Defining natural and anthropogenic ecosystems in the context of GBF Indicator A.2 Extent of natural ecosystems, based on SEEA Ecosystem Accounting

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This paper draws directly on the Compilation Guidelines for GBF Headline Indicator A.2 Extent of Natural Ecosystems, currently in advanced draft form. The Compilation Guidelines have benefited from review by members of the Expert Group on SEEA-related GBF Indicators and members of the UNCEEA Technical Committee on SEEA Ecosystem Accounting.

ABSTRACT

In this paper, we present definitions of natural ecosystem types and anthropogenic ecosystem types, developed in the context of GBF Indicator A.2 Extent of natural ecosystems. The paper sets out the rationale for the definitions, introduces two criteria for identifying anthropogenic ecosystem types based on human activity and ecosystem origin, and discusses treatment of borderline cases. The definitions are linked directly to the IUCN Global Ecosystem Typology, as the reference classification for ecosystem types in SEEA and the recommended classification in the GBF monitoring framework for harmonising national ecosystem classifications in global reporting of ecosystem-related indicators. We invite discussion and feedback from the London Group on the robustness and global applicability of these proposed definitions and criteria.

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1 Introduction

The Kunming-Montreal Global Biodiversity Framework (GBF) (CBD/COP/DEC/15/4) of the Convention on Biological Diversity (CBD) sets out an ambitious vision for a world living in harmony with nature by 2050, supported by a monitoring framework (CBD/COP/DEC/15/5) to track progress in implementing the GBF in a transparent and results-oriented manner. All Parties to the CBD are obliged to report on the headline indicators as part of their National Reports, which are submitted few years.[1] Two of the 27 headline indicators of the GBF have SEEA Ecosystem Accounting as their methodological basis: Indicator A.2 Extent of natural ecosystems (underpinned by ecosystem extent accounts) and B.1 Services provided by ecosystems (underpinned by ecosystem services accounts in biophysical terms).

Indicator A.2 is defined in the indicator metadata sheet (available here) as *the extent of natural ecosystems as a proportion of total area of the country at a particular point in time, expressed as a percentage.* The concept of natural ecosystems is thus central to the meaning of Indicator A.2, and is contrasted in the metadata with anthropogenic ecosystems. However, the complexity in differentiating between these categories and distinguishing them from ecosystem condition states, particularly for modified and semi-natural ecosystems, can pose a challenge both at the national level and for comparison across countries. While the metadata provides broad definitions of natural and anthropogenic ecosystems, further guidance is required to operationalise these definitions. This is provided in Compilation Guidelines intended to support countries in compiling the indicator, developed as part of the project "SEEA-related Indicators for the Global Biodiversity Framework", funded by the European Union and implemented by the UN Statistics Division in collaboration with partners.

A draft of the Compilation Guidelines was discussed at an Expert Group Meeting convened in February 2026, where substantial progress was made in refining the definitions of natural and anthropogenic ecosystem types, including addressing borderline cases. An advanced draft of the Compilation Guidelines is now available for information (UNSD, 2026), and a second Expert Group Meeting is planned for November 2026 to resolve outstanding technical and methodological issues. The Compilation Guidelines will be finalised in early 2027.

A survey of Parties' Seventh National Reports submitted to the CBD in February 2026 showed that less than a third of submissions reported on Indicator A.2 (Buschke et al., 2026), pointing to a lack of readiness by many Parties to measure and report on the extent of natural ecosystems and confirming the need for additional guidance.

In this paper, we focus on the central conceptual question for Indicator A.2: how to conceptualise, define and differentiate between natural and anthropogenic ecosystems as two categories, in a way that can be applied consistently across countries and over time. We discuss the rationale for Indicator A.2, followed by the proposed approach to defining natural and anthropogenic ecosystem types, including criteria for identifying anthropogenic ecosystem types. The approach is based on a

[1] Parties submitted their Seventh National Reports in early 2026. Eighth National Reports are due in mid-2029. The length of the reporting cycle is typically four years but may vary.

nuanced view of the interactions between people and ecosystems, recognising that human influence has been widespread across ecosystems for millennia. This means the distinction between natural and anthropogenic ecosystem types must depend on their ecological characteristics, and the magnitude and type of human influence on those characteristics, rather than simply the presence of human activity. We discuss the role of the IUCN Global Ecosystem Typology in operationalising the definitions as well as borderline cases related to several factors.

The paper does not provide background on the GBF monitoring framework or focus on other aspects of the guidance provided to countries on developing Indicator A.2, which includes a stepwise process: Step 0. Preparation; Step 1. Operationalising the measurement scope of the indicator; Step 2. Collecting and organising key datasets; Step 3. Compiling the accounts; Step 4. Deriving the indicator; Step 5. Reporting on the indicator. The Compilation Guidelines also point to related resources that are available to support compilation of the indicator.

