or to identify how relevant these tools and methodologies might be for their specific context.

To address this challenge, IPBES will support decision-makers forming and implementing policy by identifying policy-relevant tools and methodologies (including those arising from assessments) and making them easier for decision-makers to access. Where necessary, the Platform will also catalyse the further development of policy support tools and methodologies[9]. An expert group has been established to support the MEP and Bureau in developing a ‘Catalogue of Policy Support Tools and Methodologies’ in order to provide guidance on how the further development of such tools and methodologies could be promoted and catalysed in the context of the Platform. This catalogue and guidance will be reviewed at the 3rd Plenary session in January 2015 (IPBES 3/3/5; IPBES 3/INF/8).

[9] UNEP/IPBES.MI/2/9, 19 Appendix1, paragraph 1(d)

This chapter is based on draft guidance developed by the expert group, which provides a clear definition and explanation of what 'policy support tools and methodologies' are and conceptualizes these in the context of IPBES objectives, functions and its conceptual framework (IPBES 3/3/5; IPBES 3/INF/8). The draft guidance also suggests how the further development of the policy tools and methodologies could be promoted and catalysed and recommends how policy tools and methodologies could be more systematically identified, made accessible and disseminated by the Platform. Collectively, the catalogue and guidance seek to serve the needs of a range of social actors, focusing primarily, but not exclusively, on diverse decision-makers and implementing bodies and information providers and brokers. They also provide a channel for IPBES to engage in dialogues with other conventions and initiatives with similar visions and complementary mandates to explore possible synergies on the use and further development of relevant tools and methodologies.

11.1.1 What are policy support tools and methodologies?

The draft guidance (IPBES 3/3/5; IPBES 3/INF/8) defines policy support tools and methodologies as:

"Policy support tools and methodologies are approaches and techniques based on science and other knowledge systems that can inform and assist policy-making and implementation at local, national, regional and international levels to protect and promote nature, nature's benefits to people, and a good quality of life."

This definition seeks to include all tools and methodologies that can contribute to desired outcomes for people and nature in relation to biodiversity and ecosystem services. Such a broad definition is needed to support the development of a comprehensive catalogue and guidance that is useful for policy makers, member states, allied organisations, and other stakeholders.

The context of policy support tools and methodologies is important. Specifically, they need to be understood in the context of socio-ecological challenges and what can be done to tackle them. Figure 11.1 provides a simple illustration of the interrelation of policy formulation, policy instrument design and implementation, and policy support tools and methodologies for biodiversity loss and degradation of ecosystem services.

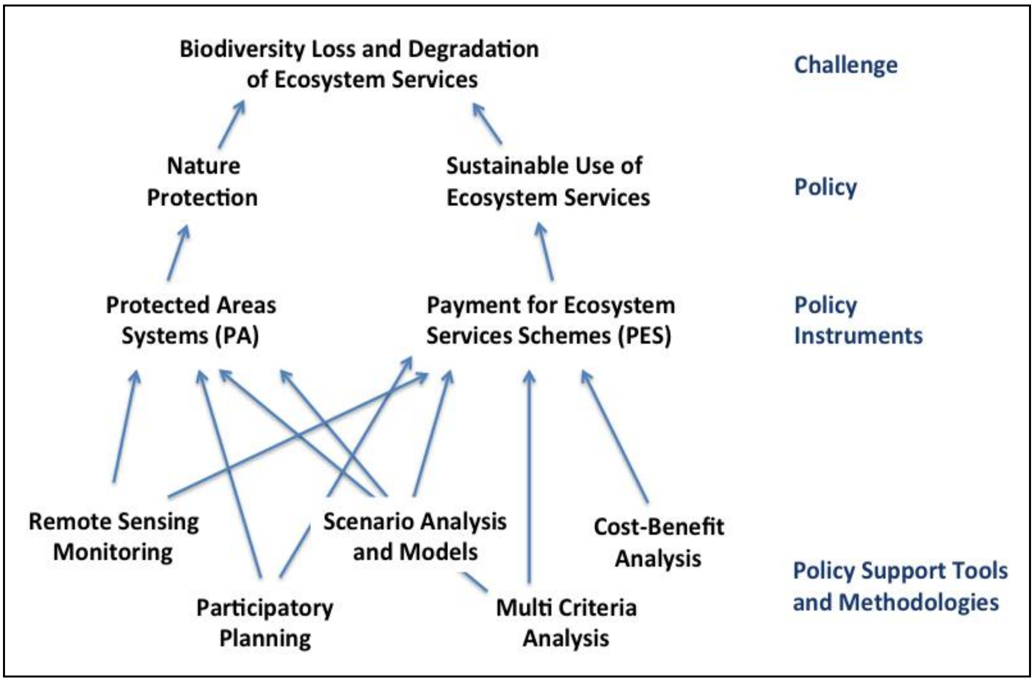

Figure 11.1: Schematic representation of the context of policy support tools and methodologies. Source: IPBES 3/3/5 and IPBES/3/INF/8

In accordance with the IPBES mandate, it is suggested the policy support function of IPBES should focus on:

1. enabling decision makers across scales to gain easy access to identified policy support tools and methodologies to better inform and assist the different phases of policy making and implementation.

2. allowing more tailored information on policy tools to be easily accessible to users of the catalogue.

3. identifying gaps in tools and methodologies and propose the need to develop new ones.

These goals will be achieved through the development of an online, user-focused platform. In addition to being a repository of high quality information on available policy support tools and methodologies, the catalogue will enable decision-makers, practitioners and other social groups to adopt a step-wise approach to identify the most relevant tools and methodologies for their individual needs.

A seven family typology of approaches and techniques has been proposed by the expert group based on the broad challenges that may arise in the development and implementation of sound policy for the benefit of people and nature. Box 11.1 provides a list of these families and gives examples of tools and methodologies for each one.

