PLOS SUSTAINABILITY AND TRANSFORMATION

OPINION

# Setting ambitious international restoration objectives for terrestrial ecosystems for 2030 and beyond

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## Introduction

The post-2020 global biodiversity framework (GBF) is the new framework under the Convention on Biological Diversity (CBD) that will guide interventions to conserve biodiversity and ecosystem services for the next 3 decades. In this article, we discuss the science behind the GBF related to terrestrial ecosystem restoration and conclude by commenting on the state of play of negotiations and what might be expected at the upcoming CBD COP-15 in December 2022.

The CBD's Strategic Plan for Biodiversity 2011 to 2020 set ambitious objectives for ecosystem restoration—specifically Aichi Biodiversity Target 14, which aimed to restore ecosystems that provide essential services, and Target 15 that called for restoring at least 15% of degraded ecosystems by 2020. These objectives were only partially met by 2020 [1]. The GBF provides an opportunity for governments to renew calls for ambitious restoration objectives and ensure that mechanisms are in place for successful implementation. This will be essential for meeting the Sustainable Development Goals for nature and people [2,3].

Ecosystem restoration actions and objectives for 2030 appear explicitly in Target 2 of the GBF, but also permeate the entire framework. The first draft of Target 2 of the GBF [4] is worded "Ensure that at least 20 percent of degraded freshwater, marine, and terrestrial

ecosystems are under restoration, ensuring connectivity among them and focusing on priority ecosystems." These restoration actions are intended to enable the achievement of Goal A of the GBF that focuses on positive outcomes for biodiversity and Goal B that focuses on nature's contributions to people (NCP).

Target 2 was most recently discussed by governments in Geneva (March 2022) and Nairobi (June 2022), but no agreement on wording or quantitative objectives has emerged [5]. During GBF negotiations, there has been considerable disagreement and confusion about terminology, how different types of restoration actions contribute to GBF objectives, and what baselines and reference states should be used for restoration. Debate has also included levels of quantitative ambition and how to express them.

This article is based on analyses prepared in support of negotiations of the GBF and provided to governments and stakeholders by the CBD [6,7], as well as follow-up work. It is a companion to several articles addressing other objectives of the GBF. Freshwater and marine ecosystems are not treated in this article due to the different conceptual bases and indicators for these systems compared to land.

## Rehabilitation and ecological restoration contribute in different ways to the goals of the GBF

Ecosystem restoration halts and reverses degradation, resulting in improved ecosystem function, nature's contributions to people, and biodiversity [3,8,9]. Ecosystem restoration covers a broad continuum of actions including reduction of pressures such as overexploitation, remediation to remove sources of degradation, rehabilitation, and ecological restoration. All of these actions contribute to the objectives of the GBF, but restoration should not be used to justify destroying or degrading existing natural ecosystems [3,8]. This paper focuses on 2 types of ecosystem restoration that are particularly important for the goals of the GBF (Fig 1) [2,3,7–9]:

i. **Rehabilitation**—The primary objective is to improve ecosystem functions and NCP in transformed ecosystems, such as agricultural or managed forest ecosystems (orange arrow, Fig 1). It contributes to NCP objectives in Goal B, ecosystem function in the managed ecosystems objectives of Goal A, and may or may not contribute to genetic and species diversity objectives of Goal A. Rehabilitation is often referred to as "regeneration" in the agricultural community [10].

ii. **Ecological restoration**—The objective is to put ecosystems on a path towards a state of high integrity using a natural state as a reference, taking into account climate change and natural ecological dynamics when setting objectives. It contributes to NCP objectives in Goal B and the natural ecosystem integrity objective of Goal A. It also contributes to the natural ecosystem area objective of Goal A if it involves restoration of a transformed ecosystem towards a natural state (dark green arrows, Fig 1).

Note that "ecological restoration" is a subset of "ecosystem restoration" and the 2 terms should not be used interchangeably.

Considerable confusion has arisen in negotiations due to lack of agreement on the meanings of the terms "ecosystem restoration," "rehabilitation," "regeneration," and "ecological restoration." The descriptions above are consistent with those used for the UN Decade on Ecosystem Restoration [9] and are well adapted to the needs of the GBF. Clarity on the different pathways for restoration and their contributions to the goals of the GBF as shown in Fig 1 is essential for informed debate on the wording of targets and quantitative objectives.