2 Rationale for GBF Indicator A.2

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 direct drivers of biodiversity loss and is reflected in the reduction of the area of natural ecosystems. Conversely, ecological restoration can result in increases in the area of natural ecosystems.

2.1 Intent of Indicator A.2

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, responding to the wording in GBF Goal A: “The integrity, connectivity and resilience of all ecosystems are maintained, enhanced, or restored, substantially increasing the area of natural ecosystems by 2050”. The indicator provides information about the extent of all natural ecosystems combined relative to all anthropogenic ecosystems, reflecting the net outcome of all declines and all increases in natural ecosystem extent. The scope of Indicator A.2 includes the terrestrial, freshwater and marine realms as well as the transitional realms between them.

While Indicator A.2 in its basic form reflects a binary distinction between natural and anthropogenic ecosystems, ecosystem-based disaggregation of the indicator can provide much richer information. At the global level, the indicator is intended to be disaggregated by realm, biome and ecosystem functional group (see Section 4), and further disaggregation by detailed ecosystem types or other relevant ecosystem-related classes at the national level is also encouraged. This means that in addition to reflecting aggregate declines or increases in the extent of natural ecosystems, the indicator can provide insights into the relative spatial coverage of different ecosystem groups or types, which ecosystem groups or types have experienced greater losses in area, and which have gained in area.

The indicator could also help in identifying main direct drivers of conversion from natural to anthropogenic ecosystems, such as agricultural, urban and industrial expansion. However, this is only possible if the anthropogenic portion of the basic indicator is disaggregated into different anthropogenic ecosystem groups or types.[2]

While Goal A of the GBF requires a substantial increase in the area of natural ecosystems by 2050, 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. Efforts to reverse loss of natural ecosystems through restoration can face several challenges, including substantial costs, the need for ongoing management, ecosystem-specific variations in implementation, and a considerable risk of failure. Gains in area of natural ecosystems are generally not as easily or quickly made as losses, and the outcomes of successful restoration may not be readily detectable based on changes in Indicator A.2, which reflects the overall net change in the area of natural ecosystems.

Indicator A.2 is one of five core ecosystem-related headline indicators of the GBF, each focusing on different aspects of the GBF Goals and Targets (Figure 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 conserve and restore ecosystems. The intention is that the ecosystem-related headline indicators complement each other and should be interpreted and evaluated together, alongside other relevant headline indicators, supplemented by additional indicators at the national level where appropriate.

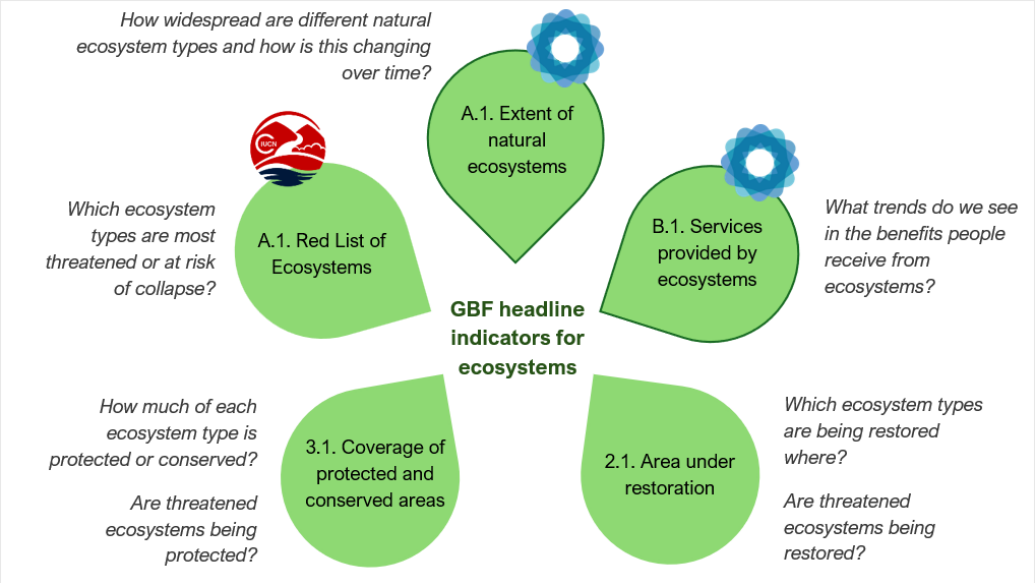

Figure 1. The five core ecosystem-related headline indicators of the GBF together provide insight into a set of inter-related questions about ecosystem types

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

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

2.2 Limitations of Indicator A.2

Indicator A.2 *does not aim to provide information on the integrity or condition of natural ecosystems*, which is reflected in Indicator A.1 Red List of Ecosystems. The IUCN Red List of Ecosystems (IUCN, 2024) uses a standard set of criteria and thresholds to assess the risk status of ecosystem types, including criteria addressing biotic and abiotic disruptions that compromise ecosystem integrity or condition. This includes direct impacts of human activity on ecosystems (such as harvesting of species, pollution, abstraction of water, human-induced fires) as well as indirect impacts (such as spread of invasive species or impacts of human-induced climate change).

