System of Environmental Economic Accounting

SEEA-related Indicators
for the Kunming-Montreal Global Biodiversity Framework

ADVANCED DRAFT: Compilation Guidelines for GBF headline indicator A.2 Extent of natural ecosystems

This advanced draft of the Compilation Guidelines has been prepared for information for the twenty-eighth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA-28) of the Convention on Biological Diversity (CBD). The Guidelines are being developed by the United Nations Statistics Division, with the support of an expert group convened under the auspices of the Technical Committee on SEEA Ecosystem Accounting of the United Nations Committee of Experts on Environmental-Economic Accounting (UNCEEA). Their development has also been informed by an Expert Group Meeting on SEEA-related indicators for the Kunming–Montreal Global Biodiversity Framework (GBF), held in February 2026. Following a final Expert Group Meeting scheduled for November 2026, a revised version of the Guidelines will be made available for public consultation.

This version of the guidelines was produced in July 2026 and is available as part of the portfolio of ‘other documents’ on the SBSTTA-28 webpages and the “SEEA- related Indicators for the Global Biodiversity Framework” project website. It is being circulated for information purposes only, and has not been finalized, endorsed, or released for public consultation.

Funded by the European Union

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Contents

List of tables

List of figures

List of boxes

Preface

These guidelines have been produced by the United Nations Statistics Division (UNSD) to support monitoring and reporting on the Kunming-Montreal Global Biodiversity Framework (GBF), adopted by the 15th Conference of the Parties of the Convention on Biological Diversity (CBD) in 2022. The production of the guidelines has been funded by the European Union under the “Neighbourhood, Development and International Cooperation Instrument”.

The GBF sets out an ambitious pathway to reach the global vision of a world living in harmony with nature by 2050. To support the implementation of the GBF, a monitoring framework has also been adopted as an essential tool for measuring progress towards achieving its ambitious goals and targets. The UNSD is the methodological custodian for two of the 26 headline indicators in the monitoring framework: Indicator A.2 Extent of natural ecosystems and Indicator B.1 Services provided by ecosystems, both of which use the System of Environmental-Economic Accounting (SEEA) Ecosystem Accounting as their methodological basis. The guidelines presented here are intended to support Parties to the CBD in reporting on Indicator A.2, with companion guidelines available for Indicator B.1. In the process of developing these indicators, it is hoped that countries will also advance their journey towards developing the full set of SEEA ecosystem accounts, which can go hand in hand with the suite of indicators for the GBF in enabling better policy, planning and decision-making for achieving the GBF vision of a world living in harmony with nature.

These guidelines have been developed through a collaborative process involving the statistical community and the biodiversity community, under the auspices of the United Nations Committee of Experts on Environmental-Economic Accounting (UNCEEA) including its Technical Committee on SEEA Ecosystem Accounting. The SEEA was initially conceived at the same time as the establishment of the CBD, and these guidelines represent a continuation of the legacy of the statistical and biodiversity communities working together to provide indicators that policy makers, planners, decision makers and the public can use with confidence.

Acknowledgements

To be confirmed.

Acronyms

ABNJ	Areas beyond national jurisdiction
CBD	Convention on Biological Diversity
DQAF	Data quality assessment framework
EBSA	Ecologically or Biologically Significant Marine Area
EFG	Ecosystem functional group
EEZ	Exclusive Economic Zone
ET	Ecosystem type
F	Freshwater realm in the Global Ecosystem Typology
FAO	United Nations Food and Agriculture Organisation
FM	Freshwater-Marine transitional realm in the Global Ecosystem Typology
GBF	Kunming-Montreal Global Biodiversity Framework
GDP	Gross Domestic Product
GET	IUCN Global Ecosystem Typology
IPLCs	Indigenous Peoples and local communities
IUCN	International Union for the Conservation of Nature
KBA	Key Biodiversity Area
LCCS	FAO Land Cover Classification System
M	Marine realm in the Global Ecosystem Typology
MFT	Marine-Freshwater-Terrestrial transitional realm in the Global Ecosystem Typology
MT	Marine-Terrestrial transitional realm in the Global Ecosystem Typology
OECM	Other Effective Area-based Conservation Measure
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice
SEEA	System of Environmental Economic Accounting
SDG	Sustainable Development Goal
SNA	System of National Accounts
T	Terrestrial realm in the Global Ecosystem Typology
TF	Terrestrial-Freshwater transitional realm in the Global Ecosystem Typology
UNCEEA	United Nations Committee of Experts on Environmental-Economic Accounting
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNSD	United Nations Statistics Division
WDPA	World Database of Protected Areas

1 Introduction

The Kunming-Montreal Global Biodiversity Framework (GBF) sets out an ambitious pathway to reach the global vision of a world living in harmony with nature by 2050. Among the Framework's key elements are four goals for 2050 and 23 action-based targets for 2030. It also includes a monitoring framework with 26 headline indicators linked to the goals and targets of the GBF, on which all Parties to the CBD are obliged to report progress at regular intervals as part of their national reports to the CBD. More information on the GBF and its monitoring framework is available here.

Two of the headline indicators, A.2 Extent of natural ecosystems and B.1 Services provided by ecosystems, use the System of Environmental-Economic Accounting (SEEA) Ecosystem Accounting as their methodological basis. Metadata sheets for each of the headline indicators, including their rationale and high-level discussion of methods and data requirements, are available here.

The **purpose of these guidelines** is to provide practical guidance to countries for compiling and reporting on GBF Indicator A.2 Extent of natural ecosystems, building on the metadata for the indicator. The guidelines are intended to be adaptable to countries at different stages of implementation of SEEA Ecosystem Accounting, and with varying levels of data availability and institutional readiness. Preliminary and interim options are provided for countries that have not yet developed SEEA ecosystem accounts, enabling them to compile and report on the indicator even in the absence of existing ecosystem extent accounts.

In addition, the guidelines should facilitate a common understanding of the indicator within and across countries. At the national level, the guidelines should support the development of a strategic approach for regular compilation of the indicator. National reporting to the CBD is coordinated through national CBD Focal Points, typically based in a country's environment ministry, while implementation of SEEA Ecosystem Accounting is typically led national statistical offices. This means that developing and reporting on Indicators A.2 and B.1 will require collaboration between the environment ministry and the national statistical office, as illustrated in Figure 1. In addition, most countries will have other national entities with mandates and technical competencies relevant to the development of the indicators, making multi-institutional cooperation essential to ensure credibility and consistency of the indicators and avoid duplication of effort.

The guidelines have been developed to reflect the requirements and guidance provided in various CBD decisions and documents related to the monitoring framework and headline indicators. Central aspects include the need for indicators to reflect diverse value perspectives on biodiversity, the need for national priorities and capabilities to inform compilation of indicators, preference for the use of national datasets as the primary source for compiling indicators, and the importance of indicators being compiled through national processes and monitoring systems. GBF indicators are intended not simply to fulfil global reporting requirements, but to play a central role in informing national biodiversity policy, planning, decision-making and action.

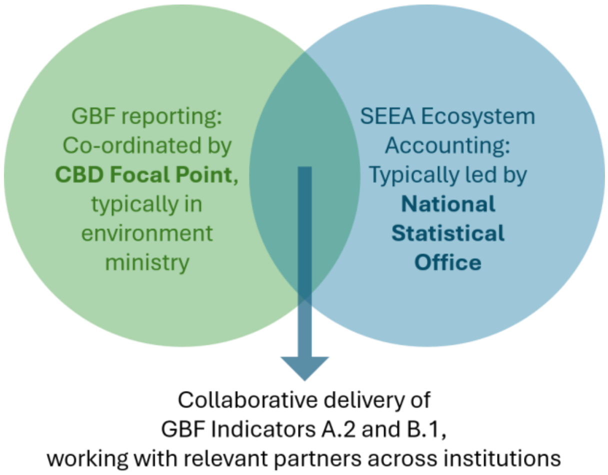

Figure 1. Inter-institutional collaboration is essential for the delivery of the SEEA-related GBF headline indicators

The **main intended users** of these guidelines are the teams of people directly involved in compiling the indicator, who would typically be drawn from several institutions, requiring strong inter-institutional collaboration as emphasised above. National statistical offices already engaged in compiling ecosystem accounts will benefit from this resource, which will help to ensure that their work directly supports the compilation of the indicator. The guidelines may also be useful for those developing datasets used in the indicator, which could be housed in several different institutions. Further, the guidelines are likely to be useful for global partners and initiatives aimed at supporting countries in compiling GBF indicators. Lastly, the guidelines may be useful to those concerned with mainstreaming biodiversity into decision-making using SEEA Ecosystem Accounting, including in the context of Target 14 of the GBF.

These guidelines do not replace the metadata for the indicator. However, *all content from the metadata that is needed for compiling the indicator has been included in these guidelines.* Users of the guidelines may wish to consult the metadata, but the intention is that users should not need to switch between the guidelines and metadata to have a complete picture of the indicator and its compilation.

The metadata for all GBF headline indicators are considered living documents. This version of the Compilation Guidelines for Indicator A.2 corresponds with the version of the metadata submitted to the 28th meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) of the CBD, available in the "Updated metadata for the headline indicators for the Kunming-Montreal Global Biodiversity Framework" (CBD/SBSTTA/28/INF/4, published 3 July 2026). The intention is that future revisions to the metadata will, where necessary, be reflected in subsequent versions of these guidelines.

These guidelines provide:

- A recap of key information from the metadata for the indicator, including the rationale for the indicator and key concepts, definitions and classifications,
- Additional guidance on key concepts and definitions covered only briefly in the metadata, for example, the distinction between natural and anthropogenic ecosystems and related concepts,

- Further guidance on the role of the IUCN Global Ecosystem Typology, including its ecosystem functional groups, in relation to the indicator,
- High-level guidance on institutional co-ordination required for compiling the indicator,
- A stepwise approach to compiling the indicator, taking into account different levels of readiness and data availability in different countries, including preliminary options for countries that do not yet have ecosystem extent accounts,
- Guidance on key national datasets required for the indicator, and on the use of global datasets as an interim option in the absence of national datasets,
- Guidance on computation methods and disaggregations of the indicator,
- Guidance on reporting on the indicator as part of national reporting to the CBD via its Online Reporting Tool.

These guidelines do *not* provide:
- Background or general information on the GBF monitoring framework,
- Detailed guidance on ecosystem accounting methods,
- Detailed guidance on the development of specific datasets required for Indicator A.2, such as national ecosystem maps,
- Detailed guidance on institutional processes at the national level for compiling the indicator, which will vary from country to country according to their national context and circumstances.

See Section 11 for short descriptions of complementary resources that are available.

The guidelines are structured in two parts, shown in Figure 2.
- Part A describes the context and rationale for the indicator, and explains the key concepts, definitions and classifications that underpin it.
- Part B provides a sequence of steps to compile and report on the indicator, with practical guidance on each step.
- The guidelines conclude with a brief description of related resources and a glossary of key terms.

Figure 2. Structure of the Compilation Guidelines for Indicator A.2

PART A. CONTEXT, CONCEPTS, CLASSIFICATIONS

2 Context and rationale for the indicator

This section provides the context for Indicator A.2, including the GBF goal and target to which it relates and its relationship to the suite of ecosystem-related indicators of the GBF. It discusses the rationale for and intent of the indicator and outlines the advantages of taking an accounting approach to compilation of the indicator. Lastly, limitations and caveats for interpretation of the indicator are discussed.

1.1 Indicator A.2 as a headline indicator for Goal A and Target 1

Indicator A.2 Extent of natural ecosystems is defined in the indicator metadata as follows: "*At the national level, the extent of natural ecosystems as a proportion of total area of the country*[1] *at a particular point in time, expressed as a percentage.*"

Indicator A.2 is one of four headline indicators for **Goal A** of the GBF, which focuses on protecting and restoring biodiversity. The Goal reads:

> *"**The integrity, connectivity and resilience of all ecosystems are maintained, enhanced, or restored, substantially increasing the area of natural ecosystems by 2050**;*
> *Human induced extinction of known threatened species is halted, and, by 2050, the extinction rate and risk of all species are reduced tenfold and the abundance of native wild species is increased to healthy and resilient levels;*
> *The genetic diversity within populations of wild and domesticated species, is maintained, safeguarding their adaptive potential."*

The three components of Goal A reflect the ecosystem, species and genetic components of biodiversity respectively. Indicator A.2 relates to the ecosystem component of the goal, in bold above, which also has the headline indicator, A.1 Red List of Ecosystems. *Indicators A.1 and A.2 should always be viewed as a pair of ecosystem-related indicators for Goal A*, as well as being seen as part of the broader suite of ecosystem-related indicators in the GBF.

Indicator A.2 is also one of three headline indicators for GBF **Target 1** Plan and manage all areas to reduce biodiversity loss, which reads:

> *"Ensure that all areas are under participatory integrated biodiversity inclusive spatial planning and/or effective management processes addressing land and sea use change, to bring the loss of areas of high biodiversity importance, including ecosystems of high ecological integrity, close to zero by 2030, while respecting the rights of indigenous peoples and local communities."*

Indicator A.2 relates particularly to the element of Target 1 that refers to "*addressing land and sea use change*". To the extent that areas of high biodiversity importance and ecosystems of high

[1] As discussed in Section 6, for countries with marine territory, the indicator should be reported separately for the total inland area and the total marine area.

ecological integrity fall within the scope of natural ecosystems, Indicator A.2 also relates the element of Target 1 that aims "*to bring the loss of areas of high biodiversity importance, including ecosystems of high ecological integrity, close to zero by 2030*".

1.2 Rationale for Indicator A.2

The metadata for Indicator A.2 includes the following paragraphs relating to the rationale for the indicator:

> 1. Natural ecosystems are the foundation of biodiversity, providing the conditions necessary for a wide array of life forms to coexist and thrive. The conversion of natural ecosystems to intensively modified or anthropogenic ecosystems, driven by human interventions such as urban development, the intensification and expansion of agriculture, and infrastructure development, is one of the main drivers of biodiversity loss and is reflected in the reduction of the area of natural ecosystems. Conversely, ecological restoration efforts can result in increases in the area of natural ecosystems.
>
> 2. This indicator aims to show the extent of natural ecosystems as a proportion of overall area, and to track changes in this proportion over time. This responds to the element of Goal A that refers to *"substantially increasing the area of natural ecosystems by 2050"*. The indicator also responds to the elements of Target 1 that refer to *"addressing land and sea use change"*, *"to bring the loss of areas of high biodiversity importance, including ecosystems of high ecological integrity, close to zero by 2030"*. The indicator is recommended to be disaggregated into different natural ecosystem types, providing insights into the relative abundance or scarcity of different natural ecosystem types as well as their relative rates of loss or gain over time.
>
> 3. The term *"natural ecosystem"* refers broadly to ecosystems where the impact of humans on ecosystem composition, structure and function are low compared to natural factors (Secretariat of the CBD, 2022). Natural ecosystem types in this broad sense can include ecosystems *modified* by human interventions but with natural compositional, structural and functional characteristics still at least partially present and recognisable. These are referred to as semi-natural ecosystems in some contexts. In contrast, anthropogenic ecosystem types are those *created and maintained* through human interventions, i.e. human interventions are the *primary determinant* of the composition, structure and functioning of the ecosystem.
>
> 4. The term natural ecosystem is used in the indicator in a broad sense for several reasons:
> (a) Natural ecosystems that have been modified often retain substantial biodiversity and are thus important from a biodiversity perspective. This contrasts with anthropogenic (including artificial and intensively modified) ecosystems, which support much less biodiversity. Thus, the key distinction from a biodiversity perspective is between natural ecosystem types on the one hand (which include modified natural ecosystems), and anthropogenic ecosystem types on the other.
> (b) If modified natural ecosystems were excluded from the indicator, this may have the unintended consequence of reducing attention to their management, conservation and in some cases restoration.
> (c) In practice there are virtually no ecosystems that are completely unimpacted by people and there is no agreed scientific basis for making firm distinctions between natural, near-natural and semi-natural ecosystems, which exist on a continuum, so a narrow definition of natural ecosystems (i.e. as "pristine" or having high integrity) would make the indicator difficult to operationalise. In contrast, classification systems exist to distinguish between natural ecosystem types and anthropogenic ecosystem types.

The overall intent of Indicator A.2 is to show the extent of natural ecosystems as a proportion of total area (of a country, a region or the globe), and to track changes in this proportion over time.

This provides information about the abundance of all natural ecosystems combined relative to all anthropogenic ecosystems combined. The indicator will reflect all declines in natural ecosystem extent, including declines resulting from conversion of natural ecosystems to anthropogenic ecosystems, which is a major direct driver of biodiversity loss. It is also intended to reflect increases in the extent of natural ecosystems, including from ecological restoration of anthropogenic ecosystems to natural ecosystems. Both these aspects of the indicator are discussed further below.

The broad understanding of the term "natural ecosystems" highlighted in paragraphs 3 and 4 of the metadata is discussed in Section 3 of these Guidelines, including definitions of natural and anthropogenic ecosystem types with examples and borderline cases. Natural ecosystems include ecosystems modified by a range of human activities, including through long-term traditional management practices, for example by Indigenous Peoples.

While Indicator A.2 in its basic form reflects a binary distinction between natural and anthropogenic ecosystems, ecosystem-based disaggregations of the indicator can provide much richer information. The indicator is intended to be disaggregated by realm, biome and ecosystem functional group (see Section 9.2), and disaggregation by detailed ecosystem types at the national level is also encouraged. This means that in addition to reflecting aggregate declines or increases in the extent of natural ecosystems relative to anthropogenic ecosystems, the indicator can provide insights into the relative abundance or scarcity of different biomes, ecosystem functional groups and ecosystem types, as well as their relative losses or gains over time.[2] This can support compilation of several of the component indicators for Goal A of the GBF, and is essential for Indicator A.2 to fulfil its role as part of the suite of ecosystem-related headline indicators of the GBF (see Section 1.3).

While the indicator itself shows proportions (of natural and anthropogenic ecosystems overall, and disaggregated proportions of different biomes, ecosystem functional groups and ecosystem types), absolute values are also available as countries provide these when reporting on the indicator, again supporting more detailed insights and applications of the indicator.

As noted in the metadata, the conversion of natural ecosystems to anthropogenic ecosystems, driven by human activities such as urban development, intensification and expansion of agriculture, and infrastructure development, is one of the main direct drivers of biodiversity loss. Some examples of such conversions, which would be captured in the indicator as a decline in the extent of natural ecosystems relative to anthropogenic ecosystems, include:

- Conversion from tropical-subtropical lowland rainforests (EFG T1.1)[3] to palm oil plantations (EFG T7.3),
- Conversion from temperate grasslands (EFG T4.5) to herbaceous croplands (EFG T7.1),
- Conversion from trophic savannas (EFG T4.1) to settlements (EFG T7.4),
- Conversion of permanent lowland rivers (EFG F1.2) (often along with surrounding floodplains and wetlands, e.g. EFG TF 1.4, TF 1.5) to large reservoirs (EFG F3.1),

[2] The indicator itself does not provide information on which ecosystem types have changed to which. However, this information can be derived from ecosystem type change matrices that are often developed together with ecosystem extent accounts. The change matrix presents the changes in extent between ecosystem types, as well as the area of each ecosystem type that remained stable, allowing for more precise interpretations.

[3] EFGs refer to ecosystem functional groups in the Global Ecosystem Typology. See Section 4.2.

- Conversion from desert shrublands (EFG T5.1) to solar energy facilities (EFG T7.4),
- Conversion from coastal shrublands (EFG MT2.1) to built coastal infrastructure (EFG MT3.1),
- Conversion from seasonal floodplain marshes (EFG TF1.4) to rice paddies (EFG F3.3).

In addition to tracking the overall conversion of natural to anthropogenic ecosystems, the indicator can help in identifying main direct drivers of conversion from natural to anthropogenic ecosystems, such as agricultural expansion, plantation development and expansion of urban settlements. However, this is only possible if the anthropogenic portion of the basic indicator is disaggregated into different anthropogenic ecosystem groups or types.

Indicator A.2 is also intended to reflect *increases* in the extent of natural ecosystems, including from ecological restoration[4] of anthropogenic ecosystems to natural ecosystems as well as passive recovery of abandoned or unused anthropogenic ecosystems to natural ecosystems. The indicator is agnostic to the mechanism by which natural ecosystem area is gained, provided the area now meets the definition of a natural ecosystem type (Section 3.4). Examples of changes that would be captured as increases in the extent of natural ecosystems relative to anthropogenic ecosystems include:
- Restoration of artificial wetlands or small dams (EFG F3.2) to natural wetlands (within the TF1 biome),
- Restoration of croplands (EFG T7.1) to a natural grassland ecosystem (within biome T4),
- Restoration of coffee plantations (EFG T7.3) to a natural forest ecosystem (within biome T1),
- Natural regeneration of abandoned croplands (EFG T7.1), pastures (EFG T7.2) or plantations (EFG T7.3) which regain the characteristics of a natural ecosystem.

Both active restoration and passive recovery of anthropogenic ecosystems towards a natural state is typically a gradual process, with context-appropriate thresholds needed to determine when an ecosystem is no longer considered anthropogenic but rather natural. For the purposes of Indicator A.2, the definitions of natural ecosystem types and anthropogenic ecosystem types provide a useful basis for making such assessments.

Instances of anthropogenic ecosystems being restored to natural ecosystems at scale may be relatively rare given the complexity of such restoration, and in many countries their area is likely to be small relative to the area converted from natural to anthropogenic ecosystems. As such, the outcomes of such restoration efforts may not be easy to detect based on changes in Indicator A.2, which reflects the overall net change in the area of natural ecosystems.

Indicator A.2 *will not reflect restoration of natural ecosystems in poor condition to better ecological condition* (linked to the discussion below that Indicator A.2 is not intended to capture information on the integrity or condition of ecosystems). Such restoration efforts should be captured in Indicator 2.1 Area under restoration, and resulting improvements in ecological condition will be reflected in Indicator A.1 if they reduce the risk of ecosystem collapse. Indicators 2.1 and A.1 both provide important complements to Indicator A.2 (see Section 1.3 on the suite of GBF indicators).

[4] Ecological restoration is a form of ecosystem restoration that aims to improve the integrity of natural ecosystems and may in some cases increase the area of natural ecosystems. It is distinguished from rehabilitation, another form of ecosystem restoration, which aims to improve ecosystem functioning and increase nature's contributions to people within anthropogenic ecosystems. (Leadley et al., 2022)

Lastly on the issue of restoration, Indicator A.2 is *not intended to reflect improved management or rehabilitation within anthropogenic ecosystems*, for example through sustainable agriculture initiatives. Biodiversity-friendly management of anthropogenic ecosystems should not be confused with restoration from anthropogenic to natural ecosystems. In some agricultural systems, there are borderline cases between anthropogenic and natural ecosystems, discussed in Section 3.8, and there may be instances in which an anthropogenic agricultural ecosystem type transitions to a natural ecosystem type (not simply a better managed anthropogenic ecosystem type) through restoration efforts. This would be captured as an increase in natural ecosystem extent in Indicator A.2.

The indicator *does <u>not</u> aim to capture information on the integrity or condition of natural ecosystems*. The wording of Goal A refers to the integrity, connectivity and resilience of ecosystems as well as the area of natural ecosystems. Information about the integrity and resilience of ecosystems is captured in headline indicator A.1 Red List of Ecosystems, which is based on an assessment of the risk of collapse of different ecosystem types using the IUCN's categories and criteria for risk status (IUCN, 2024). In addition, many of the component and complementary indicators for Goal A speak to the integrity and connectivity of ecosystems (see discussion below on the suite of ecosystem-related GBF indicators). Changes in ecosystem condition could be caused by human activities that impact directly on ecosystems (such as harvesting of species, pollution, abstraction of water, human-induced fires) or could occur through indirect impacts (such as spread of invasive species, for example wilding exotic pines in native grasslands).

Severe loss of integrity of ecosystems can result in a change in ecosystem type, for example when seagrass meadows (M1.1) transition to subtidal sand beds (M1.7) or kelp forests transition to subtidal rocky reefs (EFG M1.6). Such changes would represent a change from one ecosystem type to another, so insight into such changes is possible through disaggregating Indicator A.2 to ecosystem functional groups. Loss of integrity that results in a change in ecosystem type is also a form of ecosystem collapse[5] that would be included in Red List of Ecosystem assessments and be reflected in Indicator A.1.

Figure 3 provides a schematic summary of the information that is and is not reflected in Indicator A.2, showing that the indicator reflects conversion of natural to anthropogenic ecosystems and restoration of anthropogenic to natural ecosystems, but not changes in ecosystem condition.

[5] In the Red List of Ecosystems, ecosystem collapse is the endpoint of ecosystem decline, when an ecosystem loses its defining features (i.e. species assemblages, structure and functions) and is replaced by a different, often depauperate, ecosystem type.

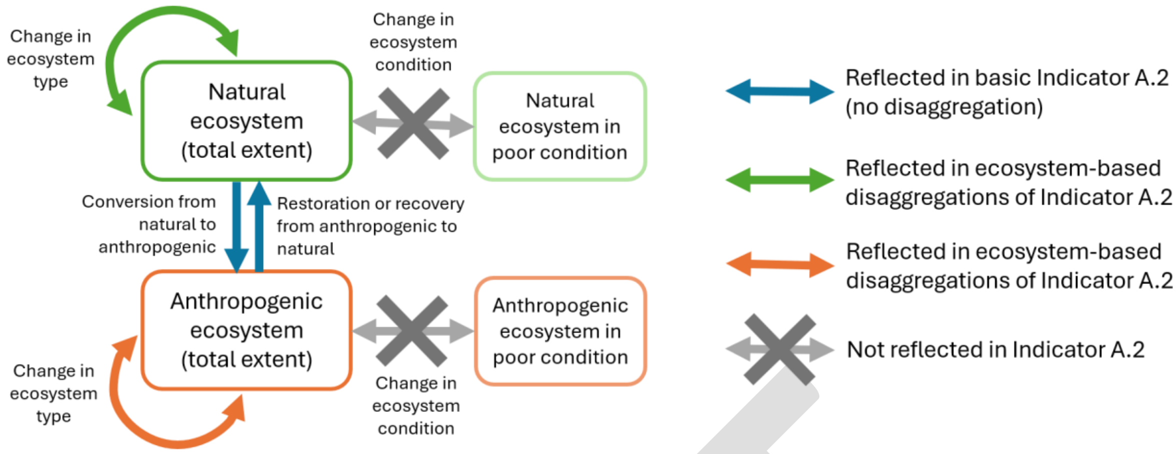

Figure 3. Indicator A.2 reflects conversion of natural to anthropogenic ecosystems and restoration of anthropogenic to natural ecosystems (shown with blue arrows), but not changes in ecosystem condition (shown with grey arrows). Disaggregation of the indicator is important for giving insight into changes in the extent of different ecosystem groups or types.