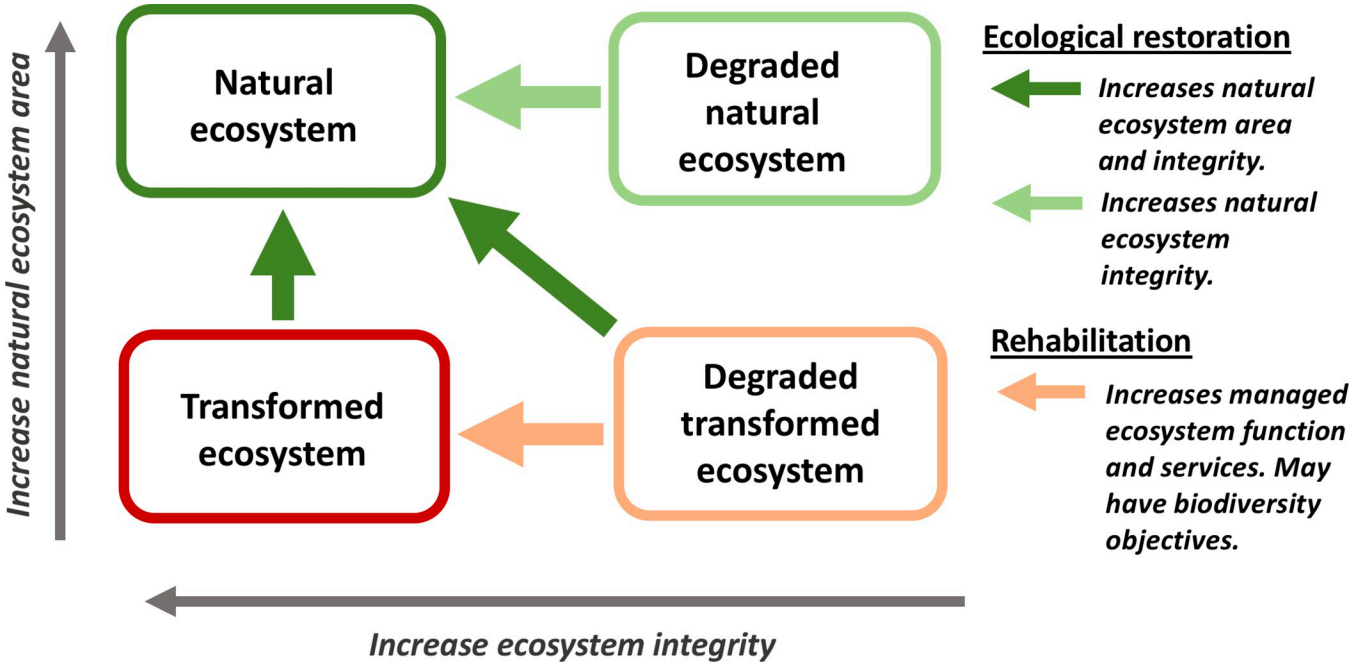


**Fig 1. Contributions of ecological restoration and rehabilitation to the goals of the post-2020 GBF.** Ecological restoration contributes to Goal A of the GBF by increasing natural ecosystem integrity (light and dark green arrows) and to area if it involves restoration of transformed ecosystems towards a natural state (dark green arrows). Ecological restoration also contributes to Goal B by improving NCP in natural ecosystems. Rehabilitation (light orange arrow) contributes to Goal B of the GBF by improving NCP in managed ecosystems and may contribute to enhancing biodiversity, but the degree and type of contributions depend on types and objectives of the rehabilitation action. Most transformed terrestrial ecosystems are managed for agriculture or forestry, and the term "regeneration" is often used in those sectors as an equivalent for rehabilitation. High ecosystem integrity for natural ecosystems is typically defined as having composition, structure, function, and ecological processes close to that of a natural reference ecosystem [11]. This figure is modified from the IPBES Land Degradation and Restoration Assessment [2] to focus on rehabilitation and ecological restoration. This simplified view of restoration does not include many of the important subtleties of the continuum of potential actions [8] nor take into account that some ecosystems are not easily classified as natural versus transformed.

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## Formulation and quantitative objectives for terrestrial restoration in Target 2 of the GBF

The wording and quantitative objectives for Target 2 will depend on (i) which types of ecosystem restoration it includes; (ii) whether or not it distinguishes different types of restoration; and (iii) whether it is expressed on a land area basis or as percent restoration of degraded land. Existing international agreements provide insight into how restoration objectives have been expressed elsewhere (Table 1), but the objectives of the GBF are sufficiently different that these should only be used to provide context.

### (i) Should Target 2 include just ecological restoration or all types of terrestrial ecosystem restoration?

Target 2 could be formulated as an all-inclusive objective covering all restoration actions in terrestrial ecosystems in the GBF such as restoration of degraded lands in protected areas (Target 3), lands undergoing remediation by de-pollution (Target 7), rehabilitation of degraded agricultural lands and managed forests (Target 10), and ecological restoration of transformed to natural ecosystems (implied in Goal A). Some governments favor an all-inclusive restoration objective since it is considered easier to communicate. This is consistent with most international objectives that do not distinguish between different types of restoration [12]. Other governments favor a narrower focus on ecological restoration actions that increase the area and integrity of natural ecosystems (green arrows, Fig 1).