Box 11.1: Proposed families of policy support tools and methodologies with examples

1. **Assembling data and knowledge (including monitoring)** – indicators, oral history, mapping of ecosystem services, census data, population dynamics.
2. **Assessment and evaluation** – trade-off analysis, management effectiveness, trend analysis, indigenous and community conserved areas (ICCAs) identification and assessment, quantitative modelling, cost-benefit analysis / non-monetary valuation, scenarios.
3. **Public discussion, involvement and participatory process** – expert interviews, stakeholder consultation, cultural mapping and implications for policy goals and criteria, social media tools.
4. **Selection and design of policy instruments** – instrument impact evaluation, ex-ante evaluation of options and scenarios, designing of individual territory sets or systems of protected areas.
5. **Implementation, outreach and enforcement** – audits, risk-based enforcement effort, process standards (e.g. ISO) , MRV (monitoring reporting and verification)
6. **Capacity building** – handbooks, manuals, guides, e-learning resources, training, education, knowledge sharing.
7. **Social learning, innovation and adaptive governance** – strategic adaptive management, social learning theory.

Source: IPBES 3/3/5 and IPBES/3/INF/8

The catalogue of policy support tools and methodologies will eventually be able to provide further guidance on how to use the tools and methodologies it contains.

11.1.2 What role do assessments play in relation to policy support tools and methodologies?

In the context of IPBES, assessments relate to policy support tools and methodologies in three distinct dimensions. Firstly, assessments are an important policy support tool in their own right. Assessment reports and the assessment process itself have become powerful tools in environmental governance. Whether regulated in the context of e.g. Environmental Impact Assessments or as a result of a larger international initiative, such as the Millennium Ecosystem Assessment, assessment reports and processes have become critical tools within policy making, in particular for the agenda setting and review phase of the policy-cycle.

Secondly, as part of their process, assessments also incorporate and utilize other policy support tools and methodologies. For example, they use scenarios (see Chapter 6 on Scenarios; Henrichs et al. 2010) to explore future changes to ecosystems and services they deliver, and valuation methodologies to better understand the trade-offs in the different kinds of values within and among stakeholders (see Chapter 5 on Values). Policy support tools can also help to visualise and communicate the findings of an assessment to different audiences. For instance, maps can be effective tools for displaying spatial variation in the delivery of ecosystem services at numerous scales. Further examples of tools and methodologies can be found in Box 11.1.

Thirdly, assessments are key mechanisms for identifying effective policy responses or policy instruments, as well as the policy support tools and methodologies needed to implement these policy instruments in the most rigorous and effective way. An assessment can evaluate the effectiveness of a range of policy instruments with different contexts, sectors and scales (such as Protected Areas Schemes or Payments for Ecosystem Services Schemes). They can also identify which policy support tools and methodologies have been used in implementing these policy instruments and their strengths and weaknesses (e.g. availability of the tool and/or data needed to feed it, effectiveness, practicability and replicability of current and emerging policy support tools and methodologies). They can identify gaps and what is needed to further strengthen the policy support tools and methodologies.

In ensuring that all IPBES assessments identify and assess the availability, effectiveness, practicability and replicability of current and emerging policy support tools and methodologies, as well as their gaps and needs, IPBES assessments will also provide a key mechanism to provide substance to the catalogue of policy support tools and methodologies and keep it up-to-date as new tools and methodologies are made available.

11.2 Guidance on identifying and assessing policy support tools and methodologies

IPBES assessments play a key role in identifying and assessing current and emerging policy support tools and methodologies. In particular, when assessing the effectiveness of policy responses or policy instruments, assessments should systematically identify and assess policy support tools and methodologies as defined by the expert group on deliverable 4c. In doing so, the assessments should address aspects such as the availability, effectiveness, practicability and reliability of policy support tools and methodologies, as well as their requirements, needs and gaps.

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- Bagstad, K.J., Semmens D.J., Waage, S., Winthrop, R. (2013) A comparative assessment of decision-support tools for ecosystem services quantification and valuation. Ecosystem Services 5: 27–39. http://www.sciencedirect.com/science/article/pii/S221204161300051X

- Henrichs, T., Zurek, M., Eichhout, B., Kok, Kasper, Raudsepp-Hearne, C., Ribeiro, T., Vuuren, D. van & Volkery, A. (2010) Scenario development and analysis for forward-looking ecosystem assessment. (2010) In: Ecosystems and Human Well-being: A Manual for Assessment Practitioners. Ash, N., Blanco, H., Brown, C., Garcia, K., Henrichs, T., Lucas, N., Raudsepp-Hearne, C., Simpson, R.D., Scholes, R., Tomich, T.P., Vira, B., and Zurek, M. (Eds). Island Press, Washington D.C. Available at: http://www.unep-wcmc.org/resources-and-data/ecosystems-and-human-wellbeing--a-manual-for-assessment-practitioners

- IPBES 3/3/5. Deliverable 4(c) guide on policy support tools and methodologies. Available at: http://www.ipbes.net/plenary/ipbes-3.html

- IPBES 3/INF/8. Update on deliverable 4(c) policy support tools and methodologies. Available at: http://www.ipbes.net/plenary/ipbes-3.html

- The Catalogue of Policy Support Tools and Methodologies will be a key resource once it has been developed.

Chapter 12: Communication and stakeholder engagement

12.1 Communication

Communication and outreach are necessary to ensure that assessment results are put into use have an impact. An assessment itself can be thought of as a communication tool between researchers and decision-makers, as it translates scientific information into policy-relevant information. If an assessment is technically proficient but fails to communicate, it tends to fail overall. Therefore, choosing the best ways to present the information from the assessment to the intended audiences deserves great care (Box 12.1). The overall products should be readable, understandable, and unambiguous.

Box 12.1 Target groups and report style

Decision-makers
Content should be short, specific, fact-based and consist of the latest information.

Media
Content should be short and consist of findings relevant for broad audiences, with messages that can easily be linked to other issues in the news.

Students
Content should be well explained, and the language should be simple.

Scientists
Content should be fact based and rely on the latest data. The language can be scientific and include technical terms.

Indigenous and Local Knowledge (ILK) Holders
Content should be simple, straightforward, problem-oriented in terms of addressing local concerns and disseminated via the most suitable, possibly non-published, media

Source: UNEP, 2007

A communication strategy should be developed at the outset and followed carefully, with continuous communication and capacity building throughout the assessment process. The main purpose of developing a communication strategy at the start of the assessment is to ensure the right people are communicated with at the right time via the right media, with salient and useful information (Box 12.2). It helps to focus resources on the specific communication ideas that are most beneficial to achieving the overall assessment goal. Once the data analysis has reached a conclusion, communication of the key findings and messages is very important.