Indicator A.2 *will not reflect restoration of natural ecosystems in poor condition to better ecological condition*. 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.

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 (see Section 5.2), 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, which would be captured as an increase in natural ecosystem extent in Indicator A.2.

Figure 2. 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. Changes in the extent of different natural and anthropogenic ecosystem types will be reflected in ecosystem-based disaggregations of the basic indicator.

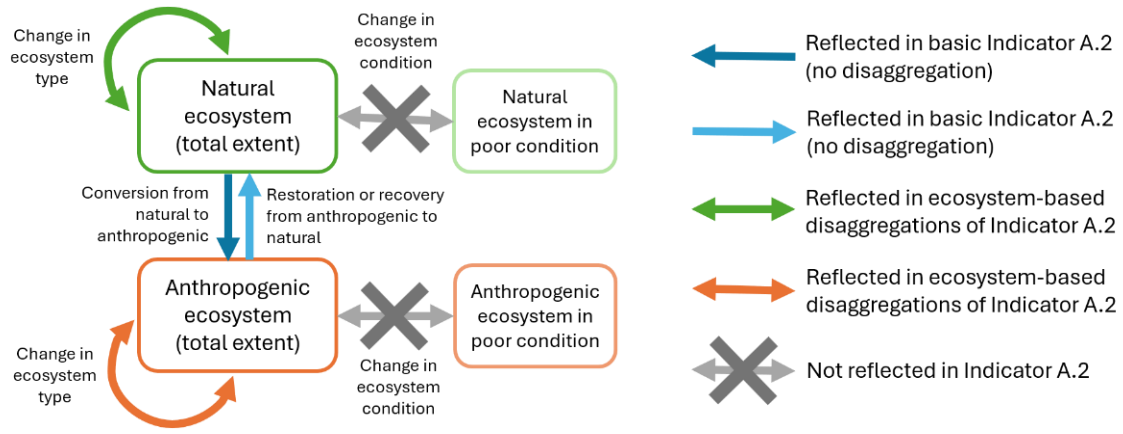

Figure 2. Indicator A.2 reflects conversion of natural to anthropogenic ecosystems and restoration of anthropogenic to natural ecosystems (shown with dark and light blue arrows), but not changes in ecosystem condition (shown with grey arrows). Disaggregation of the indicator is important for giving insight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

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

2.3 Examples of Indicator A.2

Figure 3 shows a hypothetical example of what the basic Indicator A.2 might look like compared across several countries for a particular year. A global value can be calculated as an area-weighted average across countries. 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 more detail on the graph, with each bar disaggregated into its constituent biomes or ecosystem functional groups.

Figure 4 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 in this example. 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. Disaggregation into more detailed national ecosystem types or other nationally relevant ecosystem classes would also be possible.

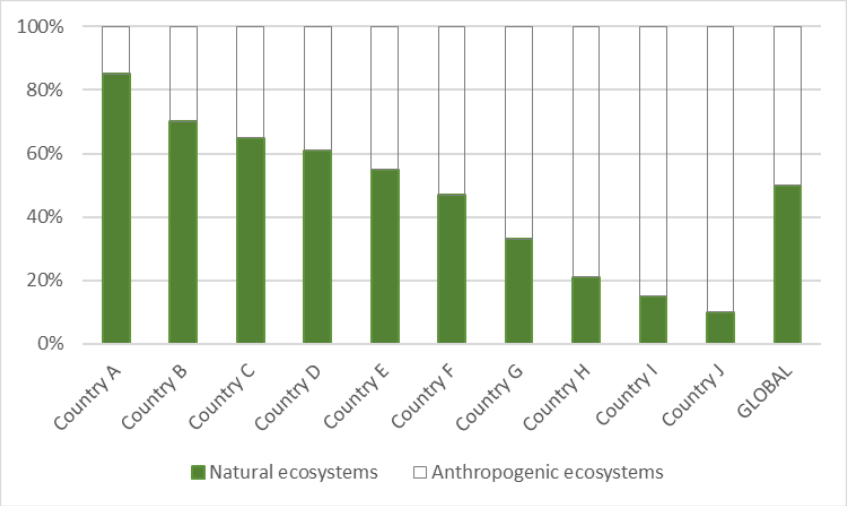

Figure 3. Mock-up of Indicator A.2 Proportion of natural ecosystems for several countries and globally, in year X