(Source: Adapted from Leadley et al., 2022)

Figure 4 shows a hypothetical example of what the basic Indicator A.2 might look like compared across several countries for a particular year.[6] A global value can then be calculated by combining these country-level values. In this example, natural ecosystems make up 85% of country A's total area, 10% of country J's total area, and 50% of total global area. Regional or continental values could also be calculated. Disaggregations of the indicator by biome or ecosystem functional group could be illustrated in a more detailed version of the graph, with each bar disaggregated into its constituent biomes or ecosystem functional groups

Figure 5 shows a hypothetical example of what the basic Indicator A.2 might look like for one country over several years, illustrating a decline in the proportion of natural ecosystems over time from 100% historically to 60% in 2025. As with the multi-country example, disaggregations of the indicator by biome or ecosystem functional group could be illustrated in a more detailed version of the graph, with each bar subdivided into its constituent biomes or ecosystem functional groups.

[6] In practice, the indicator may represent a period of a few years rather than strictly one year as not all countries may be able to report on exactly the same years. See Step 4 Reporting on the indicator (Section 0).

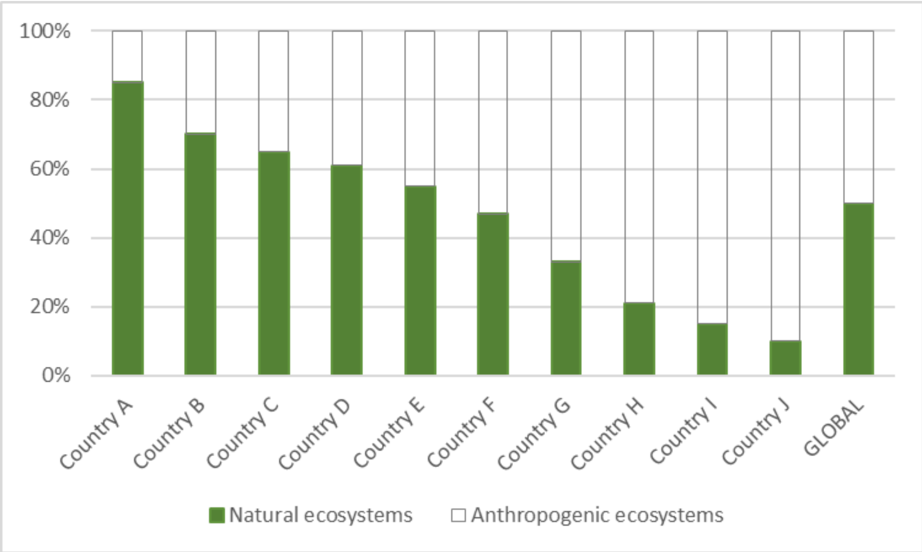

Figure 4. Mock-up of Indicator A.2 Proportion of natural ecosystems for several countries, in year X

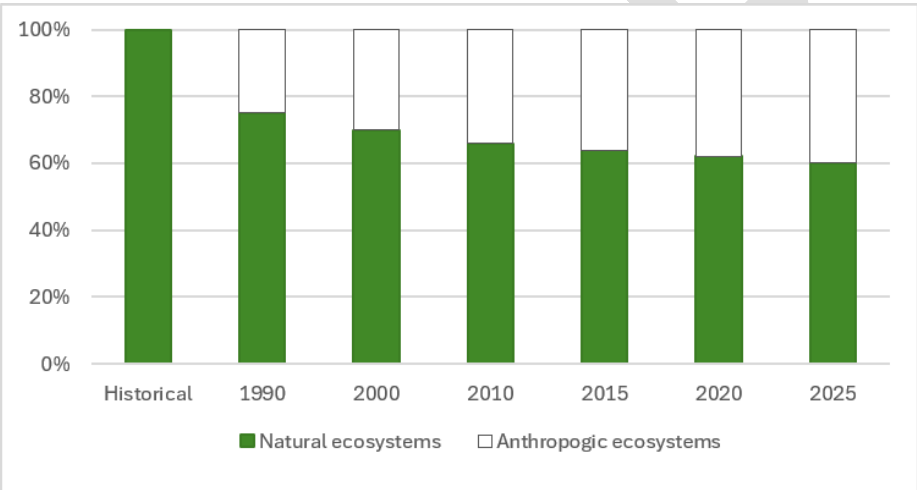

Figure 5. Mock-up of Indicator A.2 for one country, showing several years

1.3 The suite of ecosystem-related GBF indicators

The monitoring framework of the GBF has been developed with the full recognition that it is not possible for any single headline indicator to capture all components or elements of a particular GBF goal or target. Accordingly:

- Many of the goals and targets have more than one headline indicator, capturing different aspects of the goal or target concerned;
- All goals and targets have component and complementary indicators, intended to provide additional information to supplement the headline indicators.

The intention is that all headline indicators should be interpreted and evaluated together with other relevant headline indicators, supported by component and complementary indicators where these are available. They may also be supplemented by additional indicators at the national level.

The five headline indicators of the GBF that deal most directly with ecosystems are set out in Table 1. Together, this set of headline indicators can provide a well-rounded picture of the state of ecosystems, their benefits to society, and interventions to protect and restore ecosystems. The three ecosystem-related headline indicators for Goals A and B (i.e. Indicators A.1, A.2 and B.1) together provide insight into changes in the state and trends of all ecosystems and the services they provide, with each indicator providing different but complementary information. In addition, the headline indicators for Targets 2 and 3 provide information on restoration, conservation and protection efforts.

Table 1. Core ecosystem-related headline indicators of the GBF

Headline indicator	**GBF Goal/Target**	**Notes**
A.1 Red List of Ecosystems	Goal A, Target 1	Based on the IUCN Red List of Ecosystems; Methodological custodian: IUCN
A.2 Extent of natural ecosystems	Goal A, Target 1	Based on SEEA Ecosystem Accounting; Methodological custodian: UNSD
B.1 Services provided by ecosystems	Goal B, Target 11	Based on SEEA Ecosystem Accounting; Methodological custodian: UNSD
2.1 Area under restoration	Target 2	Primary custodian: UN Food and Agriculture Organisation (FAO)
3.1 Coverage of protected areas and other effective area-based conservation measures	Target 3	Draws on the World Database of Protected Areas (WDPA); Methodological custodian: UNEP World Conservation Monitoring Centre

At the country level, coordination between the entities responsible for these five indicators is highly recommended, to ensure a coherent approach that leverages common datasets where possible and enables the indicators to be effectively utilised as a suite. In particular, using a common national ecosystem map across the five indicators will greatly facilitate bringing information together to provide a coherent narrative and to be most useful for policy and implementation. National ecosystem maps include a national classification of ecosystem types and spatial datasets of their distribution, discussed further in Section 7.1. For coherence in global reporting and analysis, it is useful for countries to cross-reference their national ecosystem classification to the IUCN Global Ecosystem Typology – more about this in Section 7.1.4.

If all five ecosystem-related headline indicators are disaggregated using a consistent set of ecosystem types, they can help to answer a set of inter-related questions for specific ecosystem types, further illustrated in Figure 6:

- Indicator A.1: Is this ecosystem type threatened (at risk of collapse), and if so to what degree (e.g. Critically Endangered, Endangered or Vulnerable)?
- Indicator A.2: How much of this ecosystem type still exists? How much is being lost through conversion to anthropogenic ecosystems? How much is being regained, for example through restoration from anthropogenic to natural ecosystems?
- Indicator B.1: What services does this ecosystem type provide and are they increasing or decreasing?
- Indicator 2.1: How much of this ecosystem type is under restoration efforts?

- Indicator 3.1: How much of this ecosystem type is currently included in protected or conserved areas?

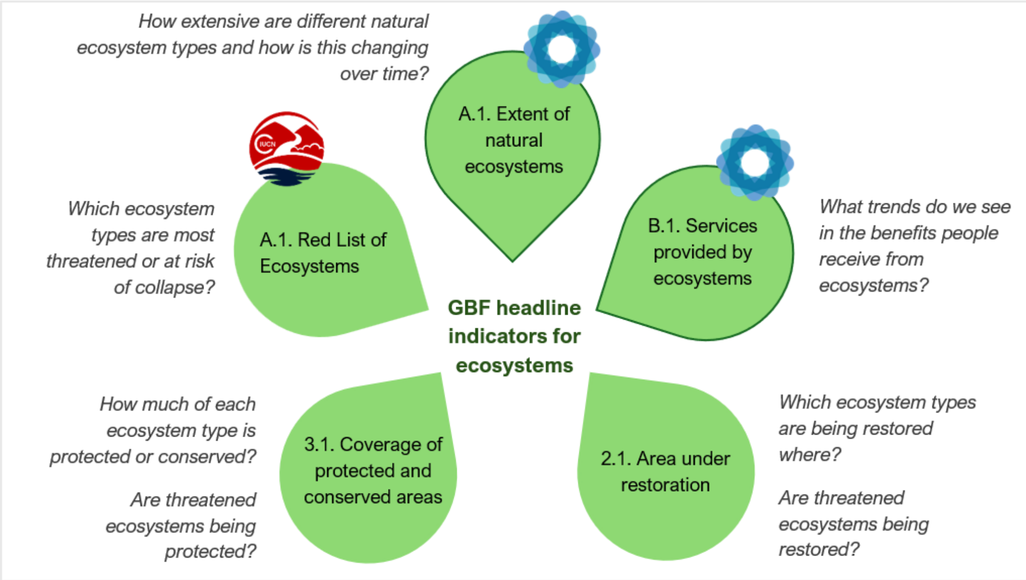

Figure 6. The five core ecosystem-related headline indicators of the GBF together provide insight into a set of inter-related questions about ecosystem types

(Source: Driver & Botts (Eds.), 2026)

In addition to a common national ecosystem map, national data foundations for this suite of indicators include consolidated spatial datasets on ecosystem condition, datasets on the location of protected areas and OECMs, consolidated registers of restoration initiatives including spatial information, and nationally comprehensive datasets on ecosystem service flows for priority ecosystem services. Collaboration between institutions mandated to develop and maintain these ecosystem-related data foundations can help to avoid duplication, leverage scarce resources, ensure that datasets are fit for more than one purpose and that the indicators are coherent.

There are several more GBF headline indicators that have an ecosystem element, and viewing them together with the core ecosystem-related indicators could yield useful information and insights:

- 10.1 Proportion of agricultural area under productive and sustainable agriculture,
- 10.2 Progress towards sustainable forest management,
- 12.1 Average share of the built-up area of cities that is green/blue space for public use for all,
- 22.1 Land use and land tenure in IPLC territories (this indicator refers to “natural lands”).

A substantial number of the component (CT) and complementary (CY) indicators in the GBF monitoring framework relate to ecosystems. *Those in italics and underlined deal directly with ecosystem extent.* In addition, several of them deal with condition or integrity of ecosystems.

- A.CT.1 Ecosystem Intactness Index
- A.CT.2 Ecosystem Integrity Index
- A.CT.3 Species Habitat Index
- A.CT.4 Biodiversity Habitat Index
- A.CT.5 Biodiversity Intactness Index

- *<u>A.CY.1 Forest area as a proportion of total land area</u>*
- A.CY.2 Rate of tree cover loss
- A.CY.3 Mountain Green Cover Index
- *<u>A.CY.4 Continuous global mangrove forest cover</u>*
- A.CY.5 Mangrove forest fragmentation
- *<u>A.CY.6 Mangrove extent</u>*
- *<u>A.CY.7 Global salt marsh extent</u>*
- *<u>A.CY.8 Wetland Extent Trends Index</u>*
- A.CY.9 Forest Fragmentation Index
- A.CY.10 Forest Landscape Integrity Index
- A.CY.11 Global Vegetation Health Products
- A.CY.12 Relative magnitude of fragmentation
- A.CY.13 Ocean Health Index
- A.CY.14 Extent of physical damage to predominant seafloor habitats
- A.CY.15 River Fragmentation Index
- B.CT.3 Total value of ecosystems services in monetary units
- 2.CT.1 Proportion of land that is degraded over total land area
- 2.CY.1 Global Ecosystem Restoration Index
- 2.CY.2 Proportion of Key Biodiversity Areas in favourable condition
- 8.CT.2 Bioclimatic Ecosystem Resilience Index
- 8.CY.1 Above-ground biomass stock in forest (tons/ha)
- 11.CT.2 Proportion of bodies of water with good ambient water quality
- 11.CT.3 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources

Ecosystem-related indicators in other global frameworks that have a direct link to Indicator A.2 include:

- Sustainable Development Goal (SDG) indicator 6.6.1 Extent of water-related ecosystems,
- SDG indicator 15.1.1 Forest area,
- Voluntary indicators on climate change adaptation in the process of being developed under the UN Framework Convention on Climate Change (UNFCCC), which include a proposed indicator on the extent of natural ecosystems.

Coordination between national entities responsible for these other global indicators and Indicator A.2 is recommended, to avoid duplication of effort, ensure consistency in the ecosystem datasets that underpin the indicators, and support coherence information to inform policy and decision-making. In particular, efforts to align approaches to mapping the extent of freshwater ecosystems and forest area may help to improve consistency and coherence across national and global reporting processes.

1.4 Rationale for an accounting approach to compiling indicators

Policy- and decision-makers are increasingly seeking robust information on the state of nature and the contributions of nature to people and the economy. SEEA Ecosystem Accounting was developed as a measurement system to provide this information and support more integrated decision-making that recognises the relationships between people, nature and the economy.

Accounting approaches are used in a range of contexts, including for national economic accounts based on the System of National Accounting (SNA) and environmental-economic accounts based on the SEEA. A familiar economic indicator derived from national accounts is Gross Domestic Product (GDP). SEEA Ecosystem Accounting has the potential to support the derivation of ecosystem-related indicators, such as GBF Indicators A.2 and B.1, that are coherent and consistent across countries and over time, and that gain similar status to key widely used economic indicators. See Chapter 14 of SEEA Ecosystem Accounting for more detail on its role in relation to indicators. Further guidance on using the SEEA for calculating selected SDG indicators, alongside other indicators, is also available here.

Key features of the accounting approach include a focus on *clear and consistent definition of the concepts* that are the focus of measurement in the accounts. This allows for the use and organisation of data from multiples sources (the base of the pyramid in Figure 7), often developed by experts in specific subject matter areas, to estimate these concepts as best as possible. Suppliers of data are often involved in the process to ensure that estimates are meaningful. Because of the focus on consistent and stable concepts, the accounting approach allows for changes in source data and evolution of measurement methods and compilation approaches over time, while nevertheless maintaining a coherent and meaningful time series of accounts and indicators (Obst, 2019).

Accounts *organise information systematically using account tables* that have a standard structure and are based on standard concepts, frameworks and classifications (the middle two layers of the pyramid in Figure 7). *Classifications* related to the concepts being measured play a central role in organising data from a range of sources consistently and coherently. A range of indicators can then be derived from the account tables (the top of the pyramid), providing consistent information that enables comparison over time within and across countries.

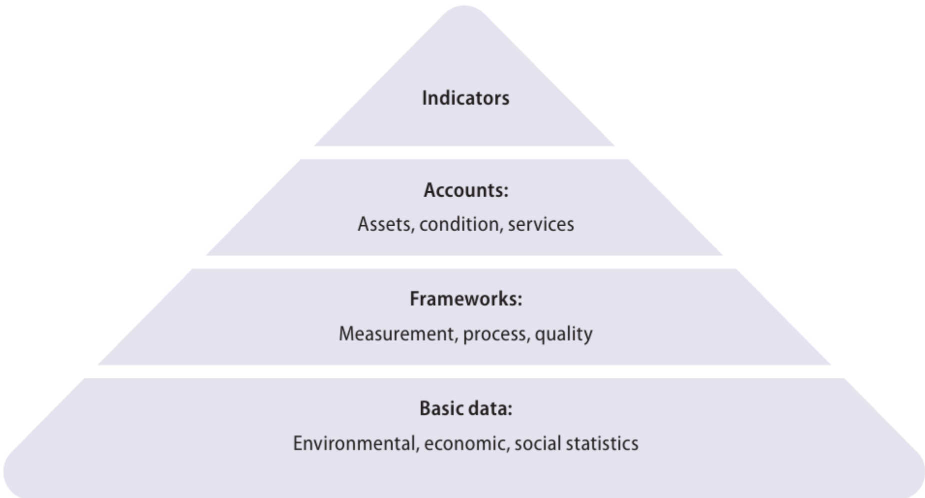

Figure 7. The information pyramid, showing the relationship between data, accounts and indicators

(Source: Figure 14.1 in SEEA Ecosystem Accounting)

Using an accounting approach to organising data also helps to clearly and systematically identify data gaps over space and time, which can then be addressed iteratively to improve the reliability of the estimates of the concepts being measured.

An important consequence of this approach is that comparability among different estimates of the concepts being measured across time and between countries is not assessed primarily based on the data or specific measurement methods. Rather, comparability is based on the extent to which different estimates accurately reflect the concept(s) being measured, and the consistent organisation of data in standard account tables. *This means that data sources and methods may evolve over time within a country, and that different countries may use different data sources and methods, while still producing accounts and indicators that are comparable*. This is especially important in the context of global headline indicators, where it would be both unrealistic and inappropriate to insist that all countries use exactly the same data and methods in compiling the indicators.

Accounting distinguishes between *stocks and flows* (for example, stocks of ecosystem assets that provides flows of ecosystem services), which are measured separately but can be conceptually linked. In the case of ecosystem accounting, this enables consistency and coherence between measurement of ecosystems themselves, as illustrated by Indicator A.2, and the services that flow from them, as illustrated by Indicator B.1.

The SEEA Ecosystem Accounting framework is *comprehensive*, accounting for all ecosystem types and a wide range of ecosystem services through a set of five core ecosystem accounts, shown in Figure 8, intended to be compiled regularly for consecutive accounting periods. This enables ecosystem accounts to support detailed analysis of changes in the extent and condition of ecosystems and the ecosystem services that flow from them. The comprehensiveness of the accounts means they can support multiple reporting requirements in a coherent manner.

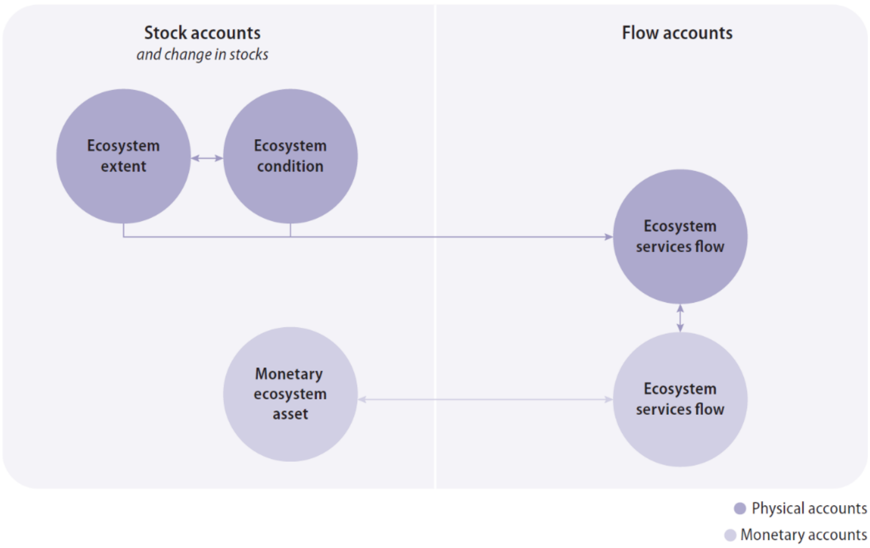

Figure 8. The five interconnected ecosystem accounts within SEEA Ecosystem Accounting provide a comprehensive and coherent view of ecosystems

(Source: SEEA Ecosystem Accounting, Figure 2.2)

Spatially detailed accounting, which is encouraged in SEEA Ecosystem Accounting, enables consistency from local to national to global levels, supporting coherence in planning and decision-making across different scales. In addition, the *alignment of SEEA with accounting principles used in the SNA* allows for integration of information about ecosystems with information about the economy.

CBD Decision 15/5 adopting the GBF monitoring framework explicitly noted "the value of aligning national monitoring with the United Nations System of Environmental-Economic Accounting statistical standard in order to mainstream biodiversity in national statistical systems and to strengthen national monitoring systems and reporting as appropriate and according to their national priorities and circumstances." For Indicator A.2, this alignment is achieved through the ecosystem extent accounts of the SEEA Ecosystem Accounting framework, which record the extent of different ecosystem types and associated reductions, additions and net changes in extent for each accounting period.

As highlighted above, organising and filtering basic data through the accounting framework can improve the consistency, comparability and comprehensiveness of indicators and support more robust monitoring and reporting. The role of SEEA Ecosystem Accounting is also to integrate those ecosystem data so as to enable a coherent and unified understanding of ecosystems and their relationship to the people and the economy. This has a wide range of applications in policy, planning and decision-making, over and above providing policy-relevant indicators, and supports mainstreaming biodiversity into social and economic development processes.

1.5 Interpreting Indicator A.2

A decrease in the value of Indicator A.2 over time reflects an overall (net) decline in the area of natural ecosystems relative to anthropogenic ecosystems, while an increase reflects an overall (net) increase in the area of natural ecosystems. Because natural ecosystems are the foundation of biodiversity, declines in the indicator suggest negative outcomes for biodiversity, while increases suggest positive outcomes. However, Indicator A.2 is not designed to capture ecosystem integrity or condition, so it is important to interpret changes in the indicator with appropriate context. The indicator is well suited to reflecting biodiversity loss associated with conversion from natural to anthropogenic ecosystem types. It is less suited to reflecting other direct drivers of biodiversity loss, such as pollution, invasive alien species, overexploitation of species, altered hydrological regimes, or climate change.

For these reasons, *Indicator A.2 should always be interpreted alongside other relevant indicators*, particularly the other ecosystem-related indicators of the GBF, rather than considered in isolation. Trends in Indicator A.2 should be considered together Indicator A.1 Red List of Ecosystems, which captures the impacts of a wide range of direct drivers of biodiversity loss, giving a comprehensive picture of the risks to ecosystems. Restoration efforts reflected in Indicator 2.1[7] and conservation

[7] While Indicator 2.1 tracks restoration efforts underway in all ecosystem types (natural and anthropogenic), Indicator A.2 will reflect ecological outcomes of successful restoration from anthropogenic to natural ecosystem types.

measures reflected in Indicator 3.1 are also relevant. Where available, national indicators of ecosystem condition provide important complementary information.

For example, a country could experience a decline in the extent of natural ecosystems overall, but if ecosystem risk status has not deteriorated and protection levels of ecosystems have increased, outcomes for biodiversity need not be negative overall. This is especially so if loss of natural ecosystems is avoided in areas of high biodiversity importance[8] (through successful implementation of GBF Targets 1 and 14), and increased coverage of protected and conserved areas is targeted towards those areas (through GBF Target 3). Conversely, a stable or increasing value of Indicator A.2 does not necessarily imply improved ecosystem integrity or reduced risk of collapse.

Indicator A.2 reports the net outcome of gains and losses in natural ecosystem area. The same net change can arise through different underlying patterns of ecosystem conversion, restoration and recovery. Countries are therefore encouraged to examine the underlying additions and reductions in natural ecosystem extent recorded in ecosystem extent accounts, rather than focusing solely on net change. Ecosystem type change matrices, often developed alongside ecosystem extent accounts, provide particularly valuable information, showing which ecosystem types have been converted to which other ecosystem types during an accounting period. These underlying account data can help explain the drivers of change and support more nuanced interpretation of the indicator.

Similarly, disaggregating the indicator by ecosystem functional group, biome, realm and, where possible, national ecosystem types can provide important insights that are not evident from the aggregate national value. For example, some ecosystem types may have experienced much greater losses in area than others, and gains in area may have occurred in only certain ecosystem types. Ecosystem-based disaggregation is therefore essential for identifying which ecosystem types are undergoing significant conversion and which are gaining extent.

Indicator A.2 should be reported separately for inland and marine areas, where applicable. The marine component of the indicator is likely to be relatively stable over time, as large-scale conversion between natural and anthropogenic ecosystem types is less common in marine realm than the terrestrial realm. Consequently, interpretation of the marine component should place particular emphasis on disaggregations of the indicator and on other headline indicators such as A.1, 2.1 and 3.1.

Linear ecosystems mapped only as one-dimensional features, which is often the case for rivers and streams, are not reflected in the indicator because it is based on ecosystem area. In countries where conversion of natural rivers to artificial structures such as canals or reservoirs is a significant biodiversity issue, a complementary national indicator based on the proportion of natural river length may provide useful additional information (see Section 6.2).

The number of countries reporting on Indicator A.2 is set to increase over time, so changes in regional or global values may partly reflect improved reporting coverage rather than actual

[8] Areas of high biodiversity importance include, for example, Key Biodiversity Areas (KBAs), Ecologically or Biologically Significant Marine Areas (EBSAs), areas with unique or threatened ecosystems, and areas high in species richness or threatened species. See the description of GBF Target 1 including its key elements.

ecological change. When presenting regional or global aggregates, the number of countries included and the extent of data coverage should therefore be clearly specified.

Interpretation and implementation of Indicator A.2 should also consider potential interactions with indicators related to governance, tenure and Indigenous Peoples and local communities, such as GBF Indicator 22.1. Countries may wish to interpret and communicate the indicator in relation to relevant national biodiversity policies and priorities, highlighting both the strengths and limitations of the indicator in their particular context.

3 Concepts and definitions relevant to the indicator

The key concepts that underpin Indicator A.2 are ecosystems, ecosystem type, natural ecosystem types, anthropogenic ecosystem types, ecosystem extent and changes in ecosystem extent. Other relevant concepts include ecosystem condition, mosaic ecosystem types, and the distinction between land cover, land use and ecosystem types.

For Indicator A.2 to be comparable between countries and over time, it is essential that these concepts are defined clearly and used consistently in all countries. As highlighted in Section 1.4 on the accounting approach, if the concepts that form the basis for measurement of an indicator are well defined and consistent, the data and methods used can evolve over time within a country and vary between countries while still allowing for an indicator that is meaningful and comparable across contexts and through time. Clear and consistent concepts allow for flexibility in how they are operationalised, including in data sources and measurement methods.

3.1 Ecosystem

An ecosystem is defined by the CBD as a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (United Nations, 1992). Important elements of this definition are the biotic (living) component, the abiotic (non-living) component and the interactions among the biota and between the biotic and abiotic components.

Alongside this definition, three attributes of ecosystems are often identified: composition, structure and function (Noss, 1992). Composition relates to the suite of species that occur within the ecosystem, structure to the physical structure and patterns of the ecosystem, and function to ecological processes.

3.2 Ecosystem type

For many real-world applications, it is useful to divide the ecosystems that occur in a continuous landscape or seascape into different ecosystem types that can be used for assessment, accounting, planning, decision making, management and monitoring (Keith et al., 2015). An ecosystem type is defined as a type of ecosystem distinguished from other types by its characteristic functional, structural and compositional properties (IUCN, 2025), and is typically identified and delineated as part of a hierarchical classification system, based on biotic and abiotic factors. Ecosystems of the same type are expected to share broadly similar ecological characteristics. Similar definitions are used for other, often synonymous, terms such as ecological communities, habitat types, biotopes, and vegetation types (Keith et al., 2013, Nicholson et al., 2021).