Box 12.2: Developing a comprehensive communications plan ensures effective outreach

The Millennium Ecosystem Assessment in Biscay (EEMBizkaia) is a local scale assessment which has achieved success due to a clear outreach and coordination strategy. An extensive communication plan was carried out in coordination with researchers, local authorities and NGOs, ensuring stakeholder participation from the outset and the subsequent socialisation of results. Key aspects of this communication plan included:

- Involving stakeholders at multiple stages of the assessment; either in educational workshops, research surveys and interviews, or sharing results via conferences or modern media channels.
- Encouraging direct contact and continuous communication between all stakeholders and the technical assessment team to voice problems and concerns and guide outputs.
- Specifically, local, national and international conferences and workshops were conducted to articulate the assessment benefits to key audiences. This was alongside continuous development of outreach materials and publications in both specialised journals and the general public media, including short, simple audio-visual media to convey key messages in a friendly manner and engage diverse interest groups. Further, continuous communication with international partners and other multidisciplinary teams, particularly the Millennium Ecosystem Assessment of Spain, ensured coordinated efforts, engagement with the wider community and scaling of results.
- With widespread buy-in from a range of key stakeholder, results of the assessment are being integrated into policy and implemented by local technical authorities.

Source: Booth et al. (2012)

When developing a comprehensive communications strategy, consider who to engage and how best to engage them and build this in to the overall assessment timeline. Using different languages and communication tools for different audiences, can help focus on their specific priorities. Tips on how to present assessment findings in a variety of ways from the Guidance Manual for TEEB Country Studies (2013) include:

- Producing a synthesis report (see Chapter 3) and accompanying presentations for use by stakeholders
- Focusing the assessment key findings to show the relevance and benefits for each stakeholder (see Box 12.3)
- Using different avenues for dissemination of results e.g.
    - Briefings for government
    - Press coverage (articles and interviews)
    - Launch events and/or workshops
    - Publication of studies in academic journals
    - Electronic communications such as websites, e-newsletters and social media (see Box 12.4)
- Using specialist writers to help convey complicated or technical messages to non-technical audiences

- Producing visual aids such as charts, graphs and pictures to easily communicate messages within the text. Use of these supporting visuals may also increase the chance of greater media coverage (UNEP, 2007)

- Encouraging eminent members of the assessment to act as ‘champions’, opening channels within their sectors and to higher levels of authority

Box 12.3 UK National Ecosystem Assessment Follow-on Phase Knowledge Exchange Strategy

In 2011 the UK National Ecosystem Assessment (UK NEA) delivered a wealth of information on the state, value (economic and social) and possible future of terrestrial, freshwater and marine ecosystems across the UK, but also identified a number of key uncertainties. A two-year ‘follow-on phase’ (UK NEAFO) was initiated in 2012 in order to further develop and promote the arguments that the UK NEA put forward and make them applicable to decision and policy making at a range of spatial scales across the UK to a wide range of stakeholders.
Following extensive stakeholder engagement, it was decided that the synthesis report of the UK NEAFO would include a series of stand-alone reports that summarise the key findings from the UK NEA and UK NEAFO that are most relevant for specific audiences and end users. These audiences were:

- national government departments;
- government agencies;
- local authorities;
- general public;
- businesses;
- environmental nongovernmental organisations; and
- the research community.

The reports were written by or with individuals from each of the target audience groups in a collaborative process with the report lead authors. The targeted reports demonstrate the usefulness of the assessment outputs across a range of user groups and help these groups to acquire a greater understanding of the assessment key messages. They also serve to create a sense of ownership of the central assessment output by further engaging stakeholders in the assessment process.

Source: UK NEA (2014)

Box 12.4. The Spanish National Ecosystem Assessment’s (EME) Communication Strategy.

The general aim of the communication strategy of the EME is to build a social network around the vision of nature conservation as a necessary action for human wellbeing. To achieve this general aim, the following objectives were set:

- To coordinate internal communication elements that allow proper scientific exchange between the research teams involved in the project under the integrated and inclusive framework of the Millennium Ecosystem Assessment.

- To bring the development of the EME to the attention of stakeholders and listen to their needs and contributions regarding ecosystem services to ensure that the results will be useful to them as well as taking into account the different actors involved in or dependent on ecosystem services.

- Develop external communication tools tailored to the needs of different target audiences or stakeholders as well as innovative formats and channels for the dissemination of the results of EME in different social spheres, such as the media, school communities, NGOs and social movements.

- Characterize the messages that define the approach of the project regarding the human-nature relationship as well as building a graphic identity for the project and amplifying its messages through existing channels and networks.
- Contribute to the international dissemination and projection of the Millennium Assessment (included the participants in the Sub-global Assessment Network) and other national and international collaboration channels associated with the project.
- Increase the interaction and information flow between the scientific community, policy-makers, businesses and society in general to improve decision making in the management of ecosystems according to the project's objectives.

Source: Evaluación de los Ecosistemas del Milenio de España (2014)

12.2 Stakeholder engagement

Stakeholder involvement is often central to creating the appropriate enabling environment to undertake an assessment. The core principles of successful assessments (relevance, credibility and legitimacy) are best achieved through strategic and effective participation of all relevant stakeholders in the assessment process. Having different stakeholders involved in an interactive process can promote knowledge and information exchange and allows for different groups express their positions and interests on issues. Furthermore the involvement of multiple stakeholders can enrich the process, with individuals and organisations working to a common goal, with ownership contributing to the authorisation environment. Stakeholder involvement in assessment can take the following forms[10]:

- Being consulted on the needs for an assessment;
- Being consulted on key questions framing the assessment;
- Receiving information about assessment progress, findings, and opportunities to participate;
- Contributing knowledge to the assessment report;
- Contributing contextual information about an ecological or social system;
- Being consulted on the condition and trends of ecosystem services and human well-being in a region (practitioners and holders if local knowledge);
- Attending a public hearing about assessment processes and findings;
- Attending education or capacity building workshops on assessment processes and findings;
- Participating in the assessment process as student interns or fellows of the assessment;
- Participating in the assessment governance;
- Being a formal end user of the assessment products;
- Participating in the peer review of the assessment; and
- Acting as a partner for the dissemination of assessment findings.