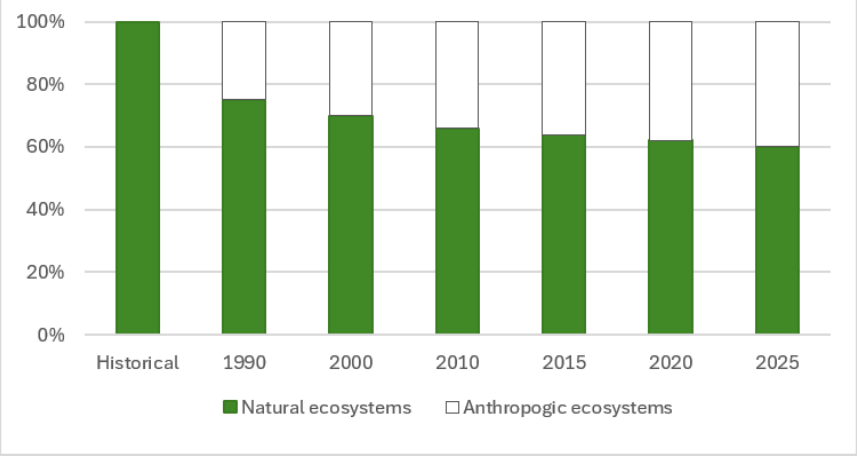

Figure 4. Mock-up of Indicator A.2 for one country, showing several years

3 Defining natural and anthropogenic ecosystem types

To compile Indicator A.2, all ecosystems must be assigned to one of two mutually exclusive categories: natural and anthropogenic. However, in practice a continuum of human influence and impact on ecosystems exists, and arguably all ecosystems on Earth have been influenced by humans in some way, over many millennia. This generates challenges for making a binary distinction between natural ecosystems and anthropogenic ecosystems.

In this section, we begin by outlining the concept of an ecosystem type as a starting point for distinguishing between natural and anthropogenic ecosystems. In the process of developing the Compilation Guidelines for Indicator A.2, an important realisation was that a focus on *ecosystem types* as distinct units in an ecosystem classification system, rather than on the more general concept of *ecosystems*,[3] would enable a systematic and meaningful distinction between natural and anthropogenic ecosystems based on their ecological characteristics.

3.1 Defining ecosystem types

Ecosystem types are foundational for ecosystem accounting, with all ecosystem assets assigned to ecosystem types and all ecosystem accounts organised by ecosystem type. For example, an ecosystem extent account records the extent (size) and change in extent of each ecosystem type in an ecosystem accounting area, for successive accounting periods.

The concept of ecosystem types is also used in other contexts, including in the Red List of Ecosystems. Indeed, 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, 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 compositional, structural and functional properties (IUCN, 2025), and reflects a distinct set of abiotic and biotic components and their interactions (SEEA EA, paragraph 2.11). Ecosystems of the same type are thus expected to share broadly similar ecological characteristics. Compositional characteristics relate to the suite of species that occur in the ecosystem type, structure to its physical structure and patterns, and function to ecological processes. 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).

Ecosystem types are typically identified and delineated as part of a *hierarchical classification system*, based on biotic and abiotic factors, with ecosystem types typically positioned at a detailed level of the hierarchy, nested within broader groups or classes. In identifying and distinguishing between ecosystem types, it is important that compositional, structural and functional characteristics are all considered together, if the ecosystem types are to provide a sound ecological basis for biodiversity conservation, ecosystem management, assessment, accounting and monitoring.

[3] Following the CBD's definition of an ecosystem as a complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (UN, 1992).

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 ecosystem accounting, these occurrences are referred to as ecosystem assets.

Some ecosystem types are characterised by *substantial temporal variability*, whether seasonal, interannual, multi-year or even decadal or more. It is essential to understand the expected range of natural variation in these dynamic ecosystem types to avoid misinterpreting natural cyclical changes as changes in ecosystem type.

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 different parts of its distribution and through time. Changes in ecosystem condition do not imply conversion to a different ecosystem type and should be clearly distinguished.

3.2 Defining natural ecosystem types

The premise for Indicator A.2 is that natural ecosystems house most of the world's biodiversity, making the extent of natural ecosystems a useful high-level indicator of the state of biodiversity and of progress towards the GBF mission of halting and reversing biodiversity loss. For the purposes of Indicator A.2, the primary need is thus to distinguish between ecosystems that support appreciable biodiversity, reflected in their composition, structure and function, and those with minimal biodiversity. Natural ecosystems that have been modified by people often retain substantial biodiversity, so for Indicator A.2 to be meaningful there is no inherent requirement that natural ecosystems must be defined as pristine, wild or devoid of human influence. On the other hand, ecosystems in which there has been major, persistent biodiversity loss, which often results from human intervention, should be excluded from the category natural ecosystems if the indicator is to be meaningful from a biodiversity perspective.