In classification and mapping, it is important that *compositional, structural and functional attributes* are all considered in identifying and distinguishing between ecosystem types. This allows ecosystem types to be identified as ecologically meaningful units that are consistent with the concept of an ecosystem as defined by the CBD, and also provides the basis for meaningful assessment of ecosystem condition (see below).

Ecosystems can be identified at different spatial scales, from vast savannas stretching across regions or large coral reef systems to localised features such a woodland patch, saltmarsh pocket or vernal pool. However, ecosystems at different scales need not all be distinguished as unique types nor mapped as separate classes.

An ecosystem type need not be contiguous in the landscape; it typically consists of several or many occurrences interspersed with occurrences of other ecosystem types. In SEEA Ecosystem Accounting these occurrences are called *ecosystem assets*, defined as contiguous spaces covered by a specific ecosystem type characterized by a distinct set of biotic and abiotic components and their interactions (paragraph 2.11).

Some ecosystem types are characterised by substantial temporal variability, whether seasonal, interannual, multi-year or even decadal or more. In classifying and mapping these dynamic ecosystems, it is essential to understand their expected range of natural variation to avoid misinterpreting natural cycles as changes in ecosystem type. For example, a seasonal wetland or floodplain does not become a different ecosystem type depending on whether it is dry or wet, and a savanna remains the same ecosystem type notwithstanding transitions between grass-dominated and tree-dominated states. Similarly, human-managed cycles in anthropogenic ecosystems, such as regular harvesting or felling, should not be confused with changes in ecosystem type. For example, a clear-felled plantation is still a plantation ecosystem type.

Ecosystem types are the building blocks for national ecosystem maps (see Section 7.1), and, when cross-referenced to the Global Ecosystem Typology, allow national classifications to be compared and aggregated globally. See *Guidelines for Developing National Ecosystem Maps* (Global Ecosystems Atlas, 2026, especially Section 2), for more on the concept of an ecosystem type and national ecosystem maps.

3.3 Ecosystem condition

Ecosystem condition is defined in SEEA Ecosystem Accounting as the quality of an ecosystem measured in terms of its abiotic and biotic characteristics. Condition is assessed with respect to an ecosystem’s composition, structure and function which, in turn, underpin the integrity of the ecosystem (paragraph 5.2).

The term ecosystem integrity as used in the GBF represents the same concept as ecosystem condition. The term ecosystem degradation is used in some contexts, such as in the Red List of Ecosystems, to communicate a loss of integrity or decline in ecosystem condition. In the context of SEEA Ecosystem Accounting, degradation refers to a decline in the value of an ecosystem asset linked to a decline in future flows of ecosystem services from that asset. To avoid potential confusion, the term degradation is avoided in discussing ecosystem condition in these guidelines.

In general, *ecosystem condition will not be uniform across the whole area of an ecosystem type*. Rather, a spectrum of ecosystem condition states may exist across its range. Ecosystem condition is assessed in part based on compositional, structural and functional characteristics, often focusing on how far these depart from a reference level associated with good ecological condition for that ecosystem type. The same ecosystem characteristics that are used to classify ecosystem types are also often used in assessing condition within the distribution of that ecosystem type. Indeed, it is important for ecosystem condition indicators to relate to the characteristics of a particular ecosystem type for condition assessments to be ecologically meaningful.

Changes in ecosystem condition do not imply conversion to a different ecosystem type and should be clearly distinguished. A given ecosystem type may exhibit a wide range of condition states across different parts of its distribution and through time without changing its identity as an ecosystem type. This distinction is particularly important when measuring ecosystem extent and changes in extent (see Sections 3.9 and 3.10).

As noted in Section 3.2, some ecosystem types are characterised by more temporal variability than others, whether seasonal, interannual, multi-year or even decadal or more. In assessing condition in these dynamic ecosystems, it is essential to understand their expected range of natural variation to avoid misinterpreting natural cycles as changes in the condition state of the ecosystem.

Also see *Guidelines for Classifying Agricultural Ecosystems in the Global Ecosystem Typology* (Driver & Botts (eds), 2025, p17-18), where the concept of ecosystem condition is explained in more detail, including its link to ecosystem services.

3.4 Natural ecosystem types

As noted in the metadata for Indicator A.2, the term "natural ecosystem" refers broadly to ecosystems where the impact of humans on ecosystem composition, structure and function are low compared to natural factors (Secretariat of the CBD, 2022). In this sense, natural ecosystem types represent a broad category of ecosystems that include:

(a) *Ecosystems influenced or modified by human interventions, but with natural compositional, structural and functional characteristics still at least partially present and recognisable*. The human interventions could be beneficial, neutral or negative from a biodiversity perspective. In some cases, the human intervention may mimic processes that would have taken place as part of the natural functioning of the ecosystem prior to human modification (e.g. grazing by wild herbivores or natural fire cycles). It may include the use and management of ecosystems by traditional and/or Indigenous societies, including practices such as fire management, nomadic grazing and other pastoral practices that in some countries have been in place for many thousands of years. In some contexts, these modified natural ecosystems are termed semi-natural (see box below).

(b) *Instances or occurrences of natural ecosystem types that are in a range of condition states*, from pristine ecosystems in excellent condition or with high integrity, through to those in poor condition or with low integrity.

To emphasise, the concept of a natural ecosystem does not imply an ecosystem uninfluenced by humans, and recognises that virtually all ecosystems on Earth have been shaped to some degree by human activity. A gradient of human influence, incorporating many human activities, is consistent with this broad definition of natural ecosystem types. There is also no implication that human intervention is always negative; indeed, it can include conservation and restoration actions.

Box 1. A note on the term semi-natural

The term "semi-natural" may be used to describe a *condition state* of a natural ecosystem in which composition and structure have been modified but the characteristic functional and structural properties of the natural ecosystem type are still recognisable and at least some of the key native biota are still present. The ecosystem has been modified relative to an undisturbed reference state. In this sense, semi-natural ecosystems are modified natural ecosystems that fall clearly within natural ecosystem types as defined above. Consequently, in the context of Indicator A.2, we refer to "modified natural ecosystems" rather than "semi-natural ecosystems" when referring to these broadly natural ecosystems.

The term "semi-natural" is also sometimes used (especially in Europe) to describe natural ecosystems that have been transformed through human management into pastures or meadows that retain local indigenous species but from which woody components have been largely removed, and that would revert to tree-dominated ecosystem types without ongoing human management. In this sense, semi-natural is a descriptor of certain *ecosystem types* rather than an ecosystem condition state. Although they share some functional characteristics of natural ecosystem types, the Global Ecosystem Typology places these derived semi-natural pastures in the anthropogenic terrestrial biome (T7). The reasons for this and the implications for Indicator A.2 are discussed further in Section 3.5 on anthropogenic ecosystem types.

3.5 Anthropogenic ecosystem types

The term "anthropogenic" is generally understood to mean originating from or caused by human activity. For example, anthropogenic climate change refers to climate change resulting from human actions, and anthropogenic emissions are pollutants released into the environment due to human processes.

Anthropogenic ecosystem types are defined in the metadata for Indicator A.2 as those *created and maintained* through human interventions, i.e. human interventions are the *primary determinant* of the composition, structure and functioning of the ecosystem. An anthropogenic ecosystem type has typically *replaced* a pre-existing or antecedent natural ecosystem type, which is no longer recognisably present (although small patches/fragments and some native species may persist). Human intervention does much more than influence or modify the ecosystem, even substantially. It determines the compositional, structural and functional characteristics of the ecosystem (including biotic and abiotic components), and is typically essential for maintaining those characteristics. Anthropogenic ecosystem types generally support far less biodiversity than natural ecosystem types, but they are not necessarily devoid of biodiversity and may still support native species and ecological functions.

The human interventions that create anthropogenic ecosystems are frequently connected to land- and sea-use systems that maintain modern-day industrial societies. Examples include:[9]

- In the terrestrial realm: Alterations to the physical structure of vegetation and substrates (e.g. clearing, earthworks, and drainage), the supplementation of resources (e.g. with irrigation and fertilisers), and the introduction and control of plants and animals.
- In the freshwater realm: Built structures or diversions that hold or transfer water for human use, treatment, or disposal, including large storage reservoirs, canals, farm dams or ponds, recreational and ornamental wetlands, rice paddies, freshwater aquafarms, wastewater storages and treatment ponds, and canals, ditches and drains; Application of energy, water, and nutrients, either incidentally from run-off (e.g. farm dams, ditches and storm water canals) or groundwater, or deterministically by management (e.g. rice paddies, aquafarms, and wastewater ponds).
- In the marine realm and transitional marine-terrestrial realm: Construction, deposition or dumping of artificial structures in the oceans; Marine interfaces constructed from hard, smooth surfaces, including concrete, timber, lithic blocks, and earthen fill, adjoining, extending or replacing natural shores, or floating in proximity to them.

The term “pre-existing or antecedent natural ecosystem type” is used in this context to mean existing before intensive human modification of the landscape through the types of interventions described above. In most contexts, pre-existing can be interpreted to mean pre-industrial, coinciding with pre-colonial in some cases, with no need to specify a precise date for the purposes of Indicator A.2. Pre-industrial does not imply pre-human, with full recognition that in many countries traditional and/or Indigenous settlement and management of natural ecosystems spans thousands of years. Some countries have spatial datasets on the historical distribution of ecosystem types, representing this pre-industrial period (see Section 7.1 on national datasets).

Based on this definition, there are two complementary criteria for identifying anthropogenic ecosystem types, both of which must be met:

1. The ecosystem type is *created and maintained* by human activity, i.e. the human activity is the *primary determinant* of the ecosystem’s composition, structure and function. Human activity does much more than influence or impact on the ecosystem, even substantially – it is the *origin* of the ecosystem type.
2. The antecedent or pre-existing natural ecosystem type has been largely *replaced* (not just altered) by the anthropogenic ecosystem type and is no longer recognisably present (although small patches/fragments and some native species may persist).

In applying these criteria, care should be taken not to confuse managed natural ecosystems or instances of an ecosystem type in poor ecological condition with an anthropogenic ecosystem type, as discussed further in Section 3.8 on distinguishing between natural and anthropogenic ecosystem types in practice. Natural ecosystems can be substantially modified without being converted to an anthropogenic ecosystem type.

[9] These examples are based on descriptions of anthropogenic biomes in the Global Ecosystem Typology.

For the purposes of Indicator A.2, the distinction between natural and anthropogenic ecosystem types is based on the Global Ecosystem Typology. Of the 25 biomes in the Global Ecosystem Typology, six are considered anthropogenic, containing 16 ecosystem functional groups. Omitting the subterranean biomes, which are currently out of scope of Indicator A.2, leaves 20 biomes of which four are anthropogenic, collectively containing 13 ecosystem functional groups. These anthropogenic biomes and ecosystem functional groups are shown in Table 2. As explained in Section 4.2, ecosystem types are nested within ecosystem functional groups, with each ecosystem functional group typically consisting of many ecosystem types that share functional characteristics but differ with respect to, for example, species composition.

Table 2. Anthropogenic biomes and their constituent ecosystem functional groups in the Global Ecosystem Typology

Realm	*Biome*	*Ecosystem functional group**
Terrestrial (T)	T7 Intensive land-use biome**	T7.1 Annual croplands [Short-rotation croplands]
		T7.2 Sown pastures and fields [Sown livestock pastures]
		T7.3 Plantations [and woody croplands]
		T7.4 Urban and industrial ecosystems
		T7.5 Derived semi-natural pastures and old fields***
Freshwater (F)	F3 Artificial wetlands biome	F3.1 Large reservoirs
		F3.2 Constructed lacustrine wetlands
		F3.3 Rice paddies [Aquatic and semi-aquatic croplands]
		F3.4 Freshwater aquafarms
		F3.5 Canals, ditches and drains
Marine (M)	M4 Anthropogenic marine biome	M4.1 Submerged artificial structures
		M4.2 Marine aquafarms
Marine-terrestrial (MT)	MT3 Anthropogenic shorelines biome	MT3.1 Artificial shorelines

* Name changes for some ecosystem functional groups were under consultation by the Scientific Committee of the Global Ecosystem Typology at the time of writing (see Governance - Global Ecosystem Typology). The proposed new names are in square brackets.
** May be referred to as the anthropogenic terrestrial biome, to align with names of other anthropogenic biomes, and in recognition that a continuum of intensity of land use is associated with this biome.
*** Specific ecosystem types within EFG T7.5 may be grouped with the broad category "natural" for the purposes of Indicator A.2 if the ecosystem type existed pre-industrially and/or has substantial importance for biodiversity (see discussion below). The assessment of whether an ecosystem type meets these criteria should be made at the national level.

In general, all ecosystem types within an ecosystem functional group would be considered either natural or anthropogenic, in line with the characterisation of the ecosystem functional group as a whole. In other words, if the ecosystem functional group is considered anthropogenic, all its constituent ecosystem types would be anthropogenic. However, ecosystem functional group T7.5 Derived semi-natural pastures and old fields presents a complex case where, for the purposes of Indicator A.2, some ecosystem types within this group may be considered part of the broad category of natural ecosystems in some national contexts.

As noted in Box 1 in Section 3.4, the semi-natural pastures in EFG T7.5 share some functional characteristics with natural ecosystems, even though they fall within the anthropogenic terrestrial biome T7. These derived pastures (and in some cases meadows) meet the criteria for anthropogenic ecosystem types because they were *created* through human intervention, involving the removal of woody components from an antecedent or pre-existing woody ecosystem type that was *replaced* and is no longer recognisably present. Human intervention is also required to *maintain* the ecosystem type, as without continued human management (in the form of ongoing removal of woody biomass) the ecosystem would revert to a tree-dominated ecosystem type. The human activity that created these ecosystem types may date back hundreds or even thousands of years in some cases, such as traditional livestock grazing systems in the European context. Within these ecosystem types, human intervention typically affects only part of the vegetation structure and leaves basic ecosystem functions (such as soil profile, nutrient status, hydrological cycle) intact. Although structurally simpler than the ecosystems from which they were derived, they often retain an appreciable diversity of local native species.

Derived semi-natural ecosystem types that fall within EFG T7.5 may be grouped with the broad category "natural" if the ecosystem type existed pre-industrially and/or has substantial importance for biodiversity. It is important to emphasise that this consideration applies at the level of specific ecosystem types (preferably identified in a national ecosystem classification) within this ecosystem functional group, rather than implying that the entire ecosystem functional group can be treated as "natural" for the purposes of Indicator A.2. The assessment of whether an ecosystem type meets these criteria should be made at the national level with input from relevant experts and knowledge holders.

The old fields in EFG 7.5 are typically cultivated fields that are no longer in use for agriculture, for a range of possible reasons, but have not (yet) reverted to a natural ecosystem type. Their functional, structural and compositional characteristics are generally far from those of the antecedent or pre-existing natural ecosystem type. Although old fields do not meet the criterion of being *maintained* through human intervention, they were created through human intervention and replaced a pre-existing ecosystem type that is no longer recognisably present. They are thus considered anthropogenic. Generally, they are poor in biodiversity. Old fields should in general be grouped with the broad category "anthropogenic". In exceptional cases, where they are considered to have regained sufficient characteristics of a natural ecosystem type (either through active restoration or passive recovery) and to have significant value from a biodiversity perspective, they could be treated as "natural" for the purposes of Indicator A.2. Possible criteria for assessing whether an anthropogenic ecosystem is considered to have reverted to a natural ecosystem, which are relevant old fields, are discussed at the end of Section 3.8 on borderline cases.

3.6 Relationship between land cover, land use and ecosystem types

Land cover and land use are related to some ecosystem types but they are *conceptually distinct from ecosystems*, which means that ecosystem types should not be conflated with land cover classes or land use classes. Land cover refers to the observed physical and biological land cover of the Earth's surface and includes natural vegetation and abiotic (non-living) surfaces (SEEA Central Framework, paragraph 5.257). Land cover data are generally derived from satellite imagery and primarily capture the structural characteristics of ecosystems that are visible in the imagery, rather than their compositional and functional attributes, which may differ substantially across ecosystems with similar land cover. A single land cover class may correspond to multiple ecosystem types, or a single ecosystem type may contain several land cover classes. Land use is defined based on the human activities and institutional arrangements in a given area (SEEA Central Framework, paragraph 5.246), not based on the compositional, structural and functional attributes of the ecosystems in which they take place.

Because land cover and land use classifications are not based on the combination of compositional, structural and functional properties that define ecosystems, they are generally inconsistent with the ecosystem concept. Consequently, *land cover and land use classes do not, in most cases, meaningfully represent ecosystem types.* Land cover *data* may be a useful input for mapping and modelling some ecosystem types, but that does not imply that land cover *classes* represent ecosystem types.

The common misperception that land cover classes can be used as a proxy for ecosystem types can be compounded by the similar names of some land cover classes and some ecosystem types. Examples are grasslands, shrublands and in some cases forests. Grass cover in a land cover map is not necessarily associated with grassland ecosystems – it could represent, for example, a grassy area in a savanna ecosystem, a shrubland in poor condition that has been overrun by grass species, a sown pasture or an urban park. All these grass-covered areas belong to different ecosystem types, some natural and some anthropogenic. Tree cover in a land cover map could represent, for example, a forest ecosystem, a treed area in a savanna ecosystem, a plantation or orchard, or woody invasive vegetation in a grassland ecosystem in poor condition, all of which belong to different ecosystem types. Caution should thus be applied in linking land cover classes to ecosystem types based on names of classes. Where names such as grassland, shrubland or forest are used for land cover classes, these may be more appropriately called grass cover, shrub cover or tree cover respectively, to reduce the possibility of confusion between land cover classes and ecosystem types.

For freshwater ecosystems, waterbodies visible in land cover data often represent only a portion of the full distribution of the ecosystem types within which they occur. Remote sensing typically captures only the surface extent of water, whereas freshwater ecosystem boundaries reflect the broader ecological system, including its hydrological context beyond the visible water surface. This is particularly important for seasonal and ephemeral freshwater ecosystems, where surface water extent can fluctuate substantially and can include dry periods, without implying any change in the distribution of the ecosystem type.

The exception to this general case of poor correspondence between land cover/land use classes and ecosystem types is anthropogenic ecosystem types, as the human activities that determine their compositional, structural and functional characteristics are often directly related to land use and directly reflected in land cover. Some land cover and land use classes may thus be useful for mapping the distribution of some anthropogenic ecosystem types.

Table 3 and Table 4 show the high-level land cover and land use classifications from the SEEA Central Framework. Links between some SEEA land cover classes and the anthropogenic ecosystem functional groups of the Global Ecosystem Typology (Table 2) are evident. For example, EFG T71 Annual/short-rotation croplands is likely to have characteristics in common with SEEA land cover class 2 Herbaceous crops, and EFG T7.3 Plantations and woody croplands is likely to overlap with SEEA land cover class 3 Woody crops. However, EFG T7.3 Plantations and woody croplands is also likely to elements of SEEA land cover class 6 Tree-covered areas, illustrating some of the challenges of using land cover classes to represent ecosystem types.

The FAO Land Cover Classification System (LCCS) (Di Gregorio & Leonardi, 2016) identifies eight major land cover types, shown in Table 5, some of which distinguish natural or semi-natural from cultivated cover. The LCCS focuses on observed physical cover on the Earth's surface with recognition that this may be useful as a geographical reference for other disciplines, including ecology. While the distinction between natural or semi-natural and cultivated cover does not make it an ecosystem classification, it can provide a closer approximation to the distinction between natural and anthropogenic ecosystem types than some other land cover classifications.

These distinctions between ecosystem types, land cover classes and land use classes are important for identifying and/or developing the key datasets that are required for Indicator A.2, discussed in Step 2 (Section 7).

Table 3. Land cover classification from the SEEA Central Framework

	Category
1	Artificial surfaces (including urban and associated areas)
2	Herbaceous crops
3	Woody crops
4	Multiple or layered crops
5	Grassland
6	Tree-covered areas
7	Mangroves
8	Shrub-covered areas
9	Shrubs and/or herbaceous vegetation, aquatic or regularly flooded
10	Sparsely natural vegetated areas
11	Terrestrial barren land
12	Permanent snow and glaciers
13	Inland water bodies
14	Coastal water bodies and intertidal areas

(Source: SEEA Central Framework. Table 5.12, page 178)

Table 4. Land Use Classification in the SEEA Central Framework

1	**Land**	
1.1		Agriculture
1.2		Forestry
1.3		Land used for aquaculture
1.4		Use of built-up and related areas
1.5		Land used for maintenance and restoration of environmental functions
1.6		Other uses of land n.e.c.
1.7		Land not in use
2	**Inland waters**	
2.1		Inland waters used for aquaculture or holding facilities
2.2		Inland waters used for maintenance and restoration of environmental functions
2.3		Other uses of inland waters n.e.c.
2.4		Inland waters not in use

(Source: SEEA Central Framework, Table 5.11, page 176)

Table 5. Major land cover types in the FAO Land Cover Classification System

Major land cover type	
1.	Cultivated and Managed Terrestrial Areas
2.	Natural and Semi-Natural Terrestrial Vegetation
3.	Cultivated Aquatic or Regularly Flooded Areas
4.	Natural and Semi-Natural Aquatic or Regularly Flooded Vegetation
5.	Artificial Surfaces and Associated Areas
6.	Bare Areas
7.	Artificial Waterbodies, Snow and Ice
8.	Natural Waterbodies, Snow and Ice

3.7 Mosaic ecosystem types

Some ecosystem types take the form of mosaics of patches or elements, which can include natural (including modified natural) and anthropogenic elements that function collectively as an ecosystem. These are sometimes referred to as heterogenous ecosystem types, characterised by an intrinsic mix of features.[10] The mosaic patches and elements may be mapped at different levels of granularity, depending on purpose and data availability, at scales of metres to hundreds of metres.

For compiling Indicator A.2, it will be necessary to make decisions about whether mosaic or heterogenous ecosystem types that combine anthropogenic and natural elements are predominantly natural or predominantly anthropogenic, for example using thresholds related to the relative proportion of natural and anthropogenic elements combined with expert judgement. This is discussed Section 3.8 below. A mosaic anthropogenic ecosystem type may include patches of natural

[10] Eurostat's *Ecosystem Accounts Handbook* (2026) includes a short discussion on dealing with heterogenous areas in Section 2.5.

habitat for native species, including threatened or endemic species, which can sometimes persist even in small fragments.

Also see *Guidelines for Classifying Agricultural and Plantation Forestry Ecosystems in the IUCN Global Ecosystem Typology* (Driver & Botts (eds), 2025, p22-23) where mosaic ecosystem types are discussed in the context of agricultural and plantation forestry ecosystems but with wider applicability.

3.8 Distinguishing between natural and anthropogenic ecosystem types in practice, including borderline cases

There are many ecosystems in which human interventions take place without converting the ecosystem from a natural ecosystem type to an anthropogenic ecosystem type, i.e. the ecosystem is *influenced or modified* by human interventions but would still be classified as a natural ecosystem type. If the degree of influence of the human activities is relatively limited, there is generally a clear case that those activities are not the *primary* determinant of the ecosystem's composition, structural and functional characteristics and that it falls within the broad category of natural ecosystems. However, in cases where the degree of human influence is strong, judgement may be needed as to whether the ecosystem should still be considered a modified natural ecosystem or whether it has been converted from a natural ecosystem type or to an anthropogenic ecosystem type. The two criteria for identifying anthropogenic ecosystem types, set out in Section 3.5, should be utilised in making such judgements.

Table 6 gives some examples of natural and anthropogenic ecosystem types, contrasted with each other in pairs, to help illustrate how the conceptual distinctions discussed above can be put into practice. For each example, the associated biome or ecosystem functional group in the Global Ecosystem Typology is shown. The specific ecosystem types would ideally be identified at the national level and then cross-referenced to an ecosystem functional group (see Sections 4.2 and 7.1).

More detailed discussion follows on:

- Differentiating between natural ecosystems in poor condition and anthropogenic ecosystem types,
- Borderline cases related to agriculture, forestry and settlements,
- Borderline cases related to restoration of anthropogenic ecosystems towards natural ecosystem types.

Table 6. Pairs of examples of natural and anthropogenic ecosystem types to illustrate the distinction between the two, with associated biomes or ecosystem functional groups shown in brackets

Natural ecosystem type	**Anthropogenic ecosystem type**
Savanna with livestock grazing (e.g. in Indonesia) (T4 biome) ○ Includes instances where the condition of the ecosystem has been substantially impacted by grazing and related human activities (e.g. management to increase grazing biomass)	Sown pastures (T7.2)

Natural ecosystem type	Anthropogenic ecosystem type
Tropical lowland rain forest with logging (e.g. in Thailand) (T1.1) ○ Includes instances where the condition of the ecosystem has been substantially impacted by logging and related human activities (e.g. building access roads for removing timber)	Teak plantation (T7.3)
Managed boreal pine forests (e.g. in Finland) (T2.1)	Pine plantation (T7.3)
Shaded cocoa (natural forest interspersed with cocoa trees) (e.g. in Ghana) (T1 biome)	Mono-cropped cocoa plantation (T7.3)
Grassland with alien invasive trees (e.g. in South Africa) (T4.5)	Eucalypt plantation (T7.3)
Grassy woodland with invasive grasses (e.g. in Australia) (T4.4)	Sown pasture (T7.2)
River modified for flood control or irrigation in an agricultural area (e.g. in Egypt) (F1.2)	Canals, constructed irrigation channels (F3.5)
Savanna with managed fire regimes (e.g. in Brazil) (T4.2)	Slash-and-burn forest destruction for largescale livestock farming (T7.2) or crop production (T7.1)
Mixed mangrove-aquaculture systems (e.g. in Viet Nam) (MFT 1.2)	Freshwater aquafarms (F3.4)
Large permanent natural lake with fishing (e.g. in Malawi) (F2.1)	Artificial (man-made) lake (F3.1)
Small permanent freshwater lakes with fishing (e.g. in Uganda) (F2.2) ○ Includes instances where the condition of the ecosystem has been substantially impacted by fishing and related human activities	Freshwater aquafarms (e.g. intensive fishponds or purpose-built aquaculture facilities) (F3.4)
Natural shellfish beds and reefs with low-intensity shellfish culture (e.g. in Canada) (M1.4)	Marine aquafarms (e.g. intensive finfish cage systems or purpose-built aquaculture facilities) (M4.2)
Coastal dunes stabilised with grasses (e.g. in the Netherlands) (MT 2.1)	Constructed seawall (MT 3.1)
Permanent marshes (e.g. in China) (TF 1.3)	Irrigated rice paddies (F3.3)
Lowland calcareous grasslands (e.g. in the United Kingdom) (T7.5)	Sown livestock pastures (T7.2)

3.8.1 Differentiating between natural ecosystems in poor condition and anthropogenic ecosystem types

In distinguishing between natural and anthropogenic ecosystem types, it is important that occurrences of a natural ecosystem type in a modified condition state, which may be considered poor ecological condition, should not be confused with conversion from a natural to anthropogenic ecosystem type. Some examples of natural ecosystems in a modified condition state include:

- *Coral reefs in the Great Barrier Reef (Australia) (M1.3):* Climate change, coastal development, pollution and overfishing have caused coral bleaching and biodiversity loss, and tourism also exerts pressure. However, the reef system continues to function as a marine ecosystem with complex trophic interactions, natural reproduction of corals, and habitat provision for thousands of species.
- *Savannas in Southern Africa (T4.2):* In some cases, fire regimes have been altered by humans, and introduction of livestock grazing, fencing, and conversion to farmland have reshaped species composition and migration patterns. However, these landscapes are still dominated by native

grasses, shrubs, and wildlife, with ecological processes like herbivory, predation, and seasonal rainfall cycles maintaining their dynamics.