Stakeholder involvement may involve some or all of the options outlined above, and the scale at which the assessment is taking place may influence the most appropriate involvement of stakeholders. However, there are risks involved with including a wide-range of stakeholders, which may include lobby groups and therefore stakeholder involvement should be clearly planned in order not to jeopardise the

[10] MA Methods Manual

independence of the assessment. A conflict of interest policy is likely to be an important within your stakeholder plan.

12.3 References

Booth, H., Simpson, L., Ling, M., Mohammed, O., Brown, C., Garcia, K. & Walpole, M. (2012). *Lessons learned from carrying out ecosystem assessments: Experiences from members of the Sub-Global Assessment Network.* UNEP-WCMC, Cambridge

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Section VI Strengthening Capacities in the Science - Policy interface

This section deals with capacity building under the fourth function of IPBES, *Identify and prioritize capacity building needs for improving the science-policy interface at appropriate levels, and provide, call for and facilitate access to the necessary resources for addressing the highest priority needs directly relating to its activities.* Assessments are often viewed as vehicles for developing capacity at different scales (e.g. learning through doing).

This section draws upon the work of the Task Force for Capacity Building and sets out the opportunities available to build capacity through IPBES and elements which assessment practitioners working at national and local scales might like to consider when planning an assessment.

Chapter 13 Identifying and addressing Capacity Building Needs through Assessments

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13.1 The capacity building function of in IPBES

Capacity building is a fundamental element of IPBES' work. It is committed to improving human, institutional and technical capacities for the informed and effective implementation and use of assessments, for the development and use of policy support tools and methodologies, and for improving access to necessary data, information and knowledge. It aims not only to enable experts and institutions to contribute to and benefit from IPBES' own deliverables, but also to more generally improve the science-policy interface. Its efforts are geared towards fully integrating capacity building into the implementation of the work programme, as well as to enhancing the enabling environment for its implementation. Capacity building is supported and facilitated through the IPBES Trust Fund, and in addition IPBES will catalyse support for capacity building through its matchmaking facility. This facility aims at matching priority capacity building needs related to its activities with financial and technical resources.

13.2 Issues, concepts and definitions of key terms

13.2.1 Capacity building in IPBES

The focus of capacity building in IPBES is set out in the resolution establishing IPBES[11] (UNEP 2012). The IPBES programme of work 2014-2018 identifies two capacity building deliverables, which address the following issues:

- ***Priority capacity building needs to implement the Platform's work programme are matched with resources through catalyzing financial and other in kind support***. Priority capacity building needs will be identified based on submissions from member states and observers, and through the scoping of Platform deliverables (including the various assessments). The Platform is also mandated to provide a "forum" with conventional and potential sources of funding which

[11] Adopted on 21 April 2012 by the second session of the Plenary meeting to determine modalities and institutional arrangements for an intergovernmental science-policy platform on biodiversity and ecosystem services in Panama City, 16-21 April 2012 in Panama City, Panama

amongst other things would advise the Plenary on the identification of priority capacity-building needs and the acceptance of financial and in- kind support. The forum would also oversee a web-based "matchmaking facility" set up to help to match available technical and financial resources with priority capacity-building needs.

- ***Ensure that capacities needed to implement the Platform's work programme are developed***. Capacity-building activities will address the priority needs identified under the previous deliverable. Activities would include technical assistance, training workshops, fellowship and exchange programmes and support for the evolution of national, subregional and regional science-policy networks, platforms and centres of excellence, including consideration of indigenous knowledge systems where appropriate. These activities would constitute an integrated part of the processes for delivering the assessment, data management and policy support tools set out in other deliverables of the work programme. Capacity-building would be supported through, and build on, a geographically widespread network of institutions and initiatives.

Terms of reference for an IPBES Task Force on Capacity Building were agreed by the second IPBES Plenary. Following a nomination process, a task force of 20 members has been appointed who serve together with two members of the IPBES Bureau, and two members of the IPBES Multidisciplinary Expert Panel. Additional resource persons can be invited at the discretion of the co-chairs of the task force. The Technical Support Unit for the task force is provided as in-kind support by the Norwegian Environment Agency.

The task force and its technical support unit will help to identify and address the prioritized capacity-building needs agreed by the Plenary, drawing on resources made available through the Platform's trust fund or provided through additional in-kind financial and technical resources. Periodically, the task force will analyse the extent to which priority capacity-building needs identified by the Platform have been addressed.

13.2.2 Priority capacity building needs

Priority capacity building needs are those that have been agreed by the IPBES Plenary. The Task Force on capacity building has recommended that the highest priority capacity-building needs are those that fulfil the following criteria:

(a) They can be addressed through activities that are integrated into deliverables of the Platform's work programme (resourced through the Platform trust fund, in-kind contributions, the capacity-building forum and the matchmaking facility);

or:

(b) They can be addressed through activities which enable the implementation of the Platform's work programme (resourced through the capacity-building forum and the matchmaking facility);

and in both cases:

(c) They are driven by demands expressed and promote the sustainability of capacity-building over time, including by building on existing initiatives and institutions;

(d) They stimulate awareness of and engagement with the Platform and support the implementation of and interlinkages among multilateral environmental agreements.The Platform acknowledges with appreciation the expressions of capacity-building needs received through submissions and consultations. The expressions are summarized and categorized in the table below. The table also suggests how such needs can be matched with resources.

Drawing on the expressions of capacity-building needs identified in the table, the following initial priority needs are proposed, together with the most appropriate approach for identifying sources of support:

(a) Focus on the ability to participate in the Platforms deliverables; primarily addressed through the proposed fellowship, exchange and training programme, with the priority placed on the Platform's regional assessments. This would be resourced through the Platform's trust fund and in-kind contributions. The extent and reach of this programme will be increased over time by facilitating the mobilization of resources through the capacity-building forum and the piloting of a prototype matchmaking facility;

(b) Focus on enhancing the capacity to undertake and use national assessments of biodiversity and ecosystem services, by facilitating the development and implementation of proposals based on expressions of interest. Facilitation will be resourced through the Platform's trust fund and in-kind contributions, while support for the development and implementation of national project proposals will be sought through the capacity-building forum and the piloting of a prototype matchmaking facility;

(c) Focus on the development and implementation of pilot or demonstration projects addressing other categories of needs, by facilitating the development and implementation of proposals based on expressions of interest. Facilitation will be resourced through the Platform's trust fund and in-kind contributions, while support for the development and the implementation of national project proposals will be sought through the capacity-building forum and piloting of the matchmaking facility.