A nuanced view of human influence in the landscape and seascape is therefore required for Indicator A.2. Human activities can take a range of forms, which may be negative, neutral or beneficial from a biodiversity perspective. While human activities frequently drive biodiversity loss, either directly or indirectly, they can also be consistent with maintaining and managing biodiversity and may include conservation and restoration actions. In some cases, human intervention may mimic ecological processes that would have taken place as part of the natural functioning of the ecosystem prior to human influence (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. Notably, the GBF vision of people living in harmony with nature does not imply removing human influence from ecosystems.

Establishing a boundary between ecosystems that can be considered natural in a broad sense and those that are anthropogenic is greatly facilitated by the concept of an ecosystem type, with its focus on the compositional, structural and functional attributes that characterise different ecosystem types. Taking this approach, 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 somewhat negative from a biodiversity perspective, as discussed above; there is no implication that human intervention is always negative. In some contexts, these modified natural ecosystems are termed semi-natural (see Box 1).

(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.

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, the term "modified natural ecosystems" rather than "semi-natural ecosystems" is used when referring to these broadly natural ecosystems.

The term "semi-natural" is also sometimes used (especially in Europe) to describe ecosystems that have been transformed through human management from naturally forested or wooded states 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 considers these derived semi-natural ecosystem types anthropogenic. Implications for Indicator A.2 are discussed in Section 4.

3.3 Defining anthropogenic ecosystem types

The term "anthropogenic" is generally understood to mean originating from or caused by human activity. In line with this commonly used definition, anthropogenic ecosystem types are defined 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. Anthropogenic ecosystem types typically *replace* one or more pre-existing or antecedent natural ecosystem types, which are no longer recognisably present (although small patches/fragments and some native species may persist).

In anthropogenic ecosystem types, 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. Although these ecosystem types generally support far less biodiversity than natural ecosystem types, they are not necessarily devoid of biodiversity and may still support some 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:[4]

- 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 and seascape 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 traditional and/or Indigenous settlement and management of natural ecosystems spans thousands of years in many parts of the world. Some countries have spatial datasets on the historical distribution of ecosystem types, representing this pre-industrial period.

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 typically 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. Natural ecosystems can be substantially modified without being converted to an anthropogenic ecosystem type. Navigating these distinctions is discussed further in Section 5.

An important feature of this approach is that the definition of natural ecosystem types is broad while anthropogenic ecosystem types are more narrowly or tightly defined. Ecosystems that do not meet

[4] These examples are based on descriptions of the anthropogenic biomes in the Global Ecosystem Typology (see Section 4).

the quite stringent criteria for identifying anthropogenic ecosystem types should be seen as belonging to a natural ecosystem type, albeit in some cases a modified form of that ecosystem type. This narrow definition of anthropogenic ecosystem types helps to ensure that modified natural ecosystems, which often support appreciable biodiversity, are included in the measurement of the extent of natural ecosystems for Indicator A.2, consistent with the GBF vision of people living in harmony with nature.

4 The role of the IUCN Global Ecosystem Typology

The IUCN Global Ecosystem Typology (Keith et al., 2020; Keith et al., 2022) 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 5.

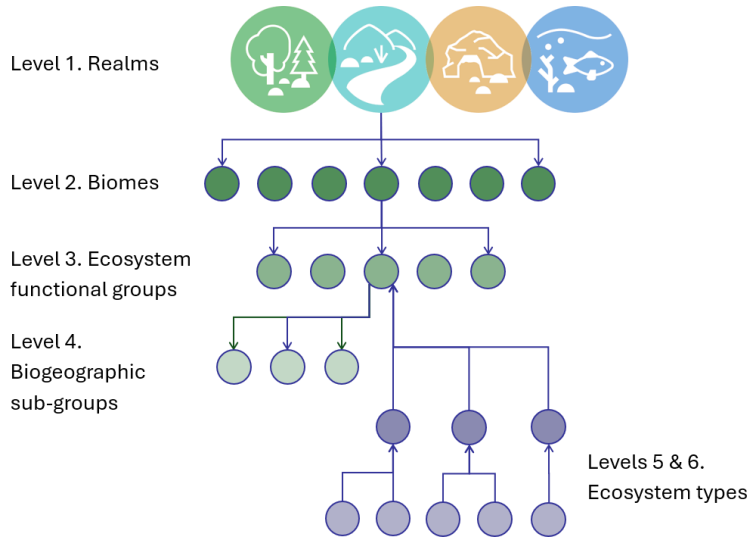

Figure 5. The Global Ecosystem Typology enables global consistency at the upper levels of the hierarchy (shown in realm icons and green circles) while encouraging detailed national ecosystem classifications at the lower levels (shown in purple).

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

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 Global Ecosystem Typology website provides more detail, including descriptions of all biomes and ecosystem functional groups.