- *Temperate forests in Europe (T2.1):* Centuries of logging, agriculture, and settlement have fragmented many forest ecosystems in countries such as Germany, France and the UK. Many are secondary growth forests rather than pristine old-growth. However, they retain native species, natural regeneration processes, and ecological functions such as carbon storage and hydrological regulation.
- *Desert shrublands in the Sahel or Arabian Peninsula (T5.1):* In some areas, long-term livestock grazing, fuelwood collection, groundwater extraction and off-road vehicle use have altered vegetation structure, reduced native plant cover and increased soil erosion. However, these areas remain desert ecosystems shaped primarily by natural climatic and geomorphological processes, with characteristic native species and ecological functions still present.

3.8.2 Borderline cases related to agriculture, forestry and settlements

Borderline cases between natural and anthropogenic ecosystem types often involve agricultural or forestry related activities, which can take place in many biomes and ecosystem functional groups, both natural and anthropogenic. For example, forestry can take place in timber plantations (anthropogenic ecosystems) and in natural ecosystem types from which timber is harvested, sometimes involving substantial management of the ecosystem. Agriculture can take place in intensive croplands and pastures (anthropogenic ecosystems) and in natural ecosystem types from which agricultural products are harvested or produced.

Urban, industrial and other built-up areas are typically clearly linked to anthropogenic ecosystem types, with fewer borderline cases, although rural settlements can present borderline cases. In borderline cases, judgement calls need to be made based on the relative influence of natural factors and human interventions on the ecosystem and the predominant characteristics of the ecosystem in a particular context. The examples below point to some of the factors that should be considered:

- *Shifting cultivation in tropical forests*. Could fall with natural forest ecosystems in T1 Tropical-subtropical forests biome or croplands (T7.1). In these ecosystems, patches of tropical forest are cleared for cropping, followed by fallow periods during which forest regrowth occurs. Whether the ecosystem is considered natural or anthropogenic depends strongly on the length of the cultivation–fallow cycle. If the cycles are long (e.g. 10–20 years or more), forest regrowth is substantial, with native tree species, canopy structure, and faunal communities re-establishing. Ecological processes such as nutrient cycling, seed dispersal, and successional dynamics remain recognisable. These would likely be considered modified natural ecosystems. If the cycles are short (e.g. 3–5 years), regrowth is truncated, dominated by pioneer species and grasses, with limited recovery of forest structure or biodiversity. The ecosystem functions primarily as a cropland and would be considered an anthropogenic ecosystem type.

- *Seasonal or cyclical agriculture, such as flood-recession agriculture in tropical–subtropical floodplain wetlands*. Could fall within TF1.4 Seasonal floodplain marshes or F3.3 Aquatic or semi-aquatic croplands. In river systems such as the Niger, Mekong, or Zambezi, farmers practice flood-recession agriculture. Crops are planted on floodplains after seasonal inundation when waters recede, taking advantage of nutrient-rich soils and residual moisture. During the flood season, the land functions as a wetland ecosystem, supporting fish, aquatic plants, and waterbirds. During the dry season, it is temporarily converted to cropland. If cropping is low-intensity, and leaves long periods where wetland vegetation and hydrological processes dominate, the floodplain wetland remains recognisable as a natural ecosystem, albeit modified (TF1.4). If cropping is intensive, continuous, and supported by engineered irrigation or drainage, the natural wetland characteristics are lost, and the system becomes dependent on human intervention (F3.3). The key determinant is whether the wetland's ecological identity (e.g. hydrological regime, native vegetation) persists outside the cropping season. If yes, it is a modified natural wetland; if no, it is an anthropogenic aquatic cropland ecosystem.

- *Planted forests,*[11] which can take the form of intensively managed timber plantations (T7.3, anthropogenic) but in other cases may be considered modified natural forest ecosystems in the T1 or T2 biome. When planted forests are composed of native species, allowed to regenerate naturally, and managed with low intensity, they are modified natural ecosystems. For example, in parts of Europe (e.g. United Kingdom, Germany) and East Asia (e.g. Japan), large areas of forest have been re-established through deliberate planting of native tree species after historical deforestation. These planted forests often include oak, beech, or pine, and over time develop structural complexity, understorey vegetation, and wildlife communities associated with natural forests. Natural regeneration processes (succession, seed dispersal, nutrient cycling) gradually reassert themselves. When planted forests are monocultures, harvested on short rotations, or reliant on ongoing silvicultural inputs (fertiliser, pest control, replanting), they are anthropogenic ecosystems. The classification depends on whether the forest's ecological identity (species diversity, structural heterogeneity, natural regeneration) is recognisable as a forest ecosystem, or whether it functions essentially as a managed crop of trees.

- *Grazing systems.* Could exist within a range of natural ecosystem types, including natural grassland or savanna ecosystem types in the T4 biome, or anthropogenic pasture ecosystems in T7.2 Sown pastures. In many parts of the world, including African savannas, Central Asian steppes and South American grasslands, livestock grazing takes place within natural ecosystems. Where native plant communities remain dominant, ecological processes such as natural regeneration, herbivory, fire regimes and nutrient cycling continue to shape ecosystem dynamics, and grazing pressure is within a range that allows characteristic ecosystem structure and function to persist, the ecosystem should be regarded as a modified natural ecosystem. In contrast, where native vegetation has been intentionally replaced by sown forage species, ecosystem composition and structure are primarily determined by management interventions, and ongoing human inputs are required to maintain the system, the ecosystem is more appropriately classified as an anthropogenic pasture ecosystem (T7.2). The key distinction is whether livestock grazing is an activity taking place within a natural ecosystem or whether the ecosystem itself has been created and maintained primarily for livestock production.

[11] The FAO (2023) definition of planted forests is forests composed of trees established through planting and/or deliberate seeding, with "predominantly" meaning that the planted/seeded trees are expected to constitute more than 50 percent of the growing stock at maturity. A plantation is defined as an intensively managed planted forest that at maturity is composed of one or two species (native or exotic), has one age class, and has regular tree spacing.

- *Mixed-use and mosaic ecosystems* that have both natural and anthropogenic patches or elements. Classification as natural/anthropogenic requires an assessment of whether the ecosystem is *predominantly* natural or predominantly anthropogenic, based on the balance of natural and anthropogenic influences. The criteria for identifying anthropogenic ecosystem types (Section 3.5) can be used. Is the ecosystem *predominantly* created and maintained by human activity (i.e. with human activity as the *primary determinant* of the ecosystem's overall composition, structure and function)? Has most of an antecedent or pre-existing ecosystem type been replaced with a new human-created ecosystem type? If patches of the antecedent or pre-existing natural ecosystem type persist within a matrix predominated by the anthropogenic ecosystem type, the ecosystem type is probably anthropogenic on balance. If patches of human settlement or farming take place within a matrix predominated by natural areas, the ecosystem type is probably natural. A country may wish to establish thresholds for the proportion of area dominated by artificial structures and dependent on human inputs that would result in an ecosystem type being classified as anthropogenic.

Box 2. A note on agroforestry in natural and anthropogenic ecosystem types

Agroforestry (combining trees, crops and in some cases animals) can be associated with a wide range of ecosystem types, including natural and anthropogenic ecosystem types, cutting across biomes and ecosystem functional groups. In some cases, there may be ambiguity about whether an ecosystem in which agroforestry is practiced should be classified as natural or anthropogenic. The *Guidelines for Classifying Agricultural Ecosystems in the IUCN Global Ecosystem Typology* (Driver & Botts (eds), 2025, Section 12, p63-65) discuss agroforestry systems in relation to the Global Ecosystem Typology, providing the following guidance on the relationship between agroforestry and natural and anthropogenic ecosystem types:

- Agroforestry systems can be traditional or modern. Some examples of traditional agroforestry systems that are still in use today include: the Taungya system in Southeast Asia, India and Africa; the Quesungual system in Honduras, El Salvador and Nicaragua; Kandyan home gardens in Sri Lanka; Chagga home gardens in Tanzania; Juhm cultivation in Northeast India and Southeast Asia; the Rice-Fish-Azolla system in China, India and Southeast Asia; Dehesa in Spain and Montado in Portugal. The ecosystem types associated with these traditional agroforestry systems would in general be considered natural rather than anthropogenic, although this needs to be assessed in context.
- Agroforestry practices can take place in and impact on natural ecosystem types, modifying their condition but not changing the ecosystem type. Shade coffee or cocoa planted in a natural forest ecosystem is an example of this, contrasted with shade coffee or cocoa under planted trees, which is an example of an agricultural ecosystem type in T7.3 Plantations and woody croplands.
- Agroforestry systems and practices can also be implemented in anthropogenic ecosystem types. Examples include introducing trees into an annual cropland such as a wheatfield (T7.1), introducing trees into a sown livestock pasture (T7.2), shade coffee or cocoa with planted trees (T7.3), and integrating trees and shrubs into aquatic or semi-aquatic croplands (F3.3).

3.8.3 Borderline cases related to restoration of anthropogenic ecosystems towards natural ecosystems

The line between anthropogenic and natural ecosystems can also be complex to draw for *partially restored or recovering ecosystems*. Examples include a sown pasture being restored to the forest ecosystem type it replaced, an exotic pine plantation being restored to a native shrubland, a wetland re-establishing following dam removal and flow recovery, an abandoned cropland reverting to a natural ecosystem type, and a coastal dune system re-establishing following the removal of a protective seawall.

Criteria for assessing when an anthropogenic ecosystem under restoration is considered to have reverted to a natural ecosystem may differ for different ecosystem types, and involvement of ecologists is necessary to determine criteria and thresholds and assess them. Possible criteria include:

- Compositional criteria, such as:
    - Presence of key native species (e.g. indicator or keystone species characteristic of the original ecosystem are established and reproducing),
    - Species composition (e.g. native species dominate over exotics or planted non-natives, with self-sustaining populations).
- Structural and functional criteria, such as:
    - Structural similarity (e.g. vegetation layers, canopy cover, hydrological features, or geomorphological forms resemble those of the reference natural ecosystem type),
    - Ecosystem processes (e.g. nutrient cycling, hydrological regimes, disturbance dynamics operate without continuous human intervention).
- Human influence criteria, such as:
    - Limited human maintenance (e.g. restoration interventions have ceased or are minimal),
    - Infrastructure removal (e.g. anthropogenic structures have been dismantled or are no longer shaping ecosystem dynamics).

Ecosystem-specific thresholds for reclassification from the broad category anthropogenic to the broad category natural would need to be established, for example related to:

- Dominance of natural processes: When ecological functions are primarily maintained by natural drivers rather than human inputs.
- Ecological resemblance: When the system’s structure and species composition are closer to a natural reference ecosystem than to its anthropogenic origin.
- Management intensity: When human involvement shifts from essential (to sustain the system) to optional (to enhance or accelerate recovery).

3.9 Ecosystem extent

Ecosystem extent is defined in SEEA Ecosystem Accounting as the size of an ecosystem asset, where ecosystem assets are defined as contiguous spaces of a specific ecosystem type characterized by a distinct set of biotic and abiotic components and their interactions (paragraph 2.13). As discussed above, an ecosystem type may have several occurrences, i.e. be made up of several ecosystem assets. The combined extent of all these ecosystem assets or occurrences makes up the overall extent of the ecosystem type.

Ecosystem extent is a metric (expressed, for example, in hectares or square kilometres) that is calculated from a spatial dataset showing the distribution of ecosystem types. The spatial dataset provides the geographic location, boundaries and classification of ecosystem types across the landscape or seascape, whereas ecosystem extent is a numerical measure derived from that dataset. For example, a national ecosystem map may show where a particular forest ecosystem type occurs and how many separate patches it comprises, while ecosystem extent is the total area occupied by those patches combined. The spatial dataset provides an array of information about ecosystem types, while ecosystem extent answers the question: “How much area does each ecosystem type occupy?" The same spatial dataset can be used to derive several different metrics, including ecosystem extent, fragmentation measures and measures of ecosystem connectivity.

Ecosystem extent is thus one metric derived from a map of ecosystem types, recorded in an ecosystem extent account. The metric and the spatial dataset should not be conflated; for example, a map of ecosystem types should not be referred to as an “extent map”, and mapping the distribution of ecosystem types should not be referred to as “extent mapping”. This distinction is important for understanding the key datasets required for Indicator A.2, discussed in Step 2 Collecting and organising key datasets (Section 7).

3.10 Ecosystem conversions and changes in ecosystem extent

A change in the extent of an ecosystem type is a change in the total area occupied by that ecosystem type, and is associated with conversion from one ecosystem type to another. In SEEA Ecosystem Accounting, *ecosystem conversions* refer to situations in which, for a given location, there is a change in ecosystem type involving a distinct and persistent change in the ecological structure, composition and function which, in turn, is reflected in the supply of a different set of ecosystem services (SEEA Ecosystem Accounting, paragraph 4.23).

Frequently, such conversions take the form of natural ecosystems being converted abruptly to an anthropogenic ecosystem type, such as a forest ecosystem being converted to a sown pasture, a grassland ecosystem being converted to an urban area, or a wetland being converted to a dam. Conversion can also be the outcome of a gradual process, for example if an area of one ecosystem type is restored to a different ecosystem type. Restoration efforts that result in improvement in the condition of an ecosystem do *not* constitute a change in ecosystem extent as there has been no conversion from one ecosystem type to another. Such improvements in condition would be reflected in an ecosystem condition account but not in an ecosystem extent account, and are not intended to be reflected in Indicator A.2. Equally, declines in ecosystem condition should not be mistaken for conversion from one ecosystem type to another, as noted in Section 3.3.

In some cases, there can be conversion between different natural ecosystem types, as noted in Section 1.2 on the rationale for Indicator A.1. For example, direct pressures that cause severe loss of integrity can result in a transition from seagrass meadows (M1.1) to subtidal sand beds (M1.7) or from kelp forests to subtidal rocky reefs (EFG M1.6). These changes are considered a form of ecosystem collapse that would be included in Red List of Ecosystem assessments and be reflected in Indicator A.1. Climate change can result in gradual shifts in ecosystem distribution leading to one ecosystem type replacing another. For example, saltmarsh ecosystems may transition to mangrove ecosystems as mangroves expand in response to warming temperatures.

An ecosystem extent account should record both increases and reductions in ecosystem extent, which are summed to provide the net change in extent for each ecosystem type in each accounting period. As discussed in Section 1.2, the basic version of Indicator A.2 will reflect primarily overall conversion from natural to anthropogenic ecosystem types, while changes in the extent of different natural or anthropogenic ecosystem groups or types may be reflected in ecosystem-based disaggregations of the indicator.

4 Classifications

Classifications that underpin the compilation of Indicator A.2 are national ecosystem classifications and the Global Ecosystem Typology.

4.1 National ecosystem classifications

The central classification that underpins Indicator A.2 is a *national classification of ecosystem types*. A national ecosystem classification distinguishes between different ecosystem types present in a country, preferably as part of a hierarchical classification system, and provides lists and descriptions of those ecosystem types. The classification is typically accompanied by spatial datasets or maps of the distribution of the ecosystem types, with classification and mapping often taking place iteratively (see Section 7.1.1). Both the classification and spatial datasets on ecosystem types are essential foundations for compiling all ecosystem accounts.

Countries are at different stages of developing national ecosystem classifications and accompanying maps, with these resources well established in some countries but still at an early stage of development or not yet in place in others. See the *Guidelines for Developing National Ecosystem Maps* for more information and guidance on this (Global Ecosystems Atlas, 2026).

4.2 IUCN Global Ecosystem Typology

Also important for Indicator A.2 is the IUCN Global Ecosystem Typology (Keith et al., 2020; Keith et al., 2022), which is a hierarchical framework for identifying and classifying the Earth's ecosystem types across the terrestrial, subterranean, freshwater and marine realms and transitions between them. It is the only globally applicable ecosystem-based classification that covers all realms, and enables global consistency at the upper levels of the Typology while encouraging detailed national ecosystem classifications at the lower levels (typically level 5 or 6), shown in Figure 9. The Global Ecosystem Typology is the reference classification for ecosystem types in SEEA Ecosystem Accounting and was endorsed as an international statistical classification by the UN Statistical Commission in 2024.

The *Guidelines for Developing National Ecosystem Maps* (Global Ecosystems Atlas, 2026) provide a short introduction to the Global Ecosystem Typology, and the Global Ecosystem Typology website provides more detail, including descriptions of all biomes and ecosystem functional groups.

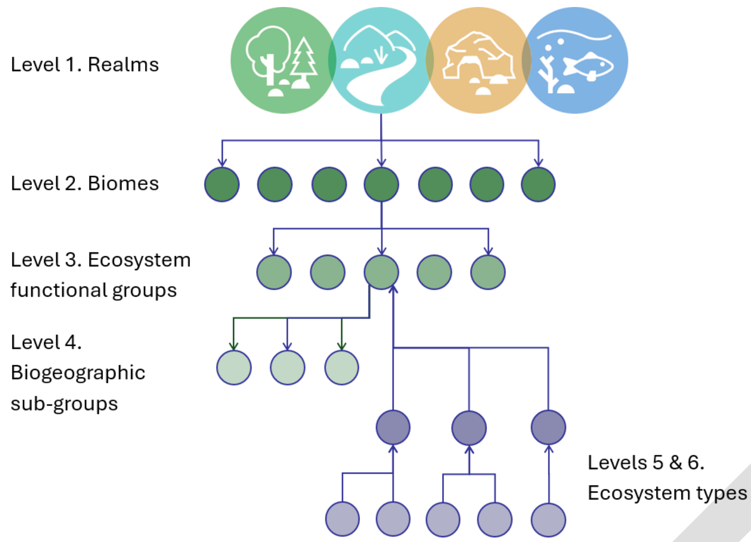

Figure 9. The Global Ecosystem Typology enables global consistency at the upper levels of the hierarchy (shown in realm icons and green circles) while encouraging detailed national ecosystem classifications at the lower levels (shown in purple).

(Source: Based on Xiao et al., 2024)

CBD Decision 16/31 on the monitoring framework includes the following text:

- “17. Encourages Parties … to take a consistent approach at the national level to monitoring ecosystems and reporting data across the goals and targets of the Framework, based on <u>national ecosystem classifications</u>;”
- “18. Invites Parties to make use of the Global Ecosystem Typology, or an equivalent methodology, and cross-reference their national ecosystem data with levels 2 and 3 of that typology, subject to national circumstances and capabilities;”

A CBD information document (CBD/COP/16/INF/3/Rev.1) provides guidance on using the indicators of the monitoring framework of the GBF, including Section 2b titled “Using a consistent ecosystem classification to support the monitoring framework of the Kunming-Montreal Global Biodiversity Framework based on the IUCN Global Ecosystem Typology”. It encourages disaggregation of ecosystem-related indicators to level 3 of the Global Ecosystem Typology rather than to level 2 (biomes), and explains the strengths of this option. Level 3 helps to differentiate of ecosystem groups by the biodiversity they support, the benefits they provide, the pressures and threats they face and thus actions needed. It provides appropriate resolution to support the objectives and information requirements of the GBF, compared with the biome level, which often obscures important information about biodiversity and may not provide enough detail to be meaningful from a biodiversity perspective.

Consistent reporting on ecosystems at level 3 of the Global Ecosystem Typology, across all the ecosystem-related GBF headline indicators, will enable the causal links across the GBF to be tracked and progress to be monitored effectively. In addition, it provides the flexibility to report the ecosystem-related indicators by biome (level 2) or realm (level 1), as ecosystem functional groups are nested within biomes, which are nested within realms.

Countries are thus encouraged to cross-reference their national ecosystem classifications to ecosystem functional groups (level 3) in the Global Ecosystem Typology. This is best linked to the process of developing or refining a national ecosystem map, as discussed in Section 7.1.1, and enables translation of an ecosystem extent account based on national ecosystem types to ecosystem functional groups for the purpose of reporting on Indicator A.2 (see Section 8.3). The cross-referencing process is supported by the IUCN's *Standards, methods and guidelines for cross-referencing ecosystem classifications and maps to the IUCN Global Ecosystem Typology* (IUCN, 2025).

It is important to emphasise that the Global Ecosystem Typology does not replace national ecosystem classifications. Rather, it provides a way of linking national ecosystem classifications to a consistent global system that allows ecosystem information to be compared across countries and regions and synthesised at the global level. The intention is that ecosystem accounts should be compiled using national ecosystem classifications, and then translated to the Global Ecosystem Typology for the purpose of global reporting.

As discussed in Sections 3.5 and 3.8, the Global Ecosystem Typology provides the basis for categorising ecosystems as either natural or anthropogenic. Figure 10 shows an example of a natural biome and an anthropogenic biome (level 2), with ecosystem functional groups (level 3) nested within each biome, and ecosystem types (level 5 or 6) nested within ecosystem functional groups. Each ecosystem type is made up of numerous occurrences or ecosystem assets.

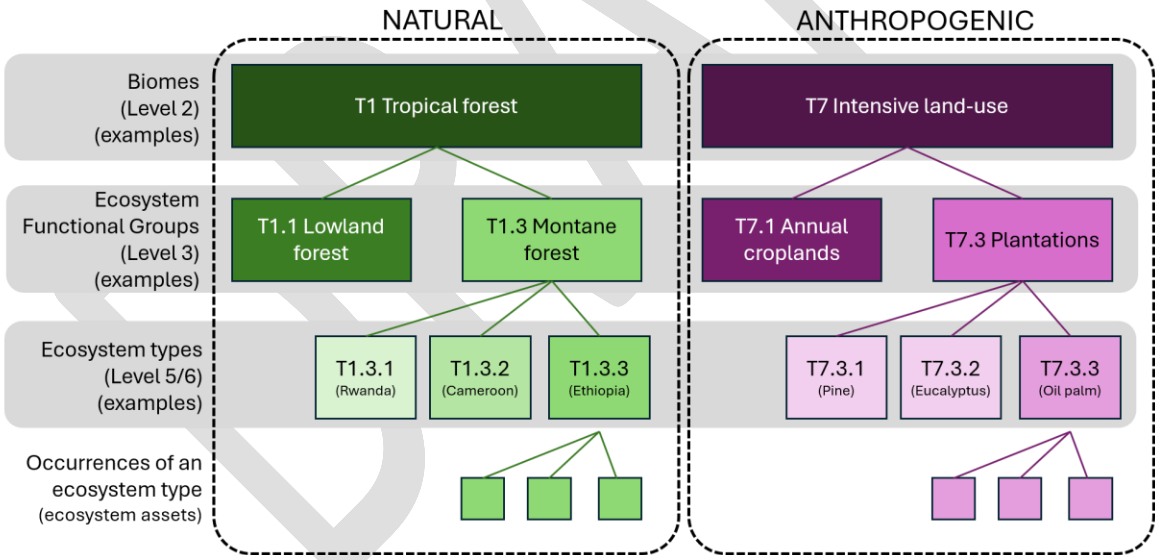

Figure 10. Examples of a natural and anthropogenic biome in the Global Ecosystem Typology, with nested ecosystem functional groups, ecosystem types, and ecosystem assets (occurrences of an ecosystem type)

PART B. DEVELOPING THE INDICATOR

This part of the guidelines sets out the process for compiling and reporting on Indicator A.2 and discusses specific compilation issues that may arise. Compilation of the indicator can be approached as a stepwise process, summarised in Figure 11, recognising that there will be iteration between the steps rather than a strictly linear process. Several of the steps are supported by complementary resources to these guidelines, which are described briefly in Section 11.

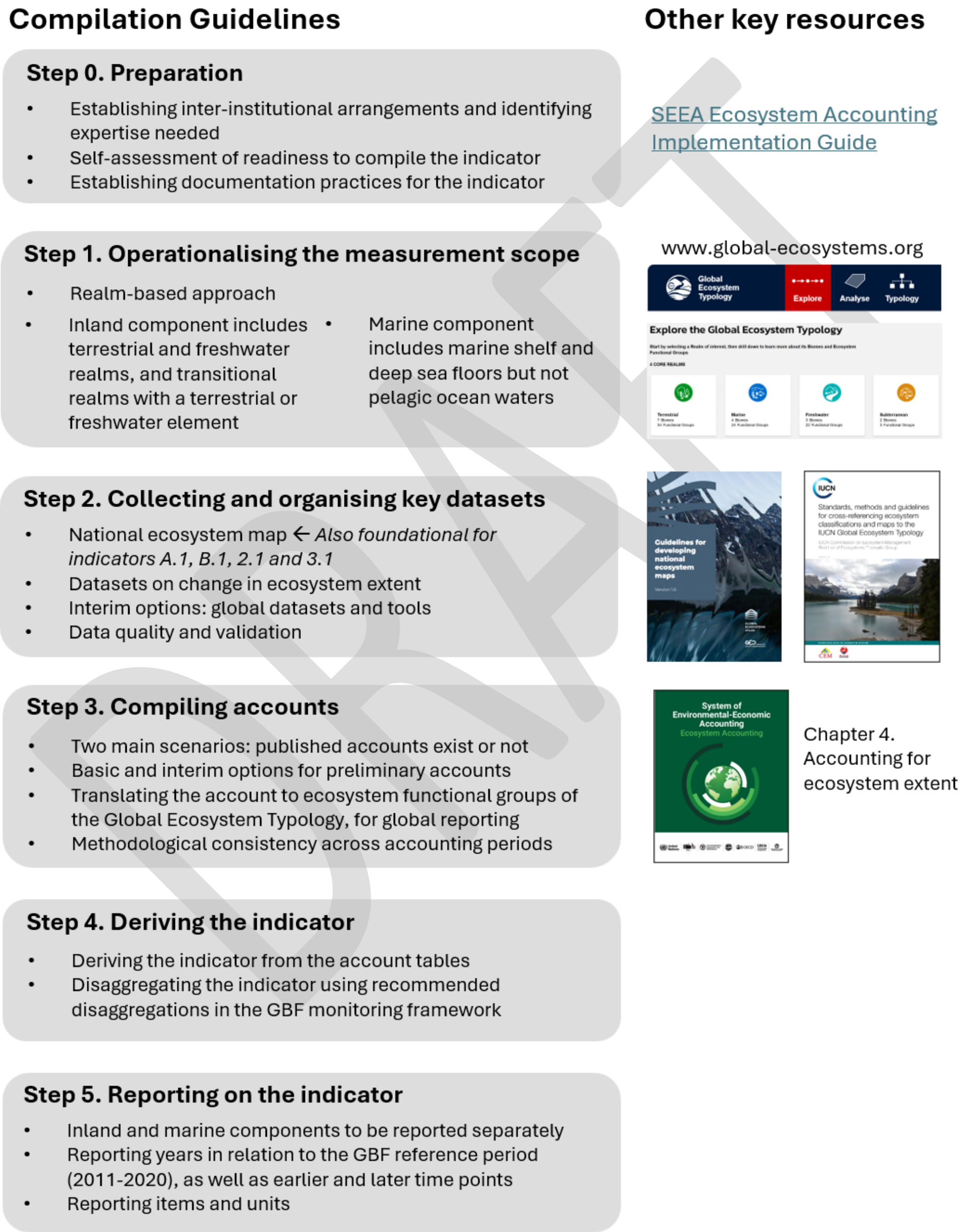

Figure 11. Summary of the stepwise approach to developing Indicator A.2, highlighting complementary resources to the Compilation Guidelines

The compilation of Indicator A.2 requires contributions from multiple institutions, including those responsible for biodiversity monitoring, ecosystem mapping, environmental accounting and national reporting. Early and sustained collaboration between these institutions is therefore a critical success factor. While the specific institutional arrangements will differ among countries, Step 0 Preparation outlines key considerations for establishing an effective collaborative process from the outset.