Capacity-building needs identified by members and other stakeholders, and potential sources of support for addressing their needs

Capacity need categories	*Needs identified by governments and other stakeholders*	*Potential source of support*		
		Trust Fund	*Matchmaking facility*	*Notes*
1. Enhance the capacity to participate effectively in implementing the Platform's work programme	1.1 Develop the capacity for effective participation in the Platform's regional and global assessments	✓	✓	Priority for the Platform's trust fund, largely delivered through the fellowship, exchange and training programme Supplemented through the Platform's matchmaking facility
	1.2 Develop the capacity for effective participation in the Platform's thematic assessments	✓	✓	
	1.3 Develop the capacity for effective participation in the Platform's methodological assessments and for the development of policy support tools and methodologies	✓	✓	
	1.4 Develop the capacity for monitoring national and regional participation in the implementation of the Platform's work programme, and responding to deficiencies identified	✓		
2. Develop the capacity to carry out and use national and regional assessments	2.1 Develop the capacity to carry out assessments, including on the lines of the Economics of Ecosystems and Biodiversity (TEEB) initiative		✓	Priority for the Platform's matchmaking facility

Capacity need categories	*Needs identified by governments and other stakeholders*	*Potential source of support*		
		Trust Fund	*Matchmaking facility*	*Notes*
	2.2 Develop the capacity to use assessments to support policy development and decision-making	(✓)	✓	
	2.3 Develop the capacity to develop and use non-market-based methods of valuing biodiversity and ecosystem services		✓	
	2.4 Develop the capacity to assess specific priority habitats and ecosystems, including ecosystems that cross ecological and political boundaries	(✓)	✓	
	2.5 Develop the capacity to develop and effectively use indicators in assessments		✓	
	2.6 Develop the capacity to value and assess management options and effectiveness		✓	
	2.7 Develop the capacity to retrieve and use all relevant data, information and knowledge		✓	
3. Develop the capacity to locate and mobilize financial and technical	3.1 Develop the institutional capacity to locate and mobilize financial and technical resources		✓	Pilot project(s) through the Platform's matchmaking facility

Capacity need categories	*Needs identified by governments and other stakeholders*	*Potential source of support*		
		Trust Fund	*Matchmaking facility*	*Notes*
resources	3.2 Develop the capacity for clearly communicating capacity-building needs to potential providers of financial and technical support		✓	
4. Improve the capacity for access to data, information and knowledge (including the experience of others)	4.1 Develop the capacity for improved access to data, information and knowledge including its capture, generation, management and use (including indigenous and local knowledge)		✓	Pilot project(s) through the Platform's matchmaking facility
	4.2 Develop the capacity to gain access to data, information and knowledge managed by internationally active organizations and publishers		✓	
	4.3 Develop the capacity for enhancing collaboration among research institutions and policymakers at national and regional levels, in particular for encouraging multidisciplinary and cross-sectoral approaches		✓	
	4.4 Develop the capacity for the conversion of scientific and social assessments of biodiversity and ecosystem services into a format easily understood by policymakers		✓	

Capacity need categories	*Needs identified by governments and other stakeholders*	*Potential source of support*		
		Trust Fund	*Matchmaking facility*	*Notes*
	4.5 Develop the capacity to understand how to combine modern science with local and indigenous knowledge, including facilitating the effective engagement of indigenous and local communities, scientists and policymakers	(✓)	✓	
	4.6 Develop the capacity to gain access to and use technologies and networks that support biodiversity taxonomy, monitoring and research		✓	
5. Develop the capacity for enhanced and meaningful multi-stakeholder engagement	5.1 Develop the capacity for effective engagement of stakeholders in assessment and other related activities at the national level, including for understanding who the stakeholders are and how they should be engaged		✓	Pilot project(s) through the Platform's matchmaking facility
	5.2 Develop the capacity for effective communication of why biodiversity and ecosystem services are important, and why their many values should be used in decision-making		✓	

Capacity need categories	*Needs identified by governments and other stakeholders*	*Potential source of support*		
		Trust Fund	*Matchmaking facility*	*Notes*
	5.3 Develop the capacity to effectively use the Platform's deliverables in implementing national obligations under biodiversity-related multilateral environmental agreements		✓	

13.2.3 Access to technical and financial resources

IPBES is mandated to provide a means for catalyzing further funding for capacity building. However this is only part of the story: technical resources are as necessary as financial resources to address priority capacity needs. As a result, IPBES has decided to establish a "matchmaking facility".

A prototype matchmaking facility is being developed to bring together those who have a specific capacity building need with expert practitioners, guidance or financial resources appropriate to meeting that need. The prototype is intended to initially be limited to one or two modules which would support deliverables of the work programme, to prudently and incrementally create a solid foundation for successful matchmaking. The first steps in the IPBES matchmaking process will entail a number of enabling activities: face-to-face contacts and networking activities that encompass regional and global dialogues supported by processes management and an online tool. The intention is to learn from the operation of the prototype and then systematically and over time build up a matchmaking facility in a modular fashion.

IPBES is also mandated to help catalyze financing for capacity-building activities by providing a forum with conventional and potential sources of funding. The IPBES Capacity Building Forum is a potential important venue for a global dialogue between IPBES and relevant public and private institutions on how their missions in capacity building could be aligned. The aim is for IPBES to be a catalyst in creating opportunities for capacity building in the science-policy interface for biodiversity and ecosystem service. The IPBES Bureau has agreed that the first meeting of the Forum will take place in 2015 on the basis of a call for expressions of interest to take part in the forum.

13.2.4 Integrating capacity building into assessments

A fellowship, exchange and training programme is being established by IPBES as a means of both building capacity and supporting delivery of the IPBES work programme, including assessments. This programme will receive support from the IPBES Trust Fund, but further investment of funds will be sought so that the programme can grow over time. Additional funding and technical support for specific activities will also be sought through the Matchmaking Facility.