CBD Decision 16/31 on the monitoring framework encourages countries to use national ecosystem classifications for monitoring and reporting on ecosystems at the national level, and to cross-reference their national ecosystem classifications to the Global Ecosystem Typology for global reporting purposes. A CBD information document (Revised guidance on using the indicators of the

monitoring framework of the Kunming-Montreal Global Biodiversity Framework, CBD/COP/16/INF/3/Rev.1) provides further guidance use of the Global Ecosystem Typology for global reporting of all the ecosystem-related headline indicators. The IUCN's *Standards, methods and guidelines for cross-referencing ecosystem classifications and maps to the IUCN Global Ecosystem Typology* provides guidance on cross-referencing national ecosystem classifications to ecosystem functional groups (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.

For the purposes of Indicator A.2, the Global Ecosystem Typology provides the basis for categorising ecosystem types as either natural or anthropogenic, based on their ecological characteristics. 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, shown in Table 1. Each ecosystem functional group typically consists of many ecosystem types that share functional characteristics but differ with respect to, for example, species composition.

Table 1. 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 Box 1 and the discussion below). The assessment of whether an ecosystem type meets these criteria should be made at the national level.

Figure 6 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.

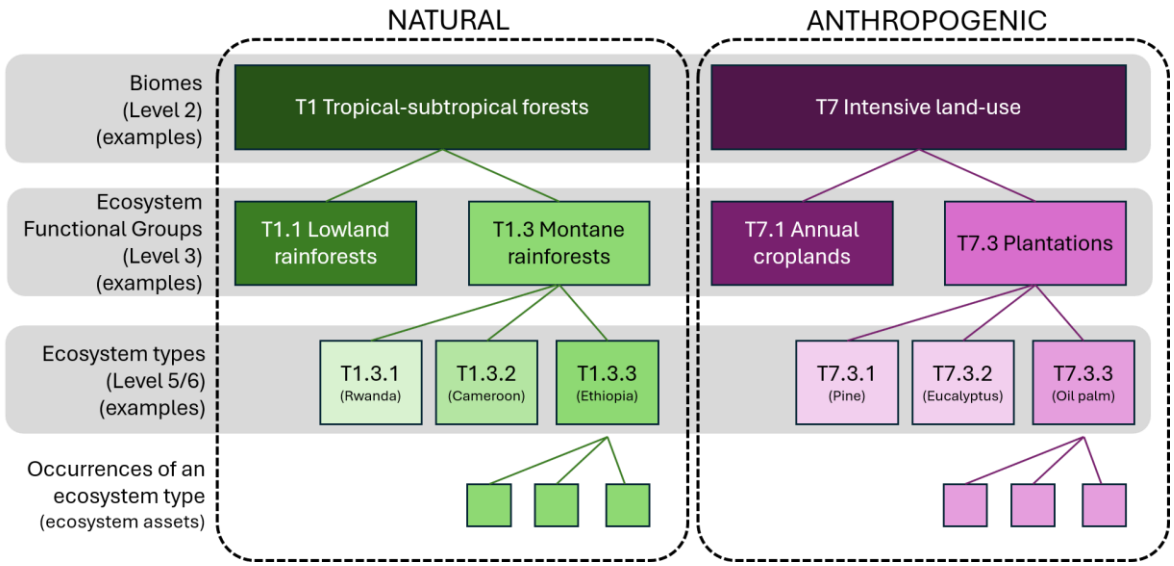

Figure 6. Examples of a natural and anthropogenic biome in the Global Ecosystem Typology, with nested ecosystem functional groups, ecosystem types, and ecosystem assets (occurrences of an ecosystem type)

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.

The derived semi-natural ecosystems within EFG T7.5 share some functional characteristics with natural ecosystems, as noted in Box 1, 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. In many cases, 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 including plants and invertebrates.

For Indicator A.2, *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". The assessment of whether an ecosystem type meets these criteria should be made at the national level, based on national data and/or classifications, with input from relevant experts and knowledge holders.

The old fields within EFG 7.5 are typically previously 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 and are thus considered anthropogenic. In general, they are poor in biodiversity relative to the ecosystem type they replaced and should be grouped with the category "anthropogenic" for Indicator A.2. In specific cases, where they are considered to have retained or regained sufficient characteristics of a natural ecosystem type (either through active restoration or passive recovery) and to support appreciable native biodiversity, 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, relevant for old fields, are discussed in Section 5.3.

5 Distinguishing natural from anthropogenic ecosystem types in practice

As noted in the discussion on natural ecosystem types, there are many instances in which human interventions influence or modify natural ecosystems without converting them to an anthropogenic 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 to an anthropogenic ecosystem type. The two criteria for identifying anthropogenic ecosystem types should be utilised in making such judgements.

Table 2 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. In many instances the distinctions illustrated in Table 2 will be quite straightforward to make.