5 Step 0. Preparation

Step 0 is the preparation phase for developing Indicator A.2. It should be used to establish the institutional arrangements and technical team. Because Indicator A.2 is derived from ecosystem extent information and relies on ecological interpretation as well as statistical compilation, it is best approached as a collaborative process involving the environment ministry, the national statistical office, national technical entities with relevant mandates, including those responsible for national ecosystem classifications and maps, and other relevant scientific, research and technical partners.

Countries should begin by bringing together the key institutions and experts and other knowledge holders who will contribute to compilation and use of the indicator. This includes ecosystem scientists and other knowledge holders with broad knowledge of national ecosystem types, specialists in ecosystem classification and mapping, custodians of key datasets, and environmental accounting experts. Early collaboration is particularly important where the expertise needed to develop or refine national ecosystem classifications and maps and cross-reference them to the Global Ecosystem Typology is distributed across several institutions, to avoid facing delays in later steps. Identifying these contributors at the outset will help ensure that the indicator is ecologically meaningful, technically robust and understood by both compilers and users.

A national self-assessment should be carried out to identify available datasets, capacity and gaps. This assessment should include a review whether a suitable national ecosystem map exists; whether it has been, or can be, cross-reference to the IUCN Global Ecosystem Typology; whether ecosystem extent accounts have already been compiled; and whether suitable datasets are available for at least two time points, including one within the period 2011-2020 and one more recent. The review should consider the coverage, scale, date of update, validation status, data sources and custodianship of each dataset. It should also identify any key datasets that will need to be developed or improved before Indicator A.2 can be compiled reliably.

The preparation phase should also be used to coordinate with teams responsible for related ecosystem indicators and reporting processes, including other GBF headline indicators and relevant SDG indicators. This coordination can help avoid duplicated mapping effort, reduce the risk of inconsistent classifications, and strengthen the case for investing in a national ecosystem map as a shared foundational dataset.

Finally, countries should establish documentation practices from the beginning of the compilation process. Technical documentation should record definitions used, ecosystem classification and cross-referencing decisions (including their rationale), data sources, spatial scale, methods, assumptions, and validation steps, with particular attention to any methodological changes between reporting periods. Maintaining this information throughout the process is essential for transparency, comparability across time, and the institutionalisation of regular indicator compilation.

The SEEA Ecosystem Accounting Implementation Guide provides further guidance to support implementation of ecosystem accounting at the national level, including strategic planning, building mechanisms for implementation and compiling the accounts, with country examples.

6 Step 1. Operationalising the measurement scope of the indicator

The measurement scope for Indicator A.2 is a country's whole territory, including all ecological realms that are present. For all countries this includes inland territory and associated realms, and for some countries it also includes marine territory. In practice, data may not initially be available for all realms and/or for a country's entire territory, so decisions on how to operationalise the scope of the indicator may be needed. The area for which the indicator is compiled at the national level should remain stable over time.

Countries with outlying territories (such as remote island territories) will need to decide whether to include these areas within the scope of Indicator A.2. In many cases, focusing the indicator on the mainland territory only will be the most pragmatic option.

Areas beyond national jurisdiction (ABNJ), i.e. areas beyond a country's Exclusive Economic Zone (EEZ), are not within scope of the indicator, as stated in the metadata.

Guidance is provided below on using a realm-based approach to allocate ecosystems to the inland and marine components of the indicator, considerations that apply to the inland and marine components of the indicator respectively, delineating the boundary between the two, where coastal ecosystems fit in, and how to deal with linear ecosystems that have been mapped only as one-dimensional features.

6.1 A realm-based approach to distinguishing the inland and marine components of the indicator

As noted in the metadata for Indicator A.2, for countries with marine territory, the indicator should be reported in two components: an inland component and a marine component. This is because status and trends in the indicator may differ widely for inland and marine areas, at the national and global level, so it will be useful to be able to track these separately, with the option of combining the results if useful for a specific purpose. From the perspective of regional or global aggregation, this will also make it easier for information for the inland area of all countries to be aggregated, regardless of whether they have marine territory.

Countries have the option of compiling a single ecosystem extent account for their entire territory, including inland and marine areas, and then splitting the inland and marine components for the purpose of reporting the indicator, OR compiling separate ecosystem extent accounts for inland and marine areas. This is discussed further in Step 3 Compiling the accounts (Section 8).

The realms of Global Ecosystem Typology provide a useful basis for determining the scope of the inland and marine components of the indicator respectively and allocating ecosystem types to each. Table 7 shows which realms and biomes in the Global Ecosystem Typology would typically be associated with a country's inland and marine territories. This is especially useful for transitional realms at the interface between the marine, freshwater and/or terrestrial realms. Note that "inland territory” includes the terrestrial and freshwater realms as well as transitional realms that have a terrestrial or freshwater element. “Inland” is thus not equivalent to “terrestrial”.

Operationalising this approach requires that countries cross-reference their national ecosystem classifications to the realms (level 1) of the Global Ecosystem Typology, for example by determining which biomes (or similar upper level) in the national classification correspond with which realms of the Global Ecosystem Typology. It does not require comprehensive cross-referencing of national ecosystem types to the ecosystem functional groups (level 3) of the Global Ecosystem Typology, although that is needed at a later stage for translating the ecosystem extent account to ecosystem functional groups for global reporting of the indicator (Section 8.3).

An important factor to consider is the need for mutually exclusive and collectively exhaustive measurement units as a principle of accounting. There should be no conceptual or spatial overlaps or gaps between the units that are being accounted for, in this case ecosystem types, as this would result in double counting or missing some areas. For Step 1, it means that ecosystems should be allocated either to the inland or the marine component of the indicator, not both, and that all ecosystems should be allocated to one of the two. Further practical implications are discussed in Section 6.2 and in later steps.

Table 7. Realms and biomes in the Global Ecosystem Typology typically associated with inland and marine territory respectively

Global Ecosystem Typology realms and biomes associated with inland territory	**Global Ecosystem Typology realms and biomes associated with marine territory**
All biomes in the Terrestrial (T) realm	All biomes in the Marine (M) realm: M1 Marine shelf biome** (includes ten EFGs: M1.1 Seagrass meadows; M1.2 Kelp forests; M1.3 Photic coral reefs; M1.4 Shellfish beds and reefs; M1.5 Photo-limited marine animal forests; M1.6 Subtidal rocky reefs; M1.7 Subtidal sand beds; M1.8 Subtidal mud plains; M1.9 Upwelling zones; M1.10 Rhodolith/Maerl beds) M2 Pelagic ocean waters biome M3 Deep sea floors biome M4 Anthropogenic marine biome
All biomes in the Freshwater (F) realm	
All biomes in the Terrestrial-Freshwater (TF) transitional realm: TF1 Palustrine wetland biome	
All biomes in the Marine-Terrestrial (MT) transitional realm:* MT1 Shorelines biome MT2 Supralittoral coastal biome MT3 Anthropogenic shorelines biome	
All biomes in the Marine-Freshwater-Terrestrial (MFT) transitional realm:* MFT1 Brackish tidal biome	
All biomes in the Freshwater-Marine (FM) transitional realm:* FM1 Semi-confined transitional waters biome	

Blue shading represents coastal ecosystems, which occur across several realms and biomes:
* These realms and biomes are typically considered coastal.
** Some marine shelf ecosystems may be considered coastal, depending on the degree of land-sea interaction. Ecosystems on the outer shelf can be tens to hundreds of kilometres offshore and are less directly influenced by land, so they would typically not be considered coastal.

The subterranean (S) realm and associated transitional realms (subterranean-freshwater and subterranean-marine) of the Global Ecosystem Typology are currently outside the scope of Indicator A.2. Including ecosystems in these realms would greatly complicate the compilation of the indicator as by definition they overlap entirely in area with other realms, which would result in double-counting of area. They are also generally poorly mapped. The exclusion of subterranean ecosystems could be revisited for future reporting cycles.

6.2 Considerations for the inland component

The inland component of the indicator should cover the whole inland territory, and should include the terrestrial and freshwater realms as well as transitional realms that have either a terrestrial or freshwater element. For countries with no marine territory, this means the terrestrial (T), freshwater (F) and terrestrial-freshwater (TF) realms should make up the inland component. For countries with marine territory, the marine-terrestrial (MT), freshwater-marine (FM) and marine-freshwater-terrestrial (MFT) realms should also be included in the inland component, as shown in Table 7.

In practice, national ecosystem maps may focus on terrestrial ecosystems and large waterbodies (such as lakes), not fully reflecting freshwater and transitional terrestrial-freshwater ecosystems. For example, not all wetlands may have been mapped, and rivers may have been mapped separately to terrestrial ecosystems as a network of lines rather than polygons. If this is the case, a country can compile and report on the indicator based only on those ecosystems that have been included in the national ecosystem map to date, aiming for more comprehensive inclusion of freshwater ecosystems and applicable transitional realms in future reporting cycles. Changes in the indicator resulting from more comprehensive mapping of ecosystem distribution would need to be distinguished from genuine changes.

Operationalising joint measurement and reporting for all inland realms requires that terrestrial, freshwater, and applicable transitional ecosystem types are delineated as mutually exclusive and collectively exhaustive. If terrestrial and freshwater ecosystems have been mapped separately, this will require integration of these data layers and resolution of any spatial overlaps. A suggested spatial hierarchy or rule-based approach for resolving overlaps is that freshwater ecosystems take precedence over transitional ecosystems, which take precedence over terrestrial ecosystems (freshwater > transitional > terrestrial).[12] However, countries should assess if this approach would be ecologically meaningful in their context and may wish to develop an alternative approach.

Countries may have spatial datasets for certain ecosystem types but not others. For example, a country may have comprehensively mapped its forest ecosystems but not yet have developed a complete (“wall-to-wall”) national ecosystem map. Although an ecosystem extent account requires comprehensive data on the area of all ecosystem types, countries may still be able to report values for some ecosystem types for Indicator A.2. This is an interim option that should be documented and reported transparently, while aiming to achieve complete spatial coverage in future reporting cycles as suitable data become available.

[12] This approach can be useful especially if freshwater ecosystem boundaries are more precisely delimited than terrestrial ones. Assigning precedence to freshwater ecosystems helps to prevent underrepresentation of wetland and riverine ecosystems that commonly overlap with spatial datasets on terrestrial ecosystems.

6.3 Considerations for the marine component (if applicable)

The marine component of the indicator should cover a country's whole marine territory, to the outer edge of the Exclusive Economic Zone (EEZ).[13] Conceptually, this includes the marine shelf biome (M1), the pelagic ocean waters biome (M2), the deep sea floors biome (M3) and the anthropogenic marine biome (M4), which together make up the marine realm (see Table 7). However, *pelagic ocean waters should be excluded from the measurement scope of the indicator.* Pelagic (water-column) ecosystem types are not subject to conversion from natural to anthropogenic ecosystems. In addition, they are challenging to classify and map, and they overlap spatially with deep sea floor ecosystems. This means they would require a separate (parallel) ecosystem extent account to the accounts for other marine ecosystems, and would need to be reported in a separate indicator, which would effectively remain constant at a proportion of natural ecosystems of 100%.

The deep sea floors biome is typically spatially extensive, and is seldom subject to large-scale conversion from natural and anthropogenic ecosystem types. For example, in archipelagic countries with large marine areas, most direct drivers of ecosystem conversion (such as coastal development, aquaculture, harbour construction) impact inshore or nearshore areas, with offshore areas generally less affected. In some cases deep sea floors are repeatedly trawled, causing major destruction to the ecosystems concerned, but this would typically be reflected as a change in condition of the ecosystem rather than a change in extent. For most countries, the extent of natural deep sea ecosystems will thus be constant or close to constant at the full extent of those ecosystems, resulting in a value of 100% or close to that for the marine component of the basic indicator with negligible change over time. However, ecosystem-based disaggregations of the indicator may reveal important distinctions and trends in different biomes, ecosystem functional groups or ecosystem types within the marine realm, including smaller ecosystem types in the marine shelf biome such as seagrass meadows, kelp forests, coral reefs, rocky reefs, sand beds and mud plains. The marine component of Indicator A.2, with ecosystem-based disaggregations, is thus necessary for the indicator to play an effective role in the suite of ecosystem-related indicators of the GBF, as discussed in Section 1.3.

Many countries have not yet comprehensively mapped all ecosystem types in the marine realm. For example, countries may not have the bathymetric data needed to delineate the boundary between the marine shelf biome (M1) and the deep sea floors biome (M3) at the edge of the continental shelf. Countries are more likely to have data for some marine ecosystem types (such as coral reefs or seagrass meadows) than others (such as deep sea floors ecosystems). Partial coverage of some ecosystem functional groups or ecosystem types may still have value for national applications of the indicator as well as regional and global syntheses. For example, it may be possible to obtain and track the coverage of coral reef extent for a region, even if none of the countries have sufficient data to compile the complete marine component of Indicator A.2 at the national level.

[13] In instances of disputed (overlapping) EEZs, countries should clearly document how these areas have been treated in the compilation of the indicator.

6.4 Delineating the boundary between the inland and marine components

For the purposes of Indicator A.2, the boundary between the inland and marine areas should preferably be an ecologically determined boundary, based on the seaward boundary of the transitional marine realms (MT, FM and MFT), illustrated in Figure 12. These transitional realms each have a terrestrial and/or freshwater element and are allocated to the inland component of the indicator (Table 7). A realm-based approach is preferable to using an administrative or jurisdictional boundary that may not correspond well with ecosystem boundaries, causing difficulties for defining an ecologically meaningful area for compiling the accounts.

This approach means that the total area of the country for calculating Indicator A.2 may not correspond exactly with its total area based on administrative boundaries. However, because the indicator is calculated as the proportion of natural ecosystems relative to the total area included within the measurement scope, small differences between administrative and ecological boundaries will not affect the validity of the indicator. Consistency between the numerator and the denominator of the indicator is more important than exact correspondence with administrative boundaries.

In some cases, ecosystems along this boundary are dynamic, with shifting delineations that could influence the size of the inland and marine areas, for example due to coastal erosion or sediment deposition. Implication of such changes in area for compiling the ecosystem extent account are discussed in Section 8.2.

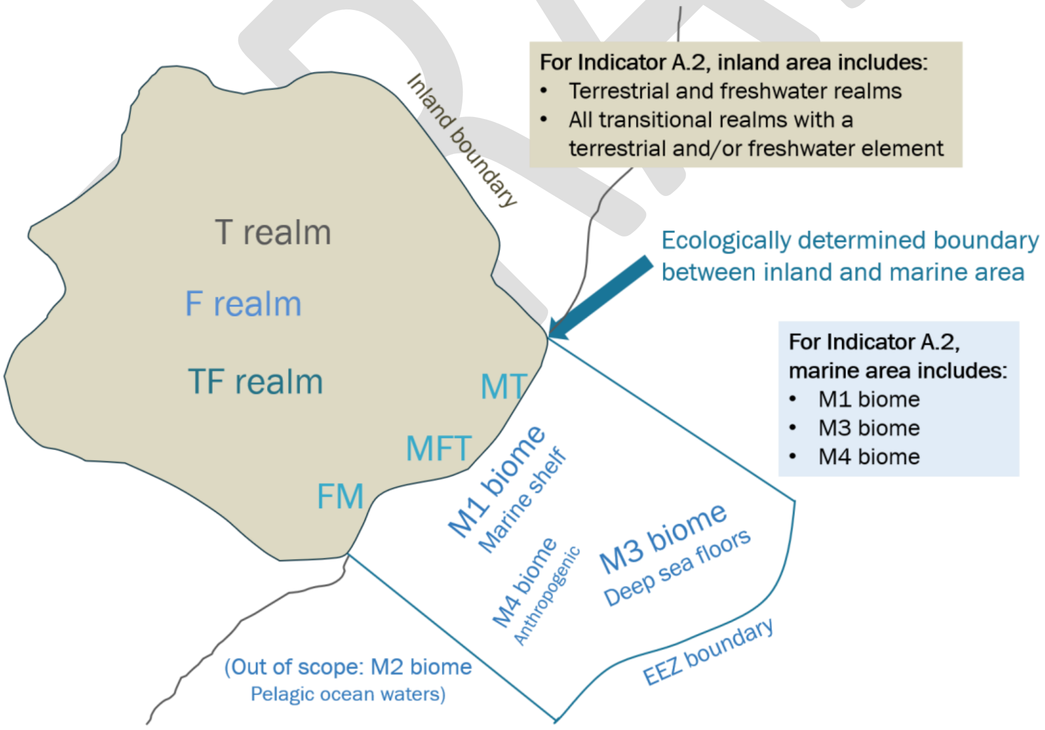

Figure 12. The boundary between the inland and marine components of Indicator A.2 should preferably be ecologically determined based on the seaward boundary of the transitional marine realms, each of which has a terrestrial and/or freshwater element (T = terrestrial; F = freshwater; M = marine)

6.5 Where do coastal ecosystems fit in?

Coastal ecosystems are characterised by land-sea interaction and occur in several realms and biomes of the Global Ecosystem Typology, as shown by the blue shading in Table 7. All ecosystems within the transitional marine realms (MT, FM and MFT) share characteristics associated with the marine and terrestrial and/or freshwater ecosystems, and are typically considered coastal. They are included in a country's inland territory for the purposes of Indicator A.2, and will be reflected in the inland component of the indicator. Some ecosystems within the marine shelf biome (M1) are also considered coastal, depending on the degree of land-sea interaction. These coastal ecosystems on the marine shelf will be included in the marine component of the indicator.

Coastal ecosystems are thus split across the inland and marine components of the indicator, as reflected by the blue-shaded realms and biomes in Table 7. Extracting and combining data on coastal ecosystems from both components of the indicator would enable an analysis of the extent and changes in extent in coastal ecosystems, which are often of policy interest.

6.6 How should ecosystems mapped as one-dimensional linear features be treated?

For linear ecosystem types that have been mapped only as one-dimensional linear features, countries have the option of compiling a separate indicator for those ecosystem types, based on length rather than area, which can be used alongside the main indicator. This applies especially to rivers and streams, which are often mapped as network of lines rather than polygons, with the result that their extent can be measured only by length not by area. It is not possible to combine length and area in a single ecosystem extent account or in the calculation of the indicator.

In the Global Ecosystem Typology, the rivers and streams biome (F1) has seven ecosystem functional groups. The ecosystem is the river channel, not the whole riparian area, with floodplains and riparian wetlands covered in the transitional palustrine wetlands biome (TF1). Some river ecosystem types (such as those in EFG F1.4 Seasonal upland streams, EFG F1.5 Seasonal lowland rivers and EFG F1.6. Episodic arid rivers) do not have permanent water in the river channel. The river is still considered to exist even when water does not flow, and its length should still count towards the total river length of a country.

In some countries, the conversion of natural rivers to anthropogenic waterbodies such as canals, and in some cases restoration of canals toward natural rivers, is of significant policy interest.[14] If these ecosystems are not mapped as polygon features and thus not captured in Indicator A.2, a country may wish to compile a separate indicator for river ecosystems based on natural river length as a proportion of total river length. This could be derived from an ecosystem extent account based on length (e.g. km), alongside the ecosystem extent account based on area, as shown in Section 4.3.3 of SEEA Ecosystem Accounting. At this stage, it is recommended that such length-based indicators

[14] A river reach would typically be considered a modified natural ecosystem even if it has been heavily modified (including straightening of rivers). When fully converted to an artificial waterbody such as a canal (corresponding to EFG F3.5 Canals, ditches and drains in the Global Ecosystem Typology) it would be considered anthropogenic.

should be used at the national level where relevant but should not be reported at the global level. This could be revisited for future national reporting cycles to the CBD.

Countries are encouraged to delineate especially their larger rivers (e.g. in F1.7 Large lowland rivers) as polygons rather than lines, so that the area of these river ecosystems can be included directly in the inland component of Indicator A.2.

7 Step 2. Collecting and organising key datasets

This section gives guidance on national datasets that are required for Indicator A.2, and on global datasets, platforms or tools that can be used as an interim measure in the absence of suitable national datasets. Text from the various CBD decisions and documents related to the GBF monitoring framework makes it clear that countries should preferably use national data for compiling the indicators, with global datasets used as a back-up option.

7.1 National datasets required for the indicator

Essential national datasets for Indicator A.2 are:

- A national ecosystem map, consisting of a classification of all ecosystem types that occur in a country and a spatial dataset representing their distribution at a baseline date. The classification and map should be mutually exclusive and collectively exhaustive, meaning that the classification covers all ecosystem types within the country without any conceptual overlaps between ecosystem types, and the associated map represents these ecosystem types without any spatial gaps or overlaps.
- Spatial datasets representing the change in distribution of ecosystem types for successive time points.

National datasets should preferably be recognised as authoritative by the relevant technical entities in each country. Where possible, information from official national processes and monitoring systems should be used. Where parallel sources of similar information exist, it is important to carefully assess their suitability for Indicator A.2 (for example, using the questions related to data validation in Section 7.1.6) in deciding which to use or how to reconcile them.

7.1.1 National ecosystem map at a baseline date

A national ecosystem map showing the distribution of different ecosystem types in a country is the foundation for Indicator A.2. It is also an input into the other ecosystem-related GBF headline indicators and supports implementation of several GBF targets. The *Guidelines for Developing National Ecosystem Maps* (Global Ecosystems Atlas, 2026) provide a comprehensive explanation of what these maps are (extract in Box 3 below) and how they support the GBF indicators and targets.

Box 3. What is a national ecosystem map?

The term "national ecosystem map" is used as shorthand for a national classification and map of the spatial distribution of ecosystem types in a country. A national ecosystem map may be known by another name, such as a vegetation map, habitat map, geobotanical map, or map of ecological communities. The map shows the spatial distribution (geographical locations) of the ecosystem types that occur in the landscape or seascape, and the classification distinguishes between different ecosystem types, each with a name and description. The classification should preferably be hierarchical, with ecosystem types at lower levels of the hierarchy nested within broader classes that share similar characteristics at higher levels. The map and the classification are in almost all cases developed iteratively, alongside each other, and refined and improved over time.

In practice, many national ecosystem maps are realm specific. For example, a country may have a separate national terrestrial ecosystem map, national wetland map, and national marine ecosystem map. For a particular realm, a national ecosystem map should cover all ecosystems in that realm that occur within the country rather than just focusing on a subset of ecosystems. No part of the landscape, or seascape for marine ecosystems, should be excluded from the classification and mapping effort, as this can result in unintended biases towards certain ecosystem types in many applications of the ecosystem map and limits meaningful comparison between ecosystem types.

Developing a national ecosystem map requires the integration of various types of geospatial data from a range of sources, including historical maps, Earth observation data, environmental variables and field data, together with expert and local knowledge. An interdisciplinary approach is important, drawing on expertise from ecologists, biologists, spatial analysts, environmental scientists, and remote sensing experts, among others.

A national ecosystem map should consist of a suite of products. These include: a well-organised geospatial dataset with well-annotated attribute data and metadata; technical documentation that describes the data, methods and process used to develop the map; and names and descriptions of each ecosystem type and the nested hierarchy within which they occur.

Source: Global Ecosystems Atlas. 2026. *Guidelines for developing national ecosystem maps, Version 1.0*. Group on Earth Observations, Geneva.

Different countries will be at different stages in the development of national ecosystem maps, from those that have well developed national ecosystem maps to those that have yet to begin developing such maps. Within a country, maps for different realms may be at different stages of development. In some cases, a country may have multiple existing ecosystem classifications and associated national maps, which may have been developed at different times led by different institutions. Ideally these should be reconciled through a collaborative process.

A country may have spatial data on some but not all ecosystem types within its area, and/or multiple overlapping maps or datasets for various ecosystem types with differing classification schemes. For example, forests ecosystems may have been the focus of multiple mapping efforts while grassland and shrubland ecosystems may be poorly mapped. In such cases, the relevant institutions in the country would need to assess whether a sensible result could be achieved through combining existing national datasets using a set of harmonisation or prioritisation rules to provide a national ecosystem map suitable for compiling Indicator A.2. This could include drawing on one or more global datasets representing ecosystem types to fill gaps where no suitable national datasets exist yet, provided they are conceptually consistent with national datasets and at a compatible spatial scale, as discussed further in Section 7.2.

As noted in Box 3, national ecosystem maps are in almost all cases developed iteratively, with refinements and improvements over time. Especially in large countries, the initial version of a national ecosystem map may be at a relatively broad scale, moving towards finer identification and delineation of ecosystem types in successive versions. Appropriate mapping scales will vary in different country contexts (for example in large countries with extensive natural areas compared with small countries where ecosystems are highly fragmented, as two opposite extremes). A well-considered and consistent approach to mapping scale is important for a national ecosystem map to support many of its applications, including measurement of extent for an ecosystem extent account.

A national ecosystem classification that is to be used for the purposes of Indicator A.2 should clearly distinguish between natural ecosystem types on the one hand, and anthropogenic ecosystem types on the other, with this distinction documented in the descriptions of the ecosystem types.

Initiatives to provide freely available tools to support countries in developing national ecosystem maps are underway, such as [World Ecosystem Extent Dynamics](). Methods for ecosystem mapping using AI foundation models are developing rapidly, offering significant time and resource savings provided that sufficient training data points are available, supported by appropriate ecological knowledge and validation processes.

7.1.2 Approaches to determining a baseline date or period

It is important for a country to have a baseline national ecosystem map that represents the distribution of ecosystems at a certain time. A range of approaches to determining a baseline can be taken, depending on context, aims and available information. Broadly speaking, these group into two contrasting approaches (Global Ecosystems Atlas, 2026):

- Mapping the contemporary (present-day or relatively recent) distribution of ecosystem types,
- Mapping the historical (e.g. pre-industrial) distribution of ecosystem types.

If the baseline map represents the contemporary distribution of ecosystem types, the baseline date selected could relate to, for example, the starting year of long-term datasets that provide consistent data at suitable resolution over multiple years, a policy-determined date, or the date of development of the map. “Relatively recent” could be a few decades ago, in other words “relative” is intended to mean relative to the distant past. Although typically expressed as a particular year, the baseline date may in practice represent a period of, say, a few years rather than strictly one year, as the multiple datasets required for an ecosystem map may not all neatly represent one particular year. It is important to distinguish between the date represented by the baseline map and the year it was produced or published, which may be considerably later.