The will programme consist of a range of different activities, such as fellowships, secondments, exchange programmes, mentoring schemes and training programmes, with varying target groups and durations. The programme aims to:

- build and strengthen individual and institutional capacities in support of the work programme deliverables and the overall functions of IPBES.
- contribute to enhanced science-policy dialogue and knowledge of assessment processes, and the more effective use of knowledge in decision making
- increased cooperation between centres of excellence/institutions

Particular focus during 2014-2018 would be on regional assessments and on all thematic and methodological deliverables of IPBES, included on the data management and policy support tools.

It is well understood that there are many institutions and networks that could play very valuable roles in supporting the scoping and implementation of assessments, and in facilitating and promoting the use of assessment outcomes. These range from universities to "boundary" organizations already working at the science-policy interface, and from observation and data management programmes to private sector associations. Facilitating the engagement of relevant institutions and networks, building capacity, where necessary and promoting collaboration and sharing of experience will be very important.

13.3 Roadmap with recommended practical steps to be followed for different IPBES related assessments

Step 1. Integrate capacity building into the pre-scoping phase

a) Identify the focus of the assessment in question through a pre-scoping process which may include a dialogue among stakeholders (scientists, government officials, policymakers and other stakeholders).

   i. For assessments within the IPBES work programme, the pre-scoping will be taken under the auspices of the MEP and Bureau in line with the process set out in Section 2, Chapter 3.

   ii. For assessments outside the IPBES work programme (such as assessments at national and subregional levels), practitioners are encouraged to consider the need for support for the pre-scoping process. An expression of interest for the need of such support could be submitted to the IPBES Match Making Facility in accordance with its procedures set out above. Support could entail financial and technical resources needed for the preparation, facilitation and undertaking dialogues within the pre-scoping process.

b) Identify the expertise and functions needed for scoping the assessment and institutions for managing the scoping process.

c) Assess the availability of expertise and institutions and the need for capacity to fill any gaps identified.

   i. For assessments within the IPBES work programme, the MEP and Bureau will identify the needs and request the Task Force on Capacity Building through the IPBES technical support unit for capacity building to address those needs.

   ii. For assessments outside the IPBES work programme (such as assessments at national and subregional level), practitioners are encouraged to consider the need for support to building capacities for the scoping process. An expression of interest for the need of such support could be submitted to the IPBES Match Making Facility in accordance with its procedures set out above. Support could entail financial and technical resources.

Step 2. Integrate capacity building into the scoping phase

a) Scope the assessment through a scoping process which include a dialogue among stakeholders (scientists, government officials, policymakers and other stakeholders).

   i. For assessments within the IPBES work programme, the scoping will be taken under the auspices of the MEP and Bureau in line with the process set out in Section 2, Chapter 3.

   ii. For assessments outside the IPBES work programme (such as assessments at national and subregional level), practitioners may want to consider the need for support to the scoping process. An expression of interest for the need of such support could be submitted to the IPBES Match Making Facility in accordance with its procedures set out above. Support could entail financial and technical support for the preparation, facilitation and undertaking dialogues within the scoping process.

b) Identify the expertise and functions needed for undertaking the assessment and institutions for managing the assessment process.

c) Assess the availability of expertise and institutions and the need for capacity to fill any gaps identified.

Step 3. Solicit support for capacity building needs in assessment

a) Solicit support for addressing capacity building in order to fill gaps identified in the scoping process.

i. For assessments within the IPBES work programme, the MEP and Bureau will identify the needs and request the Task Force on Capacity Building through the IPBES technical support unit for capacity building to address those needs.

ii. For assessments outside the IPBES work programme (such as assessments at national and subregional level), scientists, government officials, policymakers and other stakeholders initiating the assessment are encouraged to consider the need for support to building capacities for the assessment process. An expression of interest for the need of such support could be submitted to the IPBES Match Making Facility in accordance with its procedures set out above. Support could entail developing a proposal for financial and technical support to undertaking the assessment in accordance with the scope of the assessment.

Step 4. Integrate capacity building into the assessment process

a) Identify opportunities for capacity building in support of the undertaking of the assessment by Co Chairs, Coordinating Lead Authors, Authors, Reviewers and Peer Review Editors as supported by technical support units through technical assistance and the IPBES Fellowship, exchange and training programme.

i. For assessments within the IPBES work programme, the assessment Co-chairs and the assessment TSU will in consultation with experts and stakeholders involved in the assessment identify the needs and submit them to the Task Force on Capacity Building through the IPBES technical support unit for capacity building to address those needs.

ii. For assessments outside the IPBES work programme (such as assessments at national and subregional level), the assessment Co-chairs and the assessment TSU are encouraged to identify the need for support to building capacities for the assessment process in consultation with experts and stakeholders involved in the assessment. An expression of interest for the need of such support could be submitted to the IPBES Match Making Facility in accordance with its procedures set out above. Support could entail financial and technical resources.

Step 5. Identify capacity building needs through the assessment process

a) Use the assessment to identify capacity building needs in the science policy interface relevant to IPBES at all levels. This would apply to both assessments within and outside the IPBES work programme. In assessing capacity building needs authors may want to identify the urgency, importance and quantity of capacity building needs related to aspects of the assessment process.

b) Use the assessment to assess options for how such needs best could be addressed.

Step 6. Use the assessment findings to sustain capacity in the science policy interface

a) Explore ways of capitalising on the capacities built throughout the assessment in processes such as: research, monitoring, and the development of policies and policy support tools. This would apply to both assessments within and outside the IPBES work programme.

b) Enter into a dialogue with scientists, government officials, policymakers and other stakeholders involved in capacity development in order to communicate the assessment findings on capacity building needs.

i. For assessments within the IPBES work programme, the Bureau, MEP and Task Force on Capacity Building as supported by the TSU will use the findings as relevant in implementing the capacity building aspects of the IPBES work programme.

ii. For assessments outside the IPBES work programme (such as assessments at national and subregional level), the assessment Co-chairs and the assessment TSU are encouraged to convey their findings to the IPBES secretariat.

13.4 References

UNEP. (2012). Report of the second session of the plenary meeting to determine the modalities and institutional arrangements for IPBES, UNEP/IPBES.MI/2/9, http://ipbes.net/images/Functions operating principles and institutional arrangements of IPBES 2012.pdf

UNEP. (2013). Report of the second session of the Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, UNEP/IPBES/2/17, decision IPBES-2/5 Annex 1, http://ipbes.net/images/decisions/Decision%20IPBES_2_5.pdf

Glossary

Acceptance of the Platform's global, regional, subregional, eco-regional, thematic and methodological reports at a session of the Plenary signifies that the material has not been subjected to line-by-line discussion and agreement, but nevertheless presents a comprehensive and balanced view of the subject matter.