More detailed discussion follows on cases where distinguishing between natural and anthropogenic ecosystem may be complex:

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

Table 2. 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 livestock pastures (T7.2) ○ Native woody plants, grasses and herbivores have been largely or entirely removed and replaced by introduced species
Tropical lowland rainforest 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) ○ Native vegetation has been replaced by stands of planted teak trees, which may be native or introduced depending on the region
Managed boreal pine forests (e.g. in Finland) (T2.1) ○ Includes instances where the condition of the ecosystem has been substantially impacted by forestry activities (e.g. selective harvesting, thinning, management to promote timber production)	Pine plantation (T7.3) ○ Native vegetation has been replaced by stands of pine trees, which may be native or introduced depending on the region
Shaded cocoa (natural forest interspersed with cocoa trees) (e.g. in Ghana) (T1 biome) ○ Includes instances where the condition of the ecosystem has been substantially impacted by cocoa cultivation and related management activities (e.g. understorey clearance, enrichment planting and selective removal of native trees)	Mono-cropped cocoa plantation (T7.3) ○ Native vegetation has been replaced by cultivated cocoa trees, which may be native or introduced depending on the region
Grassland with invasive trees (e.g. in South Africa) (T4.5) ○ The ecosystem has been modified by the establishment and spread of invasive trees, impacting negatively its condition	Eucalypt plantation (T7.3) ○ Native vegetation has been replaced by stands of eucalyptus trees, which may be native or non-native depending on the region
Grassy woodland with invasive grasses (e.g. in Australia) (T4.4) ○ The ecosystem has been modified by the establishment and spread of invasive grasses, impacting negatively its condition	Sown livestock pasture (T7.2) ○ Native woody plants, grasses and herbivores have been largely or entirely removed and replaced by introduced species

Natural ecosystem type	Anthropogenic ecosystem type
River modified for flood control or irrigation in an agricultural area (e.g. in Egypt) (F1.2) ○ Includes instances where the condition of the ecosystem has been substantially impacted by river engineering and water management activities (e.g. channel modification, flow regulation and water abstraction)	Canals, constructed irrigation channels (F3.5) ○ Native ecosystems (typically freshwater or terrestrial-freshwater transitional ecosystems) have been replaced by a constructed irrigation channel that is maintained through human intervention
Savanna with managed fire regimes (e.g. in Brazil) (T4.2) ○ Includes instances where the condition of the ecosystem has been negatively impacted by managed fires, which may differ from the natural fire regime in frequency, seasonality or intensity	Slash-and-burn forest destruction for largescale livestock farming (T7.2) or crop production (T7.1) ○ Native forest ecosystems have been cleared through burning and replaced by agricultural ecosystems used for livestock or crop production.
Mixed mangrove-aquaculture systems (e.g. in Viet Nam) (MFT 1.2) ○ Includes instances where the condition of the mangrove ecosystem has been substantially impacted by aquaculture and related activities (e.g. construction of ponds and modification of water flows)	Freshwater aquafarms (F3.4) ○ Native ecosystems (typically freshwater or terrestrial-freshwater transitional ecosystems) have been replaced by managed aquaculture systems used to cultivate native or introduced aquatic organisms.
Large permanent natural lake with fishing (e.g. in Malawi) (F2.1) ○ Includes instances where the condition of the ecosystem has been substantially impacted by fishing and related human activities	Artificial (man-made) lake (F3.1) ○ Native ecosystems (often including terrestrial and freshwater ecosystems) have been replaced by an artificial lake created through impoundment of water.
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) ○ Native ecosystems (typically freshwater or terrestrial-freshwater transitional ecosystems) have been replaced by managed aquaculture systems used to cultivate native or introduced aquatic organisms.
Natural shellfish beds and reefs with low-intensity shellfish culture (e.g. in Canada) (M1.4) ○ Includes instances where the condition of the ecosystem has been substantially impacted by harvesting and culture activities (e.g. placement of culture structures or stock enhancement) while retaining recognisable shellfish bed or reef structure and ecological functions	Marine aquafarms (e.g. intensive finfish cage systems or purpose-built aquaculture facilities) (M4.2) ○ Native marine or marine-transitional ecosystems have been replaced by managed mariculture systems used to cultivate native or introduced aquatic organisms
Coastal dunes stabilised with grasses (e.g. in the Netherlands) (MT 2.1) ○ Includes instances where the condition of the ecosystem has been substantially impacted by dune stabilisation activities, altering natural patterns of sand movement and vegetation dynamics	Constructed seawall (MT 3.1) ○ Native coastal ecosystems have been replaced by the construction and maintenance of a seawall, for example for coastal protection. The replacement may involve only a portion of the ecosystem, with adjacent natural areas being heavily modified.
Permanent marshes (e.g. in China) (TF 1.3) ○ Includes instances where the condition of the ecosystem has been substantially impacted by water management and resource-use activities (e.g. water abstraction, reed harvesting, grazing or fishing)	Irrigated rice paddies (F3.3) ○ Native ecosystems (typically terrestrial or terrestrial-freshwater transitional ecosystems) have been replaced by managed rice paddies that are periodically flooded for crop production.