For baseline maps that represent the historical distribution of ecosystem types, the aim is typically to delineate ecosystem types prior to intensive human intervention in the landscape, or as close as possible an estimate. Historical distribution in this sense is often referenced to circa 1750, the start of industrial development, following which human impacts on ecosystems intensified. Such maps are sometimes called “potential ecosystem maps”. They are unlikely to include any anthropogenic ecosystem types, which were typically created through industrialisation. It is nevertheless useful for the national ecosystem classification to allow for anthropogenic ecosystem types that will form part of datasets representing change in the distribution of ecosystem types over time (Section 7.1.5).

These two approaches should be viewed as different entry points rather than competing options for mapping the distribution of ecosystem types. Information on the historical distribution of ecosystem types is useful because it provides a long-term baseline against which more recent changes in ecosystem extent can be assessed. It also enables, for example, current coverage of protected and conserved areas to be assessed in relation to the historical extent not just the remaining extent of an ecosystem type, and can help to inform restoration objectives by providing information about pre-existing ecosystem types.

7.1.3 Links between national ecosystem maps and land cover/use classes in practice

As discussed in Section 3.6, land cover and land use classes are conceptually distinct from ecosystem types and should not be conflated, even though land cover data can be a useful input for mapping and modelling some ecosystem types. This is because land cover classes are based predominantly on structural characteristics that can be discerned from remote sensing data, and do not consider the compositional and functional characteristics that are essential for distinguishing between different ecosystem types. As a result, a land cover data product is not a substitute for an ecosystem map.

However, for anthropogenic ecosystem types there may be a closer correspondence with some land cover and land use classes, because the human activities that create and maintain these ecosystem types of often directly related to land use and directly influence land cover. High quality national land cover/use products can provide a sufficient basis for an interim version of the indicator that distinguishes only between natural and anthropogenic ecosystems without allowing for ecosystem-based disaggregations, discussed in Section 8.2.

In some cases, national land cover/land use products incorporate a range of contextual data layers and information, in addition to Earth observation data, that can allow for more meaningful identification of ecosystem types. In such cases, some classes in a national land cover/land use map may a useful proxy for some ecosystem types, including some natural ecosystem types. Such enhanced national land cover/land use data products may distinguish between anthropogenic and natural ecosystem types that can be difficult to differentiate using land cover data alone (for example, forestry plantations and natural forest ecosystems, sown pastures and natural grasslands).

The degree to which a national land cover/land use product represents ecosystem types meaningfully should be carefully assessed with input from ecosystem scientists and other relevant specialists and knowledge holders with firsthand knowledge of the country’s ecosystems. Through collaboration with land cover/land use mapping agencies, the alignment between definitions of land cover/land use classes and ecosystem types and their spatial representation may be able to be strengthened, supported by rapidly improving Earth observation data and modelling techniques that are able to detect and interpret a wider range of characteristics combined with intentional use of additional contextual information and field observations.

7.1.4 Cross-referencing national ecosystem types to the Global Ecosystem Typology

National ecosystem types should preferably be cross-referenced to ecosystem functional groups in the Global Ecosystem Typology. As discussed in Section 4.2, this allows for national ecosystem data and information to be aggregated to ecosystem functional groups when needed, including for reporting on the ecosystem-related headline indicators of the GBF. For Indicator A.2, it forms the basis for translating an ecosystem extent account based on national ecosystem types to ecosystem functional groups, described in Section 8.3.

Cross-referencing should be done based on the IUCN's guidelines for cross-referencing other ecosystem-related classifications to the Global Ecosystem Typology (IUCN, 2025), which set out principles and steps for cross-referencing and provide some analytical tools. Countries can develop or retain as much detail as is useful in their national ecosystem maps and classifications while also aligning with the Global Ecosystem Typology for the purposes of cross-country comparison and regional or global aggregation. Cross-referencing does not imply replacement of or loss of detail in national classifications.

Countries developing a national ecosystem classification for the first time may choose to align national ecosystem types with the ecosystem functional groups in the Global Ecosystem Typology from the outset, so that each national ecosystem type is nested within one ecosystem functional group (see the *Guidelines for Developing National Ecosystem Maps* for more on this). For countries that have an existing national ecosystem classification, a process of cross-referencing national ecosystem types to ecosystem functional groups will need to be undertaken.

The cross-referencing process does not assume that every national ecosystem type will be an exact match or fall neatly within a single ecosystem functional group based on its ecological characteristics, but rather allows for uncertainty and partial matches in the fit between national ecosystem types and ecosystem functional groups. For example, a national ecosystem type may share characteristics with two or more ecosystem functional groups. In such cases, the principles and methods set out in the IUCN guidelines for cross-referencing will help to identify the ecosystem functional group or groups that are the most appropriate fit and the level of uncertainty involved.

The IUCN guidelines use the term "membership" to describe the degree of fit between a national ecosystem type and an ecosystem functional group. Each national ecosystem type is assigned a *membership value* across one or more ecosystem functional groups, based on the degree to which it matches the ecological characteristics of the ecosystem functional groups. The membership values can be captured in a matrix (Table 10) and provide essential information for translating an ecosystem account based on national ecosystem types to ecosystem functional groups for the purposes of global reporting on Indicator A.2. See Section 7.3 for more on how membership values are used to assign national ecosystem types to ecosystem functional groups.

If cross-referencing of national ecosystem types to ecosystem functional groups is not possible, an interim option can be to cross reference them to the biomes (level 2) of the Global Ecosystem Typology. This will support disaggregation of Indicator A.2 and the other ecosystem-related headline indicators by biome, which is the next best option to disaggregation by ecosystem functional group (see Section 9.2).

Note that the cross-referencing process is *conceptual rather than spatial*. It can be shown in tabular form, using the membership values, and does not influence the spatial delineation of national ecosystem types. Nevertheless, spatial data and spatial analysis can be useful to inform membership values, where available.

7.1.5 National spatial datasets representing change in distribution of ecosystem types

In addition to a baseline map of the distribution of ecosystem types, Indicator A.2 requires spatial datasets representing the change in distribution of ecosystem types for successive time points. To enable reporting on the indicator, they should ideally include at least one time point in the period 2011-2020 (as the reference period for reporting and monitoring progress in the implementation of the GBF), and at least one more recent time point, discussed further in Step 5 Reporting on the indicator (Section 10).

A reliable baseline map of the distribution of all ecosystem types in a country is an essential starting point for measuring changes in distribution over time. Mapping the baseline distribution of ecosystem and mapping changes in their distribution typically require different methods.

One broad approach to mapping change in the distribution of ecosystems is to remap the distribution of all ecosystem types at successive dates. If this approach is taken, changes observed in spatial datasets from different dates can reflect changes or improvements data sources, classification rules or scale, as well as effects of misclassification, rather than real ecosystem change. There is a risk of misidentifying natural variation, dynamic shifts in state or changes in condition within an ecosystem type as conversion from one ecosystem type to another. The apparent change between years can in practice be mainly a measure of the errors in the two time periods. Because uncertainties associated with each dataset are effectively combined in the change analysis, even small classification or mapping errors in either period can result in substantial overestimation or underestimation of change.

Fortunately (from an ecosystem measurement perspective), many natural ecosystem types have boundaries that are relatively stable at the timescales of accounting periods, except where they are converted to anthropogenic ecosystem types. In general, there is thus no need to remap the distribution of all ecosystem types on a frequent basis. A second broad approach to mapping change in ecosystem distribution is thus to focus on those areas and ecosystem types that are subject to short- to medium-term changes in distribution, which would typically include conversions from natural to anthropogenic ecosystem types and a limited number of natural ecosystem types with genuinely migrating boundaries[15]. Successful restoration of anthropogenic ecosystems to a natural state (distinguished from restoring the integrity of natural ecosystems) may also require a specific measurement focus.

For this second approach, using high quality land cover/land use datasets to measure conversion from natural to anthropogenic ecosystem types can be an effective method for mapping most changes in ecosystem distribution. As discussed in Sections 3.6 and 7.1.3, land cover/land use datasets can effectively represent some anthropogenic ecosystem types, with some land cover/land use classes corresponding well to some anthropogenic ecosystem types (such as croplands and built-up areas). This is especially the case if national land cover/land use products include additional contextual information, over and above Earth observation data. Anthropogenic land cover/land use classes can be extracted from a national land cover/land use dataset and then intersected with the baseline map of ecosystem types, to show which natural ecosystem types have been converted to which anthropogenic ecosystem types in a particular period.

National land cover/land use datasets in time series can thus provide a pragmatic way to track conversion of natural ecosystems to anthropogenic ecosystems. In many countries, this will reflect the bulk of change in the extent of different ecosystem types and may be sufficient for compiling an ecosystem extent account and deriving Indicator A.2. This approach greatly reduces the risks of mistaking natural variation in an ecosystem type or change in ecosystem condition as a conversion from one ecosystem type to another. It also reduces the risk of the change between years simply being a measure of the errors in the two time periods.

In this approach, land cover data products in time series are being used as a practical means of identifying likely conversions from natural ecosystem types to anthropogenic ecosystem types. They are not being used as a substitute for a national ecosystem classification or a baseline map of ecosystem types.

The approach has the disadvantage of not capturing conversions between different natural ecosystem types. However, as noted the boundaries of many natural ecosystem types are relatively stable over accounting timescales. The focus on identifying conversions from natural to anthropogenic ecosystem types using time series land cover/land use data products can be supplemented with a specific focus on mapping change in boundaries of migrating ecosystem types, where persistent shifts in ecosystem boundaries result in one natural ecosystem type replacing another. Examples could include mangrove expansion/contraction, saltmarsh migration, migrating coastal dune systems, river channel migration or upslope movement of alpine or montane ecosystem types in response to climate change.

Mapping restoration of anthropogenic to natural ecosystems may not be reliably inferred from land-cover change alone and may require restoration registers, field validation, ecosystem-specific

[15] Migrating boundaries of ecosystem types are distinct from temporal variation in dynamic ecosystem types, such as seasonal floodplain wetlands, ephemeral wetlands, intermittent rivers and streams, tidal flats, and seasonally inundated marshes, where the state of the ecosystem within its outer boundary may vary dramatically over time without any associated change in ecosystem type. Such changes should not be confused with changes in the boundary of an ecosystem type or conversion of one ecosystem types to another.

criteria and expert assessment. However, in many countries the area of successful restoration from anthropogenic to natural ecosystem types is likely to be small relative to the area converted from natural to anthropogenic ecosystems. As a result, while restoration gains should be measured wherever possible, incomplete detection of such gains is unlikely to materially affect the overall pattern of change reflected in the ecosystem extent account or Indicator A.2.

The second approach to measuring changes in ecosystem distribution does not preclude improvements to the baseline map of ecosystem types over time, as data sources and methods evolve and the national ecosystem classification is refined. If an improved version of the baseline map is developed, the time series on change in ecosystem distributions should preferably be back-cast using the new baseline map. More generally, where methods and data sources for measuring change in the distribution of ecosystem types improve, time series should preferably be back-cast or a break in time series should be recorded. If this is not possible, uncertainties this introduces should be recorded. Further guidance on consistency across accounting periods is provided in Section 8.4.

7.1.6 Data quality and validation of national datasets

National datasets used for Indicator A.2 should be of suitable quality, both in terms of fitness for purpose and technical quality. Specific technical and statistical data quality standards should be determined by countries in their national context. National statistical offices are likely to have established data quality assessment frameworks (DQAF) that would apply, building on the Fundamental Principles of Official Statistics and the UN National Quality Assurance Frameworks Manual for Official Statistics (see Box 4). Chapter 7 of the *Guidelines on Biophysical Modelling for Ecosystem Accounting* (UN, 2022) provides more detail on each of the dimensions listed in Box 4.

Box 4. Data quality dimensions

The UN National Quality Assurance Framework for Official Statistics (UN, 2019) distinguishes the following quality dimensions that can be used to characterize the quality of a statistical product, as specified in Principles 14-18:

• *Relevance*: the extent to which the statistics satisfy the needs of the users.
• *Accuracy*: the closeness of estimates to the exact or true values that the statistics were intended to measure.
• *Reliability*: the closeness of the initially estimated value(s) to the subsequent estimated value(s) if preliminary figures are disseminated.
• *Timeliness*: the length of time between the end of a reference period (or date) and the dissemination of the statistics.
• *Punctuality*: the time lag between the release date and the target date by which the data or statistics should have been delivered.
• *Accessibility*: the ease and conditions with which statistical information can be obtained.
• *Clarity*: the availability of appropriate documentation relating to the statistics and additional assistance that producers make available to users.
• *Coherence*: the ability to reliably combine statistics and data sets in different ways and for various uses. Consistency is often used as a synonym for coherence.

• *Comparability*: the extent to which differences in statistics from different geographical areas, non-geographical domains, or over time, can be attributed to differences between the true values of the statistics.

In addition to meeting statistical and technical data standards, national ecosystem maps and datasets on change in the distribution so ecosystem types should be validated through appropriate institutional processes within the country, involving relevant in-country knowledge holders. The objective is to ensure that datasets provide a credible representation of the country's ecosystems, not that they are perfectly accurate. Uncertainty or confidence levels should preferably be documented as part of the validation process. It is also useful for the process to identify and document key knowledge gaps and research or other further work needed to fill them.

7.2 Global datasets and tools as an interim option

If a country does not yet have an adequate or suitable national ecosystem map to provide the basis for Indicator A.2, the process of developing a national ecosystem map should be initiated, ideally to be ready for the next cycle of national reporting to the CBD. As noted, *Guidelines for Developing National Ecosystem Maps* are available (Global Ecosystems Atlas, 2026).

If national ecosystem types have been partially mapped, existing datasets could be integrated with one or more global datasets to fill in gaps. Detailed technical guidance on this process is beyond the scope of these guidelines, but it is important to have a clear integration workflow, for example prioritising high-quality national data where available and filling gaps using only global datasets that meet certain criteria (discussed below). A rule-based approach can be developed to resolve spatial overlaps. Data provenance codes (for example: "nationally validated", "global dataset gap-fill") should be recorded for each mapped ecosystem type, ideally with some estimate of confidence levels. It is ideal to have consistent spatial resolution across all ecosystem types, but in practice some ecosystem types may be delineated at a finer scale than others. For example, a relatively fine-scale wetland map could be integrated with a broader scale map of surrounding grassland and savanna ecosystems, or a fine-scale map of coral reefs could be integrated with a broader scale map of other marine shelf ecosystems to achieve wall-to-wall coverage of the area concerned. The datasets and approach used should be fully documented in accompanying technical documentation.

In the absence of any national datasets on the distribution of ecosystem types, countries have the option of extracting their national area from one of more global datasets or platforms (see Box 5 for some examples). Global datasets should be carefully assessed for their suitability and should be validated at the national level – see discussion below.

The aim should be to delineate at least ecosystem functional groups (level 3 of the Global Ecosystem Typology) if at all possible. An alternative is to delineate biomes (level 2 of the Global Ecosystem Typology). If necessary, the ecosystem map could consist of a mix of biomes and ecosystem functional groups, with biomes used where it is not possible to distinguish between different ecosystem functional groups in a particular biome.

If it is not possible to delineate ecosystem functional groups or biomes, as an interim option it may be possible to distinguish between natural and anthropogenic ecosystems as two broad categories. This could be achieved with global land cover mapping products, by extracting those land cover classes that have a good correspondence with anthropogenic ecosystem types (Section 7.1.3) and considering the remaining area natural. This can support the interim option for compiling Indicator A.2 discussed in Section 8.2.

Box 5. Examples of freely available global datasets and platforms that may be useful as an interim option in the absence of suitable national datasets

[**Note on the advanced draft:** Guidance on global datasets and platforms will be discussed further at the second Expert Group Meeting planned for November 2026.]

Global ecosystem mapping platforms include:

- ARIES for SEEA
- World Ecosystem Extent Dynamics

These platforms provide tools with default global models and datasets but can also integrate national data.

The Global Ecosystems Atlas is an initiative to provide a synthesis map of ecosystem functional groups (level 3 of the Global Ecosystem Typology) worldwide. It combines the best available national and regional maps, and uses advanced technologies and data to fill gaps where national maps are not yet available. The Atlas is intended as a resource to support GBF reporting, including on Indicator A.2, as well as other applications of spatial data on ecosystems.

Several global datasets exist for specific groups of ecosystem types, such as the Allen Coral Atlas and Global Mangrove Watch. Some of these specialised global datasets have high confidence levels and may be able to be combined with other global and/or national datasets using the approach described above.

Global Forest Watch provides data and tools related to forest ecosystems and tree-covered areas. The Freshwater Ecosystems Explorer developed to support SDG indicator 6.6.1 may be useful for freshwater ecosystems. Global Wetland Watch was recently launched for some regions of the world.

Global datasets that represent anthropogenic ecosystem types:

- The Global Ecosystems Atlas team has assessed a wide range of global datasets that represent the most easily transferable source classes for mapping each of the 13 anthropogenic ecosystem functional groups of the Global Ecosystem Typology that are in scope of Indicator A.2, at 100m resolution or finer, prioritising the most recent datasets, those with the highest reported per-class accuracy estimates for EFGs where data are more abundant, and those which require the least amount of processing.

Note: The indicative distributions of ecosystem functional groups that are available on the Global Ecosystem Typology website should *not* be used. They are too broad scale and generalised to be suitable for the purpose of Indicator A.2.

Global datasets should be evaluated for their suitability for use in the national context before they are used for the purposes of the indicator, through appropriate institutional processes involving relevant in-country knowledge holders. The purpose of assessing suitability is to ensure that the global dataset gives a sufficiently credible representation of ecosystem types (or ecosystem functional groups, or biomes as a back-up option) within the country, not that it is perfect. The need for national validation of global datasets is emphasised in the CBD Decisions related to the monitoring framework. In cases where regional or continental datasets are available, the same need to evaluate suitability for national use applies as for global datasets.

By definition, if a country does not have a suitable national dataset it will be difficult to undertake quantitative validation of global datasets, so expert judgement is likely to play a key role. Even where there is some national data available to compare against the global data, many countries will face constraints in performing full quantitative validation due to limited reference datasets or resources for ground truthing. Convening the right experts and other relevant knowledge holders is important, and the process could involve interagency review.

Considerations for an expert-based evaluation of whether a global dataset on ecosystem distribution is suitable for national use include:

- Do the classes and spatial units in the dataset represent ecosystems (rather than other concepts such as land cover or land use classes)?
- Have the classes used in the dataset been or could they be cross-referenced to ecosystem functional groups in the Global Ecosystem Typology?
- Is the thematic resolution is sufficient (preferably equivalent to ecosystem functional groups or lower levels of the Global Ecosystem Typology)?
- Is the spatial resolution sufficient (for example, 100m or finer, depending on the ecological context)?
- What input data were used to produce the global dataset? Were the input data a suitable representation of the national reality?
- For modelled ecosystem distributions, what training and validation data were used? Did they include confirmed occurrences of ecosystem types in your country or region or at least in locations with similar climatic and environmental characteristics? To what degree was the global dataset ground-truthed?
- Is the dataset supported with sufficient methodological documentation, including limitations and accuracy assessment?
- Does the dataset come from a trusted data provider with long term, regular production assured (i.e., an institution with a mandate to develop this dataset)?

In addition to these considerations, an initial expert-based sense-check can provide valuable insights, answering questions such as: If we zoom in to specific parts of the country that we know firsthand, does this dataset provide sensible information, or is it substantially different from what we know to be the reality? If we look at the overall national picture provided by this dataset, is it plausible? Are there major errors of omission or commission? The assessment should bear in mind that the suitability of a global dataset may vary in across biogeographic regions within the country, given that the performance of global products may vary considerably across ecosystems.

If the global dataset does not pass either an expert-based review or more quantitative validation, it should not be used for reporting on the indicator, at the risk of providing information that could be substantially inaccurate and even misleading.

8 Step 3. Compiling the accounts

This section discusses different scenarios that a country may face regarding the existence of ecosystem extent accounts, and gives guidance on developing a preliminary account for calculating the indicator in the absence of formal ecosystem extent accounts, including basic and interim options. It also describes an approach for translating ecosystem extent accounts based on national ecosystem types to ecosystem functional groups in the Global Ecosystem Typology, and recaps from the metadata the method of calculation of the indicator based on entries from the account table. Lastly it provides guidance on disaggregations for Indicator A.2.

8.1 Possible scenarios regarding ecosystem extent accounts in a country

There are two main scenarios a country may face regarding ecosystem extent accounts, with different implications for Indicator A.2, shown in Figure 13. It is important that *a country can compile and report on Indicator A.2 from the starting point of either scenario, i.e. even if it does not yet have formally published national ecosystem extent accounts*. Nevertheless, countries that do not yet have ecosystem extent accounts are encouraged to embark on the process of developing them. The ecosystem extent account establishes the spatial foundation for all SEEA ecosystem accounts and can support multiple ecosystem-related indicators and applications in policy and decision-making, so this is a worthwhile investment over and above the role of ecosystem extent accounts in Indicator A.2.

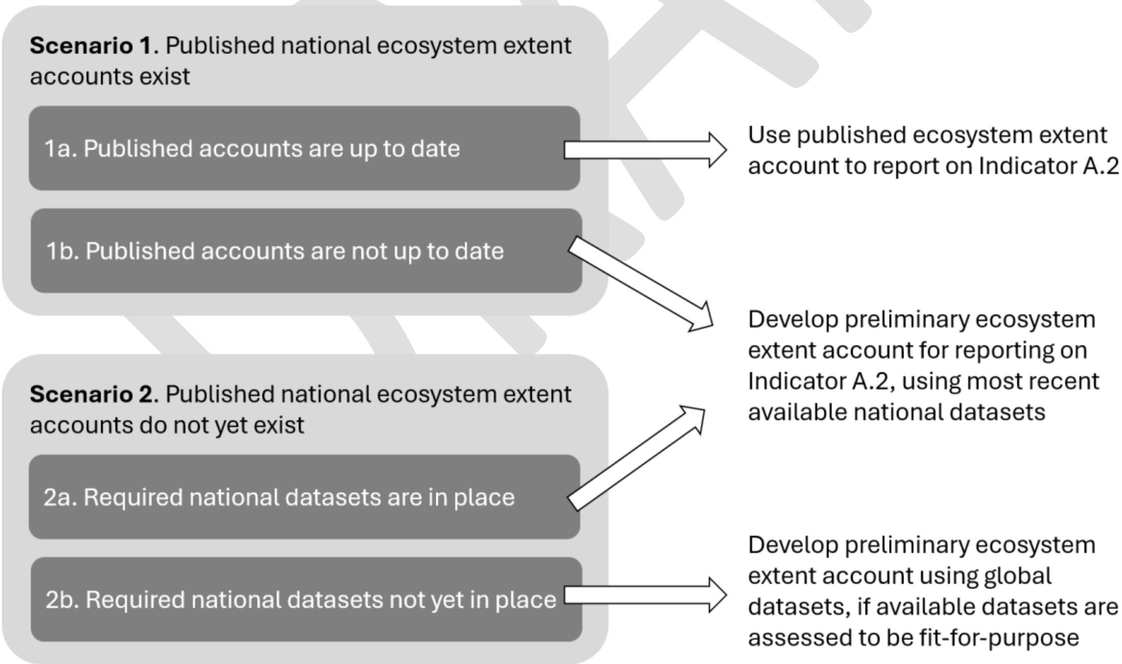

Figure 13. Possible scenarios regarding ecosystem extent accounts in a country, with implications for Indicator A.2.

A country may face different scenarios for different realms, so may face more than one scenario with respect to compiling Indicator A.2. For example, a country may be able to compile ecosystem extent accounts and derive the indicator for its inland territory but not yet for its marine territory.

Some countries may have published ecosystem extent accounts for one or more sub-national areas, for example as pilots intended to develop and test approaches for eventual national-scale ecosystem extent accounting. This is not sufficient for reporting on Indicator A.2 and would fall within Scenario 2.

If published national ecosystem extent accounts exist, compilers of Indicator A.2 should assess whether the accounting periods align with the reporting requirements for the indicator (see Step 5 Reporting on the indicator). These include at least one value within the period 2011-2020 (the reference period for the GBF monitoring framework) and at least one more recent time point, but the more time points for which accounts are available the better, including before 2011 and after 2020. It may be that existing ecosystem extent accounts were produced some time ago, in which case a preliminary account for a more recent accounting period should be developed.

Ecosystem accounts published by a national statistical office (or perhaps another government agency or ministry in some cases) would typically be subject to established national institutional processes to ensure their quality and credibility. Because responsibility for Indicator A.2 is shared between the environment ministry (or related agency) and the national statistical office, an institutional process may be required to confirm the information to be reported for the indicator. This should include national technical entities with mandates relevant to the indicator, especially if they were not directly involved in developing or validating the accounts.

In the absence of formally published ecosystem extent accounts, or if existing accounts are not up to date, a preliminary account can be developed to provide the information needed for Indicator A.2. The account could be preliminary in two senses:

- Not yet formally approved and published by the national statistical office,
- Not including the full set of possible elements in the ecosystem account table.

If the required national datasets are available, they should be used to develop the preliminary account. If national datasets are not available but suitable global datasets or tools are available (as assessed in Step 2), they can be used instead. As part of compiling the preliminary account, further work required to develop a formalised ecosystem extent account could be assessed and documented.

As noted earlier, the development of Indicator A.2 should be approached as a collaborative cross-ministerial and multi-agency process, involving technical entities with relevant competencies and mandates. In all ecosystem accounting, knowledge and judgement across a range of disciplines is needed to produce credible accounts, including ensuring that the source datasets are meaningfully interpreted. Relevant experts and knowledge holders should be involved throughout the process, even for a preliminary account, and “preliminary” should not imply poor quality. In particular, it is essential that ecosystem scientists and other knowledge holders who have broad knowledge of the country’s ecosystems are involved, to ensure the accounts are credible from an ecological perspective. This could be done through structured expert elicitation, documented to ensure repeatability and transparency. Quantitative or qualitative uncertainty levels (for example confidence intervals or expert-judgement scores) should preferably be recorded.

Preliminary accounts should be validated through appropriate national processes, depending on national institutional arrangements and context. This could include steps such as: (1) internal expert review across agencies involved in developing the account, (2) spatial accuracy checks (ideally quantitative but at least an expert-based qualitative assessment), and (3) public consultation or peer review before publication. This would strengthen credibility even before formal publication by the national statistical office.

8.2 Basic and interim options for a preliminary account

An ecosystem extent account records the extent and changes in extent for all ecosystem types in a certain geographical area, referred to as the Ecosystem Accounting Area, for successive accounting periods. In the context of Indicator A.2, the Ecosystem Accounting Area is a country's whole territory, as discussed in Step 1 Operationalising the measurement scope (Section 6). The sum of the extent of all ecosystem types must equal the total area of the Ecosystem Accounting Area. Countries with both inland and marine territory have the option of compiling extent accounts for the whole area combined or for separate inland and marine Ecosystem Accounting Areas, discussed further in Box 6 below.