Adoption of the Platform's reports is a process of section-by-section (and not line-by-line) endorsement, as described in section 3.9, at a session of the Plenary.

Approval of the Platform's summaries for policymakers signifies that the material has been subject to detailed, line-by-line discussion and agreement by consensus at a session of the Plenary.

Acceptance, adoption and preliminary approval of regional reports will be undertaken by the regional representatives at a session of the Plenary, and such reports will be "further reviewed and approved" by the Plenary as a whole

Anthropogenic assets: Built-up infrastructure, health facilities, knowledge (including indigenous and local knowledge systems and technical or scientific knowledge, as well as formal and non-formal education), technology (both physical objects and procedures), and financial assets among others.

Assessment reports are published assessments of scientific, technical and socio-economic issues that take into account different approaches, visions and knowledge systems, including global assessments of biodiversity and ecosystem services, regional, subregional and eco-regional assessments of biodiversity and ecosystem services with a defined geographical scope, and thematic or methodological assessments based on the standard or the fast-track approach. They may be composed of two or more sections including: (a) summary for policymakers; (b) optional technical summary; (c) individual chapters and their executive summaries.

Baseline: A minimum or starting point with which to compare other information (e.g. for comparisons between past and present or before and after an intervention).

Biocultural diversity: The total sum of the world's differences, irrespective of their origin. The concept encompasses biological diversity at all its levels and cultural diversity in all its manifestations. It is derived from the myriad ways in which humans have interacted with their natural surroundings. [UNESCO 2010]

Biodiversity: The variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems. [UNESCO 2010]

Biosphere: The sum of all the ecosystems of the world. It is both the collection of organisms living on the Earth and the space that they occupy on part of the Earth's crust (the lithosphere), in the oceans (the hydrosphere) and in the atmosphere. The biosphere is all the planet's ecosystems.

Bureau: means a subsidiary body established by the Plenary which carries out the administrative functions agreed upon by the Plenary, as articulated in the document on functions, operating principles and institutional arrangements of the Platform.

Cosmocentric: a vision of reality that places the highest importance or emphasis in the universe or nature, as opposite to and anthropocentric vision, which strongly focuses on humankind as the most important element of existence.

Drivers (of change): All the external factors that cause change in nature, anthropogenic assets, nature's benefits to people and a good quality of life. They include institutions and governance systems and other indirect drivers and direct drivers (both natural and anthropogenic).

Drivers, anthropogenic direct: Elements of direct drivers that are the result of human decisions, namely, of institutions and governance systems and other indirect drivers.

Drivers, direct: Drivers (both natural and anthropogenic) that operate directly on nature (sometimes also called pressures).

Drivers, indirect: Drivers that operate by altering the level or rate of change of one or more direct drivers. [Millennium Ecosystem Assessment 2005]

Drivers, institutions and governance and other indirect: The ways in which societies organize themselves. They are the underlying causes of environmental change that are external (exogenous) o the ecosystem in question [Millennium Ecosystem Assessment 2005].

Drivers, natural direct: Direct drivers that are not the result of human activities and are beyond human control.

Ecosystem functioning: The flow of energy and materials through the arrangement of biotic and abiotic components of an ecosystem. It includes many processes such as biomass production, trophic transfer through plants and animals, nutrient cycling, water dynamics and heat transfer. The concept is used here in the broad sense and it can thus be taken as being synonymous with ecosystem properties or ecosystem structure and function.

Ecosystem services: The benefits (and occasionally disbenefits or losses) that people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; and cultural services such as recreation, ethical and spiritual, educational and sense of place. In the original definition of the Millennium Ecosystem Assessment the concept of "ecosystem goods and services" is synonymous with ecosystem services. Other approaches distinguish "final ecosystem services" that directly deliver welfare gains and/or losses to people through goods from this general term that includes the whole pathway from ecological processes through to final ecosystem services, goods and anthropocentric values to people.

Ecosystems goods: According to the Millennium Ecosystem Assessment, they are included in the general definition of ecosystem services. According to other approaches, they are objects from ecosystems that people value through experience, use or consumption. The use of this term in the context of this document goes well beyond a narrow definition of goods simply as physical items that are bought and sold in markets, and includes objects that have no market price.

Good quality of life: The achievement of a fulfilled human life, the criteria for which may vary greatly across different societies and groups within societies. It is a context-dependent state of individuals and human groups, comprising aspects such access to food, water, energy and livelihood security, and also health, good social relationships and equity, security, cultural identity, and freedom of choice and action.

“Living in harmony with nature”, “living-well in balance and harmony with other Earth” and “human well-being” are examples of different perspectives on good quality of life

Human well-being: See well-being.

Indigenous and local knowledge system (ILK): A cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment. It is also referred to by other terms such as e.g. Indigenous, local or traditional knowledge, traditional ecological/environmental knowledge (TEK), farmers’ or fishers’ knowledge, ethnoscience, indigenous science, folk science.

Institutions: Encompass all formal and informal interactions among stakeholders and social structures that determine how decisions are taken and implemented, how power is exercised and how responsibilities are distributed.

Knowledge system: A body of propositions that are adhered to, whether formally or informally, and are routinely used to claim truth.

Level of resolution: Degree of detail or contemplated detail captured in an analysis. A high level of resolution implies a highly detailed analysis, usually associated with finer spatial and temporal scales. A low level of resolution implies a less detailed analysis, usually associated with coarser spatial and temporal scales.

Living in harmony with nature: A perspective on good quality of life based on the interdependence that exists among human beings, other living species and elements of nature. It implies that we should live peacefully alongside all other organisms even though we may need to exploit other organisms to some degree.

Living-well in balance and harmony with Mother Earth: A concept originating in the visions of indigenous peoples worldwide which refers to the broad understanding of the relationships among people and between people and Mother Earth. The concept of living-well refers to: (a) balance and harmony of individuals considering both the material and spiritual dimensions; (b) balance and harmony among individuals taking into account the relationship of individuals with a community; and (c) balance and harmony between human beings and Mother Earth. Living-well means living in balance and harmony with everybody and everything, with the most important aspect being life itself rather than the individual human being. Living-well refers to living in community, in brotherhood, in complementarity; it means a self-sustaining, communitarian and harmonic life.