**Table 1. Examples of key global restoration objectives for 2030 relevant to the GBF.**

| Objective or commitment | Mha and equivalent in % global land area | Source of objective | Comment |
|---|---|---|---|
| 1,000 Mha total restoration | 1,000 Mha<br>7.5% | - Objective of UN Decade on Ecosystem Restoration for 2030.<br>- Approximate current total commitments to land restoration.<br>- One of the proposals for Target 2 in WG2020-4 outcomes [5]. | Puts emphasis on filling the large gap between commitments and implementation.<br>Includes all types of restoration. |
| 350 Mha forest restoration | 350 Mha<br>2.6% | - Bonn Challenge for 2030.<br>- Preceded by and contributes to 1,000 Mha objective above. | Focus is on forest restoration.<br>Includes all types of restoration. |
| Restore 20% of degraded land, assuming 40% degraded globally. | 1,100 Mha<br>8.2% | - Proposal for Target 2 for 2030 in the first draft of GBF.<br>- Note: ≈1,650 Mha for 30% proposal in WG2020-4 outcomes [5]. | Allocation to different types of restorative actions is not specified. |
| Restore 20% of degraded land, assuming 20% degraded globally. | 550 Mha<br>4.1% | - Proposal for Target 2 for 2030 in the first draft of GBF.<br>- Note: ≈775 Mha for 30% proposal in WG2020-4 outcomes [5]. | Allocation to different types of restoration actions is not specified. |
| Land degradation neutrality | Unspecified | - UNCCD goal for 2030 (also SDG Target 15.3). | Area under restoration should be at least equivalent to newly degraded area, based on no net loss principles. |

Examples are from existing international commitments or were proposed for Target 2 as outcomes following the Nairobi negotiations of the GBF in June 2022 [5]. See Sewell and colleagues [12] for a more exhaustive list of international restoration objectives. Note: 1,000 million hectares (Mha) = 1 billion hectares = 10 million $km^2$, which is roughly the area of Canada.

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## (ii) Should Target 2 explicitly address different types of ecosystem restoration, potentially with separate objectives for the 3 main pathways of restoration (i.e., 3 arrow colors in Fig 1)?

Target 2 could distinguish between rehabilitation and ecological restoration, and potentially between different types of ecological restoration (Fig 1). This would clarify links between Target 2, Goal A and Goal B of the GBF, and underline ambitions for ecological restoration.

About 400 Mha of ecological restoration of transformed ecosystems towards natural states (dark green arrows, Fig 1) is necessary to achieve a net increase in natural ecosystem area of 5% by 2030—as proposed in the first draft of the GBF [7]. A complementary objective of rehabilitation of 18% to 33% of agricultural lands (orange arrow, Fig 1) would support more productive and resilient agriculture, a wide range of NCPs, and connectivity for natural ecosystems [7,13].

Explicitly addressing different types of restoration would add complexity to Target 2, and many governments prefer simple target formulations. However, conflating types of restoration risks missing ambitious objectives for gains in natural ecosystem area and integrity, in part because current restoration commitments focus on rehabilitation of managed ecosystems and lack clear commitments to ecological restoration, especially of transformed ecosystems towards natural states [3,7,14]. If not incorporated in the wording of Target 2, this issue might be addressed elsewhere in the framework, such as in technical annexes: This approach has been discussed, but no mechanism proposed.

## (iii) Should quantitative objectives be expressed on a land area basis (e.g., millions of hectares) or as a percent restoration of degraded land?

Formulation as percent restoration of degraded land is consistent with the wording of Aichi Target 15, but means the quantitative objective has high uncertainty (Table 1) [7,12]. Land

degradation takes many forms, is measured in different ways, and has subjective baselines, so there is little consensus on the extent of land degradation, and, thus, the scope of restoration actions needed [2,3]. The fraction of global land area that is considered degraded ranges from less than 20% to more than 40% (Table 1, [3] see also [15]). Other international objectives are typically expressed as land area to be restored or as zero net degradation (Table 1).

## Conclusions

Irrespective of how ecosystem restoration objectives are formulated in Target 2 of the GBF, it is critical to distinguish different types of restoration in implementation, monitoring, and reporting. In the monitoring framework of the GBF, these distinctions will require the adoption and further development of indicators and monitoring programs to track implementation of different types of restoration and their outcomes in terms of natural ecosystem integrity and area. Doing so will be essential for effective ecological restoration because current commitments are insufficient to meet the objectives of the GBF to increase natural ecosystem area and integrity.

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