Sections 4.2.2 and 4.2.3 of SEEA Ecosystem Accounting describe the structure of the ecosystem extent accounts and associated accounting entities. Table 8 shows an example of a basic ecosystem extent account table, based on Table 4.1 in SEEA Ecosystem Accounting but with the rows simplified, for a hypothetical country with ten national ecosystem types. For simplicity, all the ecosystem types are terrestrial. A preliminary ecosystem extent account could use the table structure in SEEA Ecosystem Accounting or the basic option shown in Table 8.

An account table is compiled for each accounting period, which could be a year, several years or longer, and not all accounting periods need be of the same length. Ideally, accounting periods would align with CBD reporting cycles, but data constraints may not allow for this. The opening extent, closing extent and changes in extent[16] for each ecosystem type are recorded, with the closing extent for one accounting period carried over as the opening extent of the following accounting period. The years recorded in the account table should reflect the years for which the data provides the most accurate representation, which may differ from the years in which the underlying datasets were published and from the years in which accounts were compiled or published. There can be quite long lag times between datasets being developed, accounts being compiled and accounts being finalised.

Compiling the account involves calculating the extent of ecosystem types from the relevant geospatial datasets and recording the results in an account table for each accounting period. The account tables should balance, meaning that the total opening extent and the total closing extent should be exactly equal in each table and the total extent should remain exactly the same across accounting periods. In practice, datasets used for different time periods might have slightly varying spatial extents, for various possible reasons. In a preliminary account this can be accommodated in

[16] In a full ecosystem extent account table, rows for additions and reductions in extent are included as well as a row for net changes in extent. Additions and reductions can be broken down further into managed and unmanaged subcategories.

the account table using a balancing entry in a column labelled “no data” or similar, provided the amounts are small relative to the total extent.[17]

If national datasets are used, the columns in the account table will reflect national ecosystem types, as in the example in Table 8.[18] If global datasets are used, the account will reflect the ecosystem classes in the global dataset, preferably the Global Ecosystem Typology’s ecosystem functional groups. The measurement unit for an ecosystem extent account is typically hectares or square kilometres. It is often useful to present the account in graphic form, for example in maps and graphs for national and subnational levels, as well as tabular form.

As an interim option, in the absence of spatial data on ecosystem types, a table with three columns could be compiled: natural ecosystem extent, anthropogenic ecosystem extent, and total extent (i.e. with natural extent as an aggregate, not broken down into different ecosystem types). This option, shown in Table 9, does not constitute a true ecosystem extent account as it does not provide information by ecosystem type.

It may be possible to approximate aggregate values for natural and anthropogenic ecosystems based on land cover data. A high-quality land cover/land use map can give a close approximation of the extent of anthropogenic ecosystems, especially if the classification follows the FAO Land Cover Classification System which differentiates between cultivated cover and natural or semi-natural cover in some of its land cover types. Countries with high-quality land cover/land use maps related to built-up and agricultural areas could use them to generate this interim version of Indicator A.2 while full national ecosystem maps are developed, while recognising that these estimates could overestimate natural area. For example, if the remaining area after extracting anthropogenic land cover classes is treated as natural, any anthropogenic ecosystem types that resemble natural land cover in remote sensing imagery (such as sown pastures, plantations of indigenous species, or recently abandoned croplands) will be incorrectly counted as natural. This risk can be mitigated to a degree, where data on land use is also available. Also see the discussion on the relationship between ecosystem types and land cover/land use classes in Sections 3.6 and 7.1.3.

Table 8. Basic ecosystem extent account table for one accounting period

	National ecosystem types (ETs)										**Total extent**
	ET1 Urban settle-ments	ET2 Dense rural settle-ments	ET3 Orchards	ET4 Timber plantations	ET5 Pastures (cultivated)	ET6 Traditional agro-forestry	ET7 Natural grasslands	ET8 Savannas	ET9 Woodlands	ET10 Temperate forests	
Opening extent at year X											
Net change in extent											
Closing extent at year Y											

[17] Compilers of the account will need to decide on a threshold that is considered an acceptable discrepancy. Larger discrepancies may require investigation as potential data quality problems.
[18] National ecosystem types are often detailed. If it is impractical to have tables with columns for every ecosystem type, account compilers frequently aggregate ecosystem types to broader categories or classes for the purpose of presenting the accounts, with the more detailed tables available in spreadsheets for users who want that level of detail.

Table 9. Interim option for calculating Indicator A.2 if datasets on ecosystem types are not available

	Natural ecosystems	Anthropogenic ecosystems	Total extent
Opening extent at year X			
Net change in extent			
Closing extent at year Y			

Box 6. Account compilation options for countries with both inland and marine territory

Countries with inland and marine territory have the option of compiling a single ecosystem extent account for their entire territory and then splitting the inland and marine components for the purpose of reporting the indicator, OR compiling separate ecosystem extent accounts for inland and marine areas. For many countries it may be more pragmatic to deal with compiling accounts for inland and marine territory separately (e.g. datasets for inland and marine areas may have different custodians, and data may not be available for one or the other). In practice, many countries start with accounts for their inland area, for which data is often more readily available than for marine areas. Whether the accounts are compiled together or separately, there should be no gaps or overlaps in the mapping of inland and marine ecosystems, so that areas are not missed or double-counted in the accounts. This will be facilitated by the approach to dealing with transitional ecosystems discussed in Step 1 Operationalising the measurement scope (Section 6), and will require close coordination between ministries and entities with mandates related to transitional marine ecosystems.

Some countries face the challenge that ecosystems along the boundary between their inland and marine areas are dynamic, with shifting delineations that could influence the size of the Ecosystem Accounting Area, for example due to coastal erosion or sediment deposition. In general, changes in the distribution of these dynamic ecosystems will be small relative to uncertainty in measurement more generally, although with some exceptions (e.g. on a decadal basis there can be kilometres of change in the area of some intertidal ecosystems). The total extent of an ecologically determined Ecosystem Accounting Area could also change due to building of artificial islands or land reclamation for a range of purposes. In such instances, compilers of the accounts should record and explain changes in the total extent of the Ecosystem Accounting Area transparently, for example using table notes that explain the change in total extent from one accounting period to the next.

8.3 Translating an ecosystem extent account to ecosystem functional groups of the Global Ecosystem Typology

The reporting template for Indicator A.2 requests countries to submit absolute values on the extent of each ecosystem functional group of the Global Ecosystem Typology that occurs in the country (see Step 4 Reporting on the indicator). This means that, if the ecosystem extent account has been compiled based on national ecosystem types, an additional step for global reporting is translating the account table from national ecosystem types to the ecosystem functional groups.

It is important to emphasise that *the version of the ecosystem extent account based on national ecosystem types remains the version that would typically be used at the national level*. There is no requirement for countries to adopt ecosystem functional groups for national ecosystem accounts and the indicators that are derived from them for national and sub-national use. The purpose of translating the account from national ecosystem types to ecosystem functional groups is to facilitate comparison across countries and global aggregation to show broad patterns and trends. A country can use the EFG-version of Indicator A.2 *only* for reporting to the CBD, while using a version of the indicator based on national ecosystem types for policy, monitoring, reporting and other purposes at the national level.

Section 7.1 on national datasets briefly discussed the process of cross-referencing a national ecosystem map to the Global Ecosystem Typology, in line with the IUCN's guidelines for the cross-referencing process (IUCN, 2025). As a reminder, each national ecosystem type is assigned a *membership value* across one or more ecosystem functional groups, based on the degree to which it matches their ecological characteristics. These scores can be shown in a cross-referencing matrix. The cross-referencing process is conceptual rather than spatial and does not influence the spatial delineation of national ecosystem types.

Table 10 shows an example of a cross-referencing matrix for a hypothetical country with ten national ecosystem types, which have been cross-referenced to six ecosystem functional groups. Five of the ten national ecosystem types have a one-to-one match with an ecosystem functional group (membership value of 1), while the other five have a one-to-many fit (membership of more than one ecosystem functional group, with the total membership value adding to 1).

Table 10. Hypothetical example of a cross-referencing matrix showing membership values of national ecosystem types across ecosystem functional groups of the Global Ecosystem Typology

			Anthropogenic EFGs			Natural EFGs		
National ecosystem types	**Anthropogenic/ Natural**	**GET EFGs** with membership scores:	T7.2 Sown livestock pastures	T7.3 Plantations & woody croplands	T7.4 Urban & industrial ecosystems	T2.6 Temperate forests & woodlands	T4.2 Pyric tussock savannas	T4.5 Temperate grasslands
ET1 Urban settlements	Anthropogenic				1			
ET2 Dense rural settlements	Anthropogenic				0,9			0,1
ET3 Orchards	Anthropogenic			1				
ET4 Timber plantations	Anthropogenic			1				
ET5 Pastures (cultivated)	Anthropogenic		1					
ET6 Traditional agroforestry	Natural			0,2		0,5		0,3
ET7 Natural grasslands	Natural						0,3	0,7
ET8 Savanna	Natural						0,9	0,1
ET9 Woodlands	Natural					1		
ET10 Temperate forests	Natural					1		

Membership values

Once this cross-referencing matrix has been developed, there are two main possible approaches for translating a national ecosystem extent account to an account based on ecosystem functional groups:

- A *proportional-fit approach*, where the extent of each national ecosystem type is split proportionately between one or more EFGs based on its membership values,
- A *best-fit approach*, where the full extent of each national ecosystem type is assigned to a single EFG based on its highest membership value.

The approach used can influence the value of the indicator, as explained in Step 4 Deriving the indicator (Section 9).

For the proportional-fit approach, the membership values for each national ecosystem type are used directly in translating the ecosystem extent account to ecosystem functional groups. For the best-fit approach, a single best fit ecosystem functional group must be identified for each national ecosystem type based on its highest membership value. If a national ecosystem type has a membership value that is split exactly equally between more than one ecosystem functional group (e.g. 50/50 across two ecosystem functional groups), expert judgement will be required to assign it to one of them for the purposes of compiling Indicator A.2.[19] Table 11 shows the best-fit ecosystem functional group for each of the ten national ecosystem types in the hypothetical country introduced above, based on the membership values shown in Table 10.

Table 11. Cross-reference showing best-fit ecosystem functional groups for the ten national ecosystem types in the hypothetical country used in this example

National ecosystem types	**Best fit ecosystem functional group** (required if using best-fit approach for translating the account)
ET1 Urban settlements	T7.4 Urban & industrial ecosystems
ET2 Dense rural settlements	T7.4 Urban & industrial ecosystems
ET3 Orchards	T7.3 Plantations & woody croplands
ET4 Timber plantations	T7.3 Plantations & woody croplands
ET5 Pastures (cultivated)	T7.2 Sown livestock pastures
ET6 Traditional agroforestry	T2.6 Temperate forests & woodlands
ET7 Natural grasslands	T4.5 Temperate grasslands
ET8 Savanna	T4.2 Pyric tussock savannas
ET9 Woodlands	T2.6 Temperate forests & woodlands
ET10 Temperate forests	T2.6 Temperate forests & woodlands

Translating an ecosystem extent account based on national ecosystem types to ecosystem functional groups requires summing the extent for all the ecosystem types associated with a certain ecosystem functional group. *It does not require any additional spatial analysis.* A worked example is shown in the tables below, using the hypothetical country introduced in Table 10. Table 12 shows an ecosystem extent account for one accounting period for this country, based on the country's ten national ecosystem types. Table 13 and Table 14 show the extent account expressed in ecosystem functional groups, using the proportional-fit approach in Table 13 and the best-fit approach in Table 14.

[19] Similar situations occur in economic accounting. For example, all businesses and all expenditures must be allocated to a single class in their respective classifications, even when the decision about which class is the best fit is not clear cut.

Table 12. Hypothetical national ecosystem extent account based on national ecosystem types, in hectares

Ecosystem extent account using national ecosystem types, in hectares											
	ET1 Urban settlements	ET2 Dense rural settlements	ET3 Orchards	ET4 Timber plantations	ET5 Pastures (cultivated)	ET6 Traditional agroforestry	ET7 Natural grasslands	ET8 Savanna	ET9 Woodlands	ET10 Temperate forests	Total extent
Opening extent (2020)	**50**	**80**	**60**	**70**	**100**	**120**	**170**	**200**	**90**	**60**	**1000**
Increases in extent	10	10	0	20	30	0	0	0	0	0	
Reductions in extent			10	0	0	20	20	10	10	0	
Net change in extent	10	10	-10	20	30	-20	-20	-10	-10	0	
Closing extent (2025)	**60**	**90**	**50**	**90**	**130**	**100**	**150**	**190**	**80**	**60**	**1000**

Table 13. Hypothetical national ecosystem extent account translated to ecosystem functional groups using a proportional-fit approach, in hectares

Extent account translation to EFGs using proportional fit, in hectares							
	T7.2 Sown livestock pastures	T7.3 Plantations & woody croplands	T7.4 Urban & industrial ecosystems	T2.6 Temperate forests & woodlands	T4.2 Pyric tussock savannas	T4.5 Temperate grasslands	Total extent
Opening extent (2020)	**100**	**154**	**122**	**210**	**231**	**183**	**1000**
Increases in extent	30	6	19	0	0	0	
Reductions in extent			0	20	15	20	
Net change in extent	30	6	19	-20	-15	-20	
Closing extent (2025)	**130**	**160**	**141**	**190**	**216**	**163**	**1000**

Table 14. Hypothetical national ecosystem extent account translated to ecosystem functional groups using a best-fit approach, in hectares

Extent account translated to EFGs using best fit, in hectares							
	T7.2 Sown livestock pastures	T7.3 Plantations & woody croplands	T7.4 Urban & industrial ecosystems	T2.6 Temperate forests & woodlands	T4.2 Pyric tussock savannas	T4.5 Temperate grasslands	Total extent
Opening extent (2020)	**130**	**130**	**100**	**270**	**200**	**170**	**1000**
Increases in extent	20	10	30	0	0	0	
Reductions in extent			0	30	10	20	
Net change in extent	20	10	30	-30	-10	-20	
Closing extent (2025)	**150**	**140**	**130**	**240**	**190**	**150**	**1000**

In cases where a country has cross-referenced its national ecosystem types to biomes rather than ecosystem functional groups, the same approaches can be applied but substituting biomes for ecosystem functional groups.

Countries have the option of using either the proportional-fit or the best-fit approach, depending on which they assess to be more appropriate in their context. Factors to consider include:

- If a country has an ecosystem classification that cross-references easily to the ecosystem functional groups of the Global Ecosystem Typology, with high EFG membership values for all or most national ecosystem types, the best-fit approach may be simplest.
- If a country has many ecosystem types that have membership values more or less evenly split across two or more ecosystem functional groups, which makes assigning a best-fit EFG difficult, it may be more appropriate to use the proportional-fit approach.

- If a country's national ecosystem types are very broadly defined, proportional fit may be better, as a single national ecosystem type might span more than one ecosystem functional group (i.e. a one-to-many relationship).
- If national ecosystem types are very detailed, best fit might be more appropriate, as national ecosystem types may be more likely to fit within a single ecosystem functional group (although this will not necessarily be the case).
- It is possible that different approaches may be appropriate for the inland and marine components of the indicator.

8.4 Consistency across accounting periods

Ecosystem extent accounts should preferably be compiled over multiple accounting periods, during which data sources, methods and classifications may evolve. As discussed in Section 2.4, one of the strengths of an accounting approach is that it is built on stable concepts and classifications, allowing data and methods to improve over time while maintaining a consistent basis for measurement. Nevertheless, apparent changes in ecosystem extent between accounting periods may sometimes reflect improvements in data, methodological differences or revisions to classifications rather than genuine changes in ecosystems.

This consideration is particularly important for Indicator A.2. In many countries, compilation may begin using global datasets as an interim solution and progressively transition towards national datasets of increasing quality, resolution and completeness. Similarly, national ecosystem classifications and maps may be refined over time as new information becomes available. While these developments improve the quality and relevance of the indicator, they can also introduce discontinuities in the time series if not managed carefully.

In cases where data sources, methods or classifications change, standard statistical practice provides two main approaches. The preferred approach is to recalculate, or back-cast, the time series using the updated data source, method or classification so that estimates remain comparable across accounting periods. Where this is not feasible, the resulting break in the time series should be clearly documented and communicated. Any methodological changes between reporting cycles for the indicator should therefore be fully documented and, where possible, corrected through recalculation of earlier estimates or otherwise explicitly flagged as a break in series.

Particular attention should be given to changes in the national ecosystem map that forms the foundation of the ecosystem extent account. Improvements in ecosystem classification, mapping methods or spatial resolution of the baseline map can result in substantial changes in estimated ecosystem extent that do not necessarily represent real changes in ecosystem distribution. Where possible, such improvements should be applied retrospectively across the time series to ensure consistency of the account and of Indicator A.2.

As noted in Step 0 Preparation (Section 5), countries are encouraged to establish technical documentation practices from the outset of the compilation process and to maintain them consistently over time. Documentation should record data sources, methods, classifications, assumptions and any changes introduced between accounting periods, together with their implications for comparability. When reporting on Indicator A.2, countries should also clearly identify and explain any breaks in the time series so that users can distinguish methodological effects from actual changes in the extent of natural ecosystems.

9 Step 4. Deriving the indicator from the account

9.1 Calculating the indicator from the account table

To derive Indicator A.2 from an extent account, national ecosystem types should be allocated to the broad categories of natural and anthropogenic ecosystems. The process of cross-referencing national ecosystem types to the ecosystem functional groups of the Global Ecosystem Typology helps greatly with this, as anthropogenic ecosystem functional groups have been clearly identified, as shown in Table 2 in Section 3.5. Those national ecosystem types that have a high membership value or are a best fit with an anthropogenic ecosystem functional group can be considered anthropogenic ecosystem types for the purposes of Indicator A.2.

If a country has not cross referenced its national ecosystem types to ecosystem functional groups or biomes, it should assign them to the broad categories of “natural” and “anthropogenic” based on the definitions of natural and anthropogenic ecosystem types and the two criteria for identifying anthropogenic ecosystem types discussed in Section 3.

As noted in Section 3.7, some ecosystem types may consist of a mosaic of natural and anthropogenic elements. In some cases, these ecosystem types may have a split membership value across anthropogenic and natural ecosystem functional groups, as is the case for the national ecosystem types ET2 Dense rural settlements and ET6 Traditional agroforestry for the hypothetical country introduced earlier (Table 10). In such cases, a decision will be needed about whether the ecosystem type is predominantly natural or predominantly anthropogenic, i.e. which broad category is most appropriate (for example, based on the predominant characteristics and/or relative extent of natural and anthropogenic elements). Such decisions should be documented, with a clear rationale provided, in technical documentation accompanying the indicator.

The indicator for a particular year is calculated as shown in Equation 1. The sum of the extent of the natural ecosystem types is divided by the total extent of all ecosystem types, and the final indicator is expressed as a percentage. The total extent of all ecosystem types (the final column in the extent account table) should reflect the total area of the country.[20] The indicator can be calculated for the opening year of the first accounting period and for the closing year of each subsequent accounting period.

Equation 1. Calculation of Indicator A.2

Indicator A.2 = (Total extent of natural ecosystem types / Total extent of country) x 100

Where:

- *Total extent of natural ecosystem types* is the summed extent of all ecosystem types categorised as natural,

[20] The total area of all ecosystem types in the country as reflected in the account table may not correspond precisely with the total area of the country based on administrative or jurisdictional boundaries. For the purposes of Indicator A.2, it is important to use the total area as reflected in the account table. Major differences with the total administrative area suggest data problems that should be investigated.

- *Total extent of country* is the total area included in the measurement scope of the indicator, reflected in the final column of the extent account table.

An example is shown here for the hypothetical country introduced earlier. Table 15 shows the extent account using national ecosystem types summarised to the broad categories natural and anthropogenic. The indicator is calculated as follows:

- Indicator A.2 in 2020 = (640 ha / 1000 ha) x 100 = 64%
- Indicator A.2 in 2025 = (580 ha / 1000 ha) x 100 = 58%

Table 16 shows the extent account and associated indicator values based on proportional-fit ecosystem functional groups summarised to the broad categories natural and anthropogenic, and Table 17 shows the same using the extent account based on best-fit ecosystem functional groups.

Table 18 compares the value of the indicator resulting from these different approaches. In the case of this hypothetical country, the value of the indicator is the same whether national ecosystem types or best-fit ecosystem functional groups are used, and the value is slightly lower if proportional-fit ecosystem functional groups are used. The slightly lower value of the indicator using the proportional-fit approach reflects the fact that two of the national ecosystem types (ET2 and ET6) have split membership values across natural and anthropogenic EFGs (Table 10).

For countries that are unsure whether to use a proportional-fit or best-fit approach for translating their ecosystem extent account from national ecosystem types to ecosystem functional groups, it may be useful to test both approaches and select the one that results in an indicator value that is closest to the value using national ecosystem types.

Table 15. Deriving the indicator from the hypothetical extent account based on national ecosystem types (shown in Table 12)

National ecosystem types summarised to the broad categories anthropogenic and natural, in hectares						
	Anthropo-genic	**Natural**	**Total extent**		**Value of Indicator A.2**	
Opening extent (2020)	**360**	**640**	**1000**		**64,0%**	in 2020
Increases in extent	70	0				
Reductions in extent	10	60				
Net change in extent	60	-60				
Closing extent (2025)	**420**	**580**	**1000**		**58,0%**	in 2025

Table 16. Deriving the indicator from the hypothetical extent account based on ecosystem functional groups using the proportional-fit approach (shown in Table 13)

Proportional-fit EFGs summarised to the broad categories anthropogenic and natural, in hectares						
	Anthropo-genic	**Natural**	**Total extent**		**Value of Indicator A.2**	
Opening extent (2020)	**376**	**624**	**1000**		**62,4%**	in 2020
Increases in extent	55	0				
Reductions in extent	0	55				
Net change in extent	55	-55				
Closing extent (2025)	**431**	**569**	**1000**		**56,9%**	in 2025

Table 17. Deriving the indicator from the hypothetical extent account based on ecosystem functional groups using the best-fit approach (shown in Table 14)

Best-fit EFGs summarised to the broad categories anthropogenic and natural, in hectares					
	Anthropo-genic	**Natural**	**Total extent**	**Value of Indicator A.2**	
Opening extent (2020)	**360**	**640**	**1000**	**64,0%**	in 2020
Increases in extent	60	0			
Reductions in extent	0	60			
Net change in extent	60	-60			
Closing extent (2025)	**420**	**580**	**1000**	**58,0%**	in 2025

Table 18. Comparison of the value of the indicator across these three different approaches

	2020	**2025**
National ecosystem types	64,0%	58,0%
EFGs using proportional-fit approach	62,4%	56,9%
EFGs using best-fit approach	64,0%	58,0%

9.2 Disaggregating the indicator

The optional disaggregations for Indicator A.2, as reflected in Annex II of CBD Decision 16/31 on the monitoring framework, are:

- By realm, biome and ecosystem functional group,
- By Indigenous and traditional territories,
- By natural and seminatural ecosystem, if feasible.

Countries may want to disaggregate the indicator in a range of other ways for use at the national or sub-national level. For example, it could be disaggregated by sub-national areas that have policy relevance, such as provinces, states, municipalities, catchments or marine zones. More detailed disaggregation by ecosystem types at a finer level than ecosystem functional groups, or by other ecosystem categories or classes, may be useful to support national and sub-national policy and decision-making.

Disaggregating by realm, biome and ecosystem functional group

At the highest level, the indicator will be disaggregated into inland and marine components that will be reported separately by countries for which this is relevant. As discussed in Step 1 Operationalising the measurement scope of the indicator (Section 6), the inland component should include the terrestrial and freshwater realms as well as transitional realms that have a terrestrial or freshwater element.

Disaggregation by realm, biome and ecosystem functional group is highly recommended for Indicator A.2, as this disaggregation is essential for meaningful interpretation of the indicator in the context of the suite of ecosystem-related headline indicators of the GBF. For this disaggregation, the preferred option is to disaggregate the indicator by ecosystem functional group (Global Ecosystem Typology level 3), for reasons set out in the CBD's guidance for using the indicators of the monitoring framework (CBD/COP/16/INF/3/Rev.1) and recapped briefly in Section 4.2. From a biodiversity perspective, disaggregating by ecosystem functional group is more ecologically meaningful and decision-relevant than disaggregating by biome or realm, as much information about states and trends in biodiversity is hidden at the biome or realm level.

However, practical challenges for implementing disaggregation by ecosystem functional groups remain for many countries (such as data gaps, varying spatial resolutions in ecosystem mapping, and incomplete cross-referencing between national classifications and the Global Ecosystem Typology). Disaggregation by biome (Level 2) can offer a realistic next-best option, providing useful information from a policy perspective and still linking to the hierarchy of the Global Ecosystem Typology. This requires a national ecosystem extent account (or preliminary account) that has been translated from national ecosystem types to biomes of the Global Ecosystem Typology.

If disaggregation of the indicator by ecosystem functional group or by biome is possible, this will also allow for disaggregation by realm, as ecosystem functional groups and biomes nest within realms.

The interim option for compiling the indicator, based only on total natural area and total anthropogenic area, does not allow for disaggregation to biomes or ecosystem functional groups. It may to some extent allow for disaggregation by realm, as usually the distribution between land and water is known, but this would likely involve crude assumptions about the correspondence between waterbodies and aquatic ecosystems.

Disaggregating by Indigenous and traditional territories

Disaggregation by Indigenous and traditional territories may have high policy relevance in some countries, especially those where Indigenous lands and traditional territories have been formally recognised. It may also support important insights into the role of Indigenous territories and traditional governance systems in maintaining ecosystem condition and ecosystem service flows. However, this disaggregation may not be appropriate or useful all contexts, and a range of social, cultural and political factors would likely need to be considered. The decision to undertake such a disaggregation should be made in partnership with Indigenous Peoples and local communities (IPLCs).

This disaggregation involves developing a subset of the indicator for those areas designated as Indigenous and traditional territories, i.e. it would show the extent of natural ecosystems as a proportion of the total area of those territories. This would require compiling an ecosystem extent account (at least the interim option shown in Table 9) for Indigenous and traditional territories, excluding the rest of the country. This subset of the indicator could be compared with the extent of natural ecosystems as a proportion of the country as a whole.

If this disaggregation is to be undertaken, it requires:
- Respect for national legal frameworks,

- Free, prior, and informed consent of the communities involved, and their participation in the process,
- Respect for Indigenous data sovereignty principles, including appropriate governance, control and use of data related to Indigenous Peoples and traditional territories,
- Alignment with guidance from the CBD Working Group on Article 8(j) to ensure respect for rights and cultural values,
- Reliable spatial boundaries for Indigenous and traditional territories.[21]

If any of these requirements is not met, it is not recommended to undertake this disaggregation.

Mapping, interpretation and validation of ecosystem extent in Indigenous and traditional territories should involve the participation of Indigenous Peoples and local communities, including through community-based monitoring approaches. This may improve the accuracy of ecosystem classification and interpretation, particularly in contexts where long-term traditional management practices and anthropogenic influences are not adequately reflected in national-scale or global datasets.