Natural ecosystem type	Anthropogenic ecosystem type
Lowland calcareous grasslands (e.g. in the United Kingdom) (T7.5) from which broad-leaved deciduous trees have been removed ○ May include managed domestic livestock	Sown livestock pastures (T7.2) ○ The native woody plants, grasses and herbivores have been largely or entirely removed and replaced by introduced species

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

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 United Kingdom. Many are secondary growth forests rather than primary old-growth forests. 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.

5.2 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 ecosystem types) 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 ecosystem types) and in natural ecosystem types in which agricultural outputs are harvested or produced.

Urban, industrial and other built-up areas are typically clearly linked to anthropogenic ecosystem types, with fewer borderline cases, although low density or semi-dense rural settlements and natural areas in urban settings can present borderline cases. In borderline cases, judgements 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 pioneer native tree species, canopy structure, and faunal communities undergoing some re-establishment. Ecological processes such as seed dispersal and successional dynamics remain recognisable, despite significant alteration to nutrient cycling. 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.[5] In river systems such as the Nile, 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,*[6] 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,

[5] EFG F3.3 is currently called "Rice paddies" on the Global Ecosystem Typology website, but a change in name to "Aquatic and semi-aquatic croplands" has been proposed to reflect that various crops may be grown in ecosystems with these functional characteristics.

[6] 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.

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 can include native species such as 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 with uniform stand ages, 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, understorey, 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, South American grasslands and North American prairies, 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.

- *Mixed-use and mosaic ecosystems* that have both natural and anthropogenic patches or elements that function collectively as an ecosystem.[7] 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. 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 mosaic anthropogenic ecosystem type may include patches of natural habitat for native species, including threatened or endemic species, which can sometimes persist even in small fragments, so the presence of some native species is not on its own a deciding factor. To ensure consistent

[7] These are sometimes referred to as heterogenous ecosystem types, characterised by an intrinsic mix of features. 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. Eurostat's *Ecosystem Accounts Handbook* (2026) includes a short discussion on dealing with heterogenous areas in Section 2.5.

interpretation, 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).

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

The distinction between anthropogenic and natural ecosystems can also be challenging to identify 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, performing their ecosystem functions 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 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).

6 Conclusion

In this paper we have presented an approach to differentiating between natural and anthropogenic ecosystems as distinct categories, notwithstanding the complexity of widespread human influences on ecosystems. Natural ecosystem types are conceptualised as a broad category, including modified natural ecosystems and ecosystems in a range of condition states, provided that compositional, structural and functional characteristics of the natural ecosystem type are still at least partially present and recognisable. Anthropogenic ecosystem types are defined narrowly as those created and maintained through human interventions, with human interventions being the primary determinant of their ecological characteristics. Anthropogenic ecosystem types have typically replaced a pre-existing or antecedent natural ecosystem type that is no longer recognisably present.

Central to this approach is a focus on ecosystem types, rather than ecosystems in a general sense. This enables the use of ecologically meaningful units identified and classified based on their compositional, structural and functional characteristics as the basis for distinguishing between

natural and anthropogenic ecosystems. The biomes and ecosystem functional groups of the Global Ecosystem Typology provide a practical basis for operationalising the assignment of ecosystem types either to the broad category of natural ecosystems or to the more narrowly defined category of anthropogenic ecosystems.

This approach is useful from both a statistical and biodiversity perspective. It is consistent with the logic and requirements of SEEA Ecosystem Accounting, and with the rationale for GBF Indicator A.2. It also has value in a range of other contexts, including the Red List of Ecosystems (where the focus is on natural ecosystem types) and other applications where an inclusive view of natural ecosystems that encompasses human-nature interactions is useful.

More broadly, the approach recognises that human influence is widespread across ecosystems, while maintaining a practical and ecologically meaningful distinction between ecosystems that remain recognisably natural and those whose composition, structure and function are primarily determined by human activity. This supports more consistent accounting, monitoring and reporting across countries while accommodating diverse ecological and socio-cultural contexts and long-standing human-nature interactions.

Questions for the London Group

In presenting this paper to the London Group, we look forward to discussion around the following questions:

1. Are the proposed definitions of natural and anthropogenic ecosystem types clear and coherent? Are they applicable in a range of ecological contexts around the world?
2. Are the two criteria for identifying anthropogenic ecosystem types (i.e., (i) human activities *create* and *maintain* the ecosystem type, (ii) *replacing* an antecedent natural ecosystem type) clear and sufficient?
3. For Indicator A.2, is the approach to dealing with semi-natural ecosystem types that fall within EFG T7.5 of the Global Ecosystem Typology suitable?
4. Are the definitions and criteria well aligned with nature restoration projects, especially from the perspective of GBF Goal A which includes substantially increasing the area of natural ecosystems by 2050?
5. Could these definitions be relevant and useful more widely than for Indicator A.2? For example, for other indicators and for policy, planning and monitoring more broadly?

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