Mother Earth: An expression used in a number of countries and regions to refer to the planet Earth and the entity that sustains all living things found in nature with which humans have an indivisible, interdependent physical and spiritual relationship.

Multidisciplinary Expert Panel: means a subsidiary body established by the Plenary which carries out the scientific and technical functions agreed upon by the Plenary, as articulated in the document on functions, operating principles and institutional arrangements of the Platform.

Nature: The natural world, with particular emphasis on biodiversity.

Nature’s benefits to people: All the benefits (and occasionally disbenefits or losses) that humanity obtains from Nature.

Plenary: means the Platform's decision-making body comprising all the members of the Platform.

Policy tools: Instruments used by governance bodies at all scales to implement their policies. Environmental policies, for example, could be implemented through tools such as legislation, economic incentives or dis-incentives, including taxes and tax exemptions, or tradeable permits and fees.

Policy support tools and methodologies: approaches and techniques based on science and other knowledge systems that can inform and assist policy making and implementation at local, national, regional and international levels to protect and promote nature, nature's benefits to people, and a good quality of life.

Policy instruments: structured activities by means of which decision-making authorities attempt to realize or achieve a decision to ensure support and effect or prevent social change in order to address an identified challenge. (Vedung, 2011).]

Reports means the main deliverables of the Platform, including assessment reports, synthesis reports and their summaries for policymakers and technical summaries, technical papers and technical guidelines.

Scenarios: Plausible alternative future situations based on a particular set of assumptions. Scenarios are associated with lower certainty than projections, forecasts or predictions. For example, socio-economic scenarios are frequently based on storylines describing several alternative, plausible trajectories of population growth, economic growth and per capita consumption, among other things. These are commonly coupled with projections of impacts on biodiversity and ecosystem services based on more quantitative models. The term "scenarios" is sometimes used to describe the outcomes of socio-economic scenarios coupled with models of impacts, owing to the high uncertainty associated with the socio-economic trajectories.

Scoping is the process by which the Platform will define the scope and objective of a deliverable and the information, human and financial requirements to achieve that objective.

Session of the Plenary means any ordinary or extraordinary session of the Platform's Plenary.

Session of the Bureau means a series of meetings of the elected members of the Bureau of the Plenary and the Multidisciplinary Expert Panel co-chair(s).

Session of the Panel means a series of meetings of the elected members of the Platform's Multidisciplinary Expert Panel and agreed observers (the Bureau of the Plenary and chairs of the subsidiary scientific bodies of multilateral environmental agreements, and the Chair of the Intergovernmental Panel on Climate Change).

Social-ecological system: A bio-geo-physical unit and its associated social actors and institutions. Social-ecological systems are complex and adaptive and are delimited by spatial or functional boundaries surrounding particular ecosystems and their specific context.

Synthesis reports synthesize and integrate materials contained within the assessment reports, are written in a non-technical style suitable for policymakers and address a broad range of policy-relevant questions. They are composed of two sections: (a) summary for policymakers; (b) full report.

Summary for policymakers is a component of any report, providing a policy-relevant but not policy prescriptive summary of that report.

Supporting material consists of four categories:

(a) Intercultural and interscientific dialogue reports that are based on the material generated at the eco-regional level by discussions between members of academic, indigenous and social organizations and that take into account the different approaches, visions and knowledge systems that exist as well as the various views and approaches to sustainable development;

(b) Workshop proceedings and materials that are either commissioned or supported by the Platform;

(c) Software or databases that facilitate the use of the Platform's reports;

(d) Guidance materials (guidance notes and guidance documents) that assist in the preparation of comprehensive and scientifically sound Platform reports and technical papers.

Systems of life: The complex, integrated interactions of living beings (including humans), such as the cultural attributes of communities, socio-economic conditions and biophysical variables.

Technical papers are based on the material contained in the assessment reports and are prepared on topics deemed important by the Plenary.

Technical summary is a longer and more technical summary of the material contained in the summary for policymakers.

Trend: The general direction in which the structure or dynamics of a system tends to change, even if individual observations vary.

Validation of the Platform's reports is a process by which the Multidisciplinary Expert Panel and the Bureau provide their endorsement that the processes for the preparation of Platform reports have been duly followed.

Values: Those actions, processes, entities or objects that are worthy or important (sometimes values may also refer to moral principles).

Values, bequest: The satisfaction of preserving the option of future generations to enjoy nature's benefits.

Values, existence: The satisfaction obtained from knowing that nature endures.

Values, instrumental: The direct and indirect contributions of nature's benefits to the achievement of a good quality of life. These values are conceived in terms of preference satisfaction.

Values, intrinsic: The values inherent to nature, independent of human experience and evaluation, and therefore beyond the scope of anthropocentric valuation approaches.

Values, option: The potential ability to use some nature's benefits in the future, although they are not currently used or the likelihood for their future use is low. It represents the willingness to preserve an option for the future enjoyment of nature's benefits.

Values, relational: The values that contribute to desirable relationships, such as those among people and between people and nature, as in "Living in harmony with nature".

Value systems: Set of values according to which people, societies and organizations regulate their behaviour. Value systems can be identified in both individuals and social groups and thus families, stakeholder groups and ethnic groups may be characterized by specific value systems.

Well-being: A perspective on a good life that comprises access to basic materials for a good life, freedom and choice, health and physical well-being, good social relations, security, peace of mind and spiritual experience.

Annex 4

IPBES Deliverable 2(a)

Guide on the production and integration of assessments from and across all scales

Contact Information

Name:

Institute:

E-mail address:

General Comments

Please provide any general comments concerning the draft note on deliverable 2b which presents assessment options and rationale for five regional scoping reports:

Specific Comments

Please provide specific comments in this section using the table below. If you do not use this table, please be sure to clearly indicate the specific page number and line number to which your comments refer. Note that you may enter general comments using this table if you wish, by specifying Page 0 (general comments for the entire document).

Page	Line	Comment
1	5	Comment… (*this is an example of an entry)*
0		Comment… (*this is an example of an entry of a general comment)*
		To add additional rows, select "Table", "Insert", "Rows Below"