Disaggregating by natural and semi-natural ecosystem

In many contexts, the term "semi-natural" is understood as a condition state of a natural ecosystem, as discussed in Section 3.4. Used in this sense, this disaggregation would go beyond the intended purpose of Indicator A.2. In addition, it would be highly complex to operationalise consistently for a range of reasons. The disaggregation of indicator A.2 by degrees of modification within the broad category of natural ecosystems is not recommended at the global level, but may be relevant and practicable in some national contexts.

In some cases, the term "semi-natural" is used to refer to specific ecosystem types in an ecosystem classification. Countries that use the term semi-natural in this sense may wish to disaggregate Indicator A.2 by natural and semi-natural ecosystems, especially if semi-natural ecosystem types are of policy relevance.

[21] Indigenous territories may be well defined in practice but not formally demarcated or recognised in law. Community-defined boundaries developed, for example, through participatory mapping with FPIC and documented methodology, can constitute reliable spatial boundaries for the purpose of this disaggregation.

10 Step 5. Reporting on the indicator

This section provides guidance for national reporting on Indicator A.2 as part of countries' National Reports via the CBD's Online Reporting Tool, including the reference period and baseline for the indicator, which years to report on, and reporting items and units. It does not provide guidance on the inter-institutional processes through which values are reviewed, agreed and approved for reporting, as these should be determined at the national level involving the relevant ministries and technical entities.

GBF reference period, national baseline, and years for which the indicator should be reported

Based on CBD Decisions and related documents, the reference period for reporting and monitoring progress in the implementation of the GBF is the period 2011-2020, allowing for some flexibility in the years for which countries compile and report on reference values for the indicators. The reference period does *not* imply that a multi-year mean should be calculated for the decade 2011-2020 but rather than there is flexibility to report values for a year within that decade if values for 2020 are not available. The CBD's guidance on the GBF monitoring framework clarifies that headline indicators will be reported in tabular format, ideally with values for 2020 and more recent years. It notes that historical trends are relevant, suggesting that where possible the time series for which indicators are compiled and reported should also include values prior to 2020.

In the context of Indicator A.2, it is useful to distinguish between the GBF reference period of 2011-2020 and a country's national baseline date for the indicator, which could be earlier than the global reference period. For example, a country may have ecosystem extent data going back several decades (for example, linked to the advent of freely available satellite imagery), and some countries are able to estimate the historical distribution of ecosystem types prior to intensive human intervention in the landscape, as discussed in Section 7.1 on national datasets.

The national baseline date may represent a period rather than a specific year, which is often the case with historical ecosystem maps and even with more recent ones. Nevertheless, the reporting template for the indicator requires data to be linked to specific years, and ecosystem accounts generally refer to specific years, so we refer to years in this discussion with the understanding that a particular year may in practice represent a slightly longer period.

For Indicator A.2 *countries are encouraged to submit data for all the years for which they have data*, from as far back as possible to the most recent available data. This should include all the accounting periods for which they have compiled accounts, whether published or preliminary. The first data point will be the opening extent of the first account compiled, which provides the national baseline date for the indicator, followed by the closing extent for the first account and for each subsequent account.

In summary, countries are encouraged to report values for:

- Historical extent (pre-industrial, prior to intensive human intervention in the landscape) – if available,
- Past extent (as many data points as possible, for instance 1900, 1990, 2010),

- At least one year within the GBF reference period (2011-2020),
- More recent years (as many as possible based on available data and accounts).

There is no need for countries to interpolate values for years for which data is not available.

Encouraging countries to report data for all years for which they have data allows flexibility for the indicator to be aggregated globally with a reference period of 2011-2020, while not losing valuable information about longer term trends where it is available. Collecting data for years prior to the global reference period from countries that have such data could enable additional analyses that may be useful. Historical baselines are particularly useful for identifying legacy land-use transitions and loss of natural ecosystems, which can support interpretation of post-2020 changes.

Reporting items and units

For Indicator A.2, results should be reported in terms of absolute area values rather than the value of the indicator itself, which is expressed as a proportion. This applies to the disaggregations as well as the total natural and anthropogenic area. The ideal is for countries to report the absolute area of every ecosystem functional group that occurs in the country. Table 19 shows an example of the values that should be reported based on the hypothetical country discussed in Steps 3 and 4. In this case the country is reporting the values from the best-fit cross reference of its ten national ecosystem types to six ecosystem functional groups (Table 14).

It is important for countries to provide a value for the total area of the country as well as values for the area for each natural ecosystem functional group, as this provides the denominator for the indicator. The summed areas of all ecosystem functional groups, natural and anthropogenic, should equal the total area of the country, as discussed in Section 9.1.

Table 19. Example of values required for reporting on Indicator A.2, based on the hypothetical country discussed in Steps 3 and 4

	2020 (ha)	**2025 (ha)**
T7.2 Sown livestock pastures	130	150
T7.3 Plantations & woody croplands	130	140
T7.4 Urban & industrial ecosystems	100	130
T2.6 Temperate forests & woodlands	270	240
T4.2 Pyric tussock savannas	200	190
T4.5 Temperate grasslands	170	150
Total area of country	**1000**	**1000**

In practice, experience with Seventh National Reports in early 2026 showed that some countries were able to provide values for the area of some ecosystem functional groups but not others. A country in this position could provide a “no data” value for the area for which no data on the extent of ecosystem functional groups yet exists. It is important that the individual values for ecosystem functional groups plus the “no data” value collectively add up to the total area of the country. For example, a country with a total area of 1000 ha could report that it has 200 ha of temperate forest ecosystems and 100 ha of wetland ecosystems, with the remaining 700 ha reported as “no data”. In this case, the value of Indicator A.2 would not be able to be calculated, as the overall extent of natural ecosystems relative to anthropogenic ecosystems is not known, but some useful information is nevertheless provided.

The reporting template includes separate worksheets for inland and marine territories to support independent reporting of these two components of the indicator.[22] For countries with marine territory that are not yet able to compile or report the marine component, the worksheet should be completed using “No data” values rather than being left blank. This will ensure that cases of unavailable data can be clearly distinguished from countries for which the marine component is not applicable.

Countries should report values for the inland component of the indicator in hectares, rounded to the nearest hectare. This might result in a small loss of accuracy due to rounding, but for global or regional summaries this would not be material. For the marine component of the indicator, especially where broadscale datasets have been used as the basis for compiling the indicator, square kilometres may be more appropriate than hectares.

[22] This was not the case for Seventh National Reports but should be in place for future reporting cycles.

11 Related resources

Below is a list of resources that are directly relevant to developing Indicator A.2 with short notes on their content and relevance.

11.1 Reference materials

Metadata for indicator A.2 (https://gbf-indicators.org/metadata/headline/A-2)

- Outlines the rationale, definitions, concepts and classification, method of computation, accessibility of the methodology and data sources, and recommended disaggregations of the indicator.
- Provides the basis for the Compilation Guidelines for Indicator A.2
- Relevant to all aspects of Indicator A.2

SEEA Ecosystem Accounting (UN et al., 2024)

- Provides the international statistical standard for ecosystem accounting, adopted by the United Nations Statistical Commission in 2021, and establishes a common framework for measuring ecosystem extent, condition and services.
- Organises ecosystem information using an accounting approach, enabling data from multiple sources to be compiled consistently over time and linked to economic and social information.
- Chapter 4 provides the conceptual basis, accounting structure and reporting formats for ecosystem extent accounts, including opening and closing stocks of ecosystem extent, additions and reductions in extent, and the recording of ecosystem conversions between ecosystem types.
- Includes standard ecosystem extent account tables, ecosystem type change matrices, and guidance on complementary presentations such as ecosystem extent maps and accounts for linear ecosystem features.
- Recommends the use of ecosystem classifications aligned with the IUCN Global Ecosystem Typology and provides the accounting foundation from which indicators related to ecosystem extent (such as Indicator A.2) can be derived.
- Chapter 14 discusses the derivation of indicators from ecosystem accounts.

➔ Relevant particularly to Steps 3 and 4 for Indicator A.2.

IUCN Global Ecosystem Typology: Descriptive profiles for biomes and ecosystem functional groups (Keith et al., 2020)

- The primary reference for understanding the Global Ecosystem Typology, including definitions of realms, biomes and ecosystem functional groups.
- Presents the Global Ecosystem Typology 2.0, provides detailed descriptive profiles for all biomes and ecosystem functional groups, including their defining characteristics, ecological drivers, and relationships to biodiversity and ecosystem functioning.
- Supported by the Global Ecosystem Typology website (see below).

➔ Relevant particularly to concepts and classifications for Indicator A.2

Guidelines for developing national ecosystem maps (Global Ecosystems Atlas, 2026) https://doi.org/10.60566/cd13v-0me13

- Developed for the Global Ecosystems Atlas, an initiative convened by the Group on Earth Observations with a range of partners, including the Secretariat of the CBD.
- Addresses the development of country-wide national ecosystem maps, a foundational data product for GBF Indicator A.2 as well as the conservation, management, restoration and monitoring of ecosystems more broadly.
- Identifies key considerations and provide a framework that can be adapted to different country contexts, recognising that there is no single recipe for developing a national ecosystem map, whether from a technical or institutional perspective.
- Covers the importance and applications of national ecosystem maps, core concepts for mapping and classifying ecosystems, the suite of products that make up a national ecosystem map, typical phases involved in developing a national ecosystem map, roles and skills required in ecosystem mapping teams, and institutional and social processes to consider.
- Applies across realms, including terrestrial, freshwater and marine and transitions between them, and cover natural and anthropogenic ecosystem types.
- Does not provide detailed technical guidance on mapping and classifying ecosystems, but rather to point to some high-level principles and approaches in this rapidly advancing field.

➔ Relevant particularly to concepts, classifications, and Step 2 for Indicator A.2

IUCN Standards, methods and guidelines for cross-referencing ecosystem classifications and maps to the IUCN Global Ecosystem Typology (IUCN, 2025)

- Provide a standardised approach for cross-referencing national, regional and other ecosystem classifications to ecosystem functional groups (EFGs) in the Global Ecosystem Typology.
- Developed to support the use of the Global Ecosystem Typology as a common global reference framework while maintaining the integrity and detail of national ecosystem classifications and maps.
- Explains the conceptual basis for cross-referencing and sets out four key principles: comparison of like classifications, assessment of group membership based on ecosystem properties, use of a weight-of-evidence approach, and explicit representation of uncertainty.
- Provides a five-step protocol for cross-referencing ecosystem types to EFGs, including assessing alignment with the ecosystem concept, compiling information on ecosystem properties, identifying plausible candidate EFGs, estimating membership values and documenting uncertainty through a structured synthesis process.
- Includes practical tools and templates, including a membership matrix for documenting relationships between national ecosystem types and EFGs, guidance on structured expert elicitation, and discussion of emerging digital and artificial intelligence tools to support cross-referencing.

➔ Relevant particularly to Steps 2 and 3 for Indicator A.2.

Guidelines for classifying agricultural and plantation forestry ecosystems in the IUCN Global Ecosystem Typology (Driver & Botts (eds), 2025)

- Provides guidance on identifying and classifying agricultural and plantation forestry ecosystem types within the IUCN Global Ecosystem Typology, particularly in the context of national ecosystem classifications and maps.
- Explains key concepts and terms relevant to ecosystem classification, including ecosystems, ecosystem types, natural and anthropogenic ecosystems, ecosystem condition, semi-natural ecosystems, land cover, land use, agricultural practices and agricultural mosaics.
- Clarifies the distinction between natural ecosystems that are modified by human activities and anthropogenic ecosystems that are created and maintained by human activities, providing additional detail and examples relevant to agricultural systems.
- Discusses the relationship between ecosystem types, land cover and land use, and highlights the importance of distinguishing among these concepts when classifying and mapping ecosystems.
- Includes guidance on ecosystem condition and the interpretation of semi-natural ecosystems, including derived semi-natural pastures and old fields that may present challenges for classification.
- Provides examples of agricultural ecosystem types and discusses issues such as agroforestry, rangelands and mosaic ecosystems that may be relevant when distinguishing between natural and anthropogenic ecosystem types.

➔ Relevant particularly to concepts and classifications for Indicator A.2, providing additional detail relating to agricultural and forestry ecosystems and practices.

Guidelines on biophysical modelling for ecosystem accounting: Biophysical modelling | System of Environmental Economic Accounting (UN, 2022)

- Provides guidance on the use of biophysical modelling to support SEEA Ecosystem Accounting, including ecosystem extent, condition and ecosystem service accounts.
- Introduces a tiered approach to account compilation, ranging from the use of globally available datasets and models through to nationally and locally customised approaches.
- Describes practical considerations for implementing ecsosystem accounting, including institutional arrangements, stakeholder engagement, data sharing, software, technical skills and quality assurance.
- Reviews a range of spatial datasets, remote sensing products, modelling techniques and modelling platforms that can support ecosystem accounting.
- Discusses approaches to compiling ecosystem extent accounts and the role of ecosystem classifications, remote sensing and other spatial datasets in supporting the delineation and measurement of ecosystem assets.

➔ Relevant particularly to Steps 0, 2 and 3 for Indicator A.2.

The CBD's *Revised guidance on using the indicators of the monitoring framework of the Kunming-Montreal Global Biodiversity Framework* (CBD/COP/16/INF/3/Rev.1, October 2024)

- Provides guidance developed by the CBD Ad Hoc Technical Expert Group on Indicators to support the implementation, interpretation and reporting of indicators in the GBF monitoring framework.

- Includes guidance on monitoring ecosystems across the GBF and the role of ecosystem-related indicators in supporting implementation of the ecosystem approach.
- Recommends the IUCN Global Ecosystem Typology as a common global reference framework for ecosystem-related reporting, while emphasising that national ecosystem classifications and maps remain the primary basis for national planning, monitoring and reporting.
- Explains that national ecosystem classifications can be cross-referenced to ecosystem functional groups (level 3) of the GET to support consistent reporting and disaggregation of ecosystem-related indicators across countries and across the GBF monitoring framework.
- Discusses the role of ecosystem classifications and maps in supporting ecosystem-related headline indicators, including A.1 Red List of Ecosystems, A.2 Extent of natural ecosystems, B.1 Services provided by ecosystems, 2.1 Area under restoration and 3.1 Coverage of protected and conserved areas.
- Provides guidance on the rationale for reporting and analysing ecosystem-related indicators using ecosystem functional groups, and on the links between ecosystem-related actions, such as restoration and protection, and ecosystem outcomes.

➔ Relevant particularly to Steps 1, 2, 4 and 5 for Indicator A.2.

Eurostat's Ecosystem Accounts Handbook (Eurostat, 2026)

- Provides practical guidance for compiling ecosystem accounts within the SEEA Ecosystem Accounting framework, with a primary focus on implementation in the European Statistical System.
- Expands on methodological and operational aspects of ecosystem accounting that are only addressed at a high level in SEEA Ecosystem Accounting, drawing on experience gained through implementation of ecosystem accounts in Europe.
- Includes detailed guidance on ecosystem extent accounts, covering concepts and definitions, ecosystem typologies, accounting tables, conversion matrices, ecosystem extent maps, and the compilation of ecosystem extent accounts from spatial datasets.
- Discusses practical issues that arise in compiling ecosystem extent accounts, including treatment of heterogeneous areas, linear features, ecosystem conversions, minimum mapping units, spatial resolution, data consistency over time, and quality assurance.
- Provides examples of accounting workflows, reporting formats, validation procedures and quality-control checks that can support the development of robust ecosystem extent accounts.
- Although developed primarily for the European context and based on European ecosystem typologies, datasets and reporting requirements, many of the practical considerations and compilation approaches are relevant more broadly to ecosystem extent accounting.

➔ Relevant particularly to Steps 2 and 3 for Indicator A.2.

SEEA Ecosystem Accounting Implementation Guide: [Towards the Institutionalization of the SEEA: Implementation Guide | System of Environmental Economic Accounting]() (UNSD, 2023)

- Provides practical guidance to support countries in implementing and institutionalising the SEEA Central Framework and SEEA Ecosystem Accounting.
- Focuses on country-level implementation processes, including strategic planning, stakeholder engagement, national assessments, account prioritisation and implementation planning.

- Discusses institutional, governance and coordination mechanisms that can support the regular production and use of environmental-economic accounts.
- Includes guidance on compiling accounts, identifying data sources, establishing technical working arrangements, quality assurance, dissemination and communication of account results.
- Provides examples from country implementation experiences and highlights a flexible and phased approach to developing environmental-economic accounts.
- Designed as an online resource that can be consulted selectively, depending on a country's stage of implementation and priorities.

➔ Relevant particularly to Step 0 for Indicator A.2, with additional relevance to Steps 2 and 3.

11.2 E-learning resources

SEEA e-learning resources | System of Environmental Economic Accounting

The SEEA e-learning resources provide introductory and intermediate training on the SEEA, including SEEA Ecosystem Accounting. They are particularly useful for building foundational knowledge of ecosystem accounting concepts, accounts and applications, and may support capacity development throughout the process of compiling Indicator A.2. The resources may be especially helpful for institutions and individuals who are new to ecosystem accounting or who require a broader understanding of the accounting framework that underpins the indicator.

11.3 Online platforms and tools

Indicators for the Kunming-Montreal Global Biodiversity Framework | Indicator Repository

The GBF Indicator Repository provides access to the official metadata and supporting documentation for the indicators of the Kunming-Montreal Global Biodiversity Framework. For Indicator A.2, it is the primary source for the current indicator metadata and any subsequent updates adopted through CBD processes.

Global Ecosystem Typology

The Global Ecosystem Typology website provides access to the IUCN Global Ecosystem Typology, including descriptions of realms, biomes and ecosystem functional groups, supporting documentation, scientific publications, and technical guidance. It is particularly relevant to Steps 1, 2 and 3 of the compilation process, where countries determine the measurement scope of the indicator, classify ecosystem types, distinguish between natural and anthropogenic ecosystem types, and cross-reference national ecosystem classifications to the Global Ecosystem Typology for reporting purposes.

ARIES for SEEA | System of Environmental Economic Accounting

ARIES for SEEA is a platform that supports the compilation of ecosystem accounts using the SEEA framework. It combines Earth observation data and environmental models to help generate spatially explicit ecosystem extent, condition and ecosystem service accounts. For Indicator A.2, it may be useful in Steps 2 and 3, particularly where countries are seeking an interim approach to account compilation while national ecosystem accounting datasets and systems are being strengthened.

[Global Ecosystems Atlas] and [GitHub - Global-Ecosystems-Atlas/data-catalogue]

The Global Ecosystems Atlas is an initiative to provide a synthesis map of ecosystem functional groups (level 3 of the Global Ecosystem Typology) worldwide. It combines the best available national and regional maps, and uses advanced technologies and data to fill gaps where national maps are not yet available. The Atlas is intended as a resource to support GBF reporting, including Indicator A.2, and a wide range of other applications of spatial data on ecosystems. It is particularly relevant to Steps 2 and 3 of the compilation process.

[World Ecosystem Extent Dynamics]

World Ecosystem Extent Dynamics is an initiative that provides global ecosystem mapping products, tools and data to support the monitoring of ecosystem extent and changes in ecosystem distribution over time. It is particularly relevant to Steps 2 and 3 of the compilation process, where countries require spatial data on ecosystem types and ecosystem change, especially where national datasets are incomplete or not yet available.

[Global Knowledge Support Service for Biodiversity]

The Global Knowledge Support Service for Biodiversity is a capacity-development and knowledge-sharing platform established to support implementation of the Kunming-Montreal Global Biodiversity Framework. It provides access to guidance, learning resources, tools, communities of practice and technical support related to biodiversity monitoring, reporting and implementation. For Indicator A.2, it may be useful across all stages of the compilation process, particularly for accessing training materials, technical guidance, examples from other countries and opportunities for peer learning related to ecosystem mapping, ecosystem accounting and GBF reporting.

Glossary

Anthropogenic ecosystem types	Ecosystem types created and maintained through human interventions, where human interventions are the primary determinant of the composition, structure and functioning of the ecosystem. Typically replace a pre-existing or antecedent natural ecosystem type, which is no longer recognisably present (although small patches/fragments and some native species may persist). Contrast with *Natural ecosystem types*.
Basic version of Indicator A.2	Indicator A.2 in its binary form, differentiating only between natural and anthropogenic ecosystems with no disaggregation into realms, biomes, ecosystem functional groups or ecosystem types.
Biome	A component of a realm, united by one or a few common major ecological drivers that regulate major ecosystem functions and ecological processes. Level 2 of the Global Ecosystem Typology. (Typology - Global Ecosystem Typology)
Change in ecosystem extent	A change in the area occupied by an ecosystem asset, associated with conversion from one ecosystem type to another.
Contemporary distribution (of ecosystem types)	The present-day or relatively recent geographic distribution of ecosystem types. The date may represent a period of, say, a few years rather than strictly one particular year. Contrast with *Historical distribution*.
Distribution (of an ecosystem type)	The geographic location(s) where an ecosystem type occurs in the landscape or seascape. Also see *Ecosystem extent*, a metric derived from a spatial dataset of the distribution of ecosystem types.
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (Article 2 of the CBD).
Ecosystem Accounting Area	The geographical territory for which an ecosystem account is compiled (SEEA Ecosystem Accounting, paragraph 2.12).
Ecosystem asset	A contiguous space covered by a specific ecosystem type characterised by a distinct set of biotic and abiotic components and their interactions (SEEA Ecosystem Accounting, paragraph 2.11). Also see *Ecosystem occurrence*.
Ecosystem condition	The quality of an ecosystem measured in terms of its abiotic and biotic characteristics. Condition is assessed with respect to an ecosystem's composition, structure and function which, in turn, underpin the ecosystem integrity of the ecosystem (SEEA Ecosystem Accounting, paragraph 2.13). Sometimes referred to as ecological condition. Broadly equivalent meaning to ecosystem integrity.

Ecosystem conversions	Situations in which, for a given location, there is a change in ecosystem type involving a distinct and persistent change in the ecological structure, composition and function which, in turn, is reflected in the supply of a different set of ecosystem services (SEEA Ecosystem Accounting, paragraph 4.23).
Ecosystem extent	The size of an ecosystem asset (SEEA Ecosystem Accounting, paragraph 2.13). The extent of an ecosystem type is the combined extent of all ecosystem assets (or occurrences) of that type, derived from a spatial dataset of the distribution of ecosystem types.
Ecosystem extent account	Records the extent and changes in extent for all ecosystem types in an Ecosystem Accounting Area (SEEA Ecosystem Accounting, Chapter 4).
Ecosystem functional group	A group of related ecosystem types within a biome that share common ecological drivers and ecosystem properties. Level 3 of the Global Ecosystem Typology. (Typology - Global Ecosystem Typology)
Ecosystem type	A type of ecosystem distinguished from other types by its characteristic functional, structural and compositional properties (IUCN, 2025). Identified and delineated as part of a hierarchical classification system, typically at a detailed level of the classification equivalent to level 5 or 6 of the Global Ecosystem Typology.
Ecosystem occurrence	An individual occurrence of an ecosystem type. Referred to as an *ecosystem asset* in SEEA Ecosystem Accounting.
GBF Indicator A.2	At the national level, the extent of natural ecosystems as a proportion of total area of the country at a particular point in time, expressed as a percentage (Metadata for Indicator A.2).
Global Ecosystem Typology	A hierarchical framework for identifying and classifying the Earth's ecosystem types across the terrestrial, subterranean, freshwater and marine realms and transitions between them (Keith et al., 2020; Keith et al., 2022).
Historical distribution (of ecosystem types)	The geographic distribution of ecosystem types prior to major human modification of the landscape or seascape. Often referenced to circa 1750, the start of industrial development, but not intended to represent a precise date. Sometimes referred to as "potential distribution". Contrast with *Contemporary distribution.*
Inland component of Indicator A.2	Covers the terrestrial and freshwater realms, and all transitional realms with a terrestrial or freshwater component.
Land cover	The observed physical and biological land cover of the Earth's surface, including natural vegetation and abiotic (non-living) surfaces (SEEA Central Framework, paragraph 5.257). Land cover classes are conceptually distinct from ecosystem types.

Land use	Reflects both the activities undertaken and the institutional arrangements put in place for a given area for the purposes of economic production or the maintenance and restoration of environmental functions (SEEA Central Framework, paragraph 5.246). Land use classes are conceptually distinct from ecosystem types.
Marine component of Indicator A.2	Covers the marine shelf and deep sea floors within the marine realm.
Mutually exclusive and collectively exhaustive	In the context of ecosystem classification and accounting, means that the classification covers all ecosystem types within the country, without any conceptual overlaps between ecosystem types, and the associated map represents these ecosystem types without any spatial gaps or overlaps.
Modified natural ecosystem	Ecosystems influenced or modified by human interventions, but with natural compositional, structural and functional characteristics of the natural ecosystem type still at least partially present and recognisable. Modified natural ecosystems are encompassed within *Natural ecosystem types*. Contrast with *Anthropogenic ecosystem types.*
National ecosystem classification	Distinguishes between different ecosystem types present in a country, preferably as part of a hierarchical classification system. Typically accompanied by spatial datasets or maps of the distribution of the ecosystem types, with classification and mapping often taking place iteratively.
National ecosystem map	Shorthand for a classification and map of the spatial distribution of ecosystem types in a country. The map shows the spatial distribution (geographic locations) of the ecosystem types that occur in the landscape or seascape, and the classification provides a hierarchy that differentiates ecosystems at different levels, with names and descriptions of distinct ecosystem types. (Global Ecosystems Atlas, 2026)
Natural ecosystem types	A broad category of ecosystem types, contrasted with anthropogenic ecosystem types. Includes: Ecosystems influenced or modified by human interventions, but with natural compositional, structural and functional characteristics still at least partially present and recognisable; and, instances or occurrences of natural ecosystem types that are in a range of condition states, from pristine ecosystems in excellent condition or with high integrity, through to those in poor condition or with low integrity. Also see *Anthropogenic ecosystem types*, *Modified natural ecosystems*.

Preliminary ecosystem extent account	An ecosystem extent account not yet formally approved and published by the national statistical office. May be compiled using a simplified form of the SEEA ecosystem extent account table (see Table 8. Basic ecosystem extent account table for one accounting period). At a minimum, it should be confirmed through an expert-based validation process involving relevant national experts and other relevant knowledge holders.
Realm	One of five major components of the biosphere that differ fundamentally in ecosystem organisation and function: terrestrial, freshwater, marine, subterranean, atmospheric, and combinations of these (transitional realms). Level 1 of the Global Ecosystem Typology. (Typology - Global Ecosystem Typology)
Semi-natural ecosystem	May be used to describe a condition state of a natural ecosystem in which composition and structure have been modified but the characteristic functional and structural properties of the natural ecosystem type are still recognisable and at least some of the key native biota are still present. In this sense, semi-natural ecosystems are equivalent to *modified natural ecosystems*. Also sometimes used (especially in Europe) to describe natural ecosystems that have been transformed through human management into pastures or meadows that retain local indigenous species but from which woody components have been largely removed, and that would revert to tree-dominated ecosystem types without ongoing human management. In this sense, semi-natural is a descriptor of certain *ecosystem types* rather than an ecosystem condition state.

2700

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