








BIODIVERSITY BUILDING BLOCKS FOR POLICY

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Effective biodiversity monitoring requires FAIR data and FAIR models for FAIR indicators

Findable,
Accessible,
Interoperable, and
Reusable!

Key messages



Headline indicators are a valuable starting point for **consistently monitoring the goals and targets** in the Kunming-Montreal Global Biodiversity Framework (GBF). However, Parties to the Convention on Biological Diversity (CBD) will need to couple these with additional indicators and would **benefit from shared data and methodologies**.



To foster collaboration and enhance our collective ability to monitor biodiversity, we argue that **all components required to calculate indicators** (data, workflows, and indicators) should be **FAIR** (Fig 1), and the methods used to derive these indicators should be **openly shared**.



Guidelines and **standardised metadata** are crucial to ensure the consistent use of indicators, as demonstrated by current headline indicators. Newly developed indicators should follow this example.



Open and FAIR biodiversity indicators will facilitate the sustainability and self-governance of indicators by Parties over time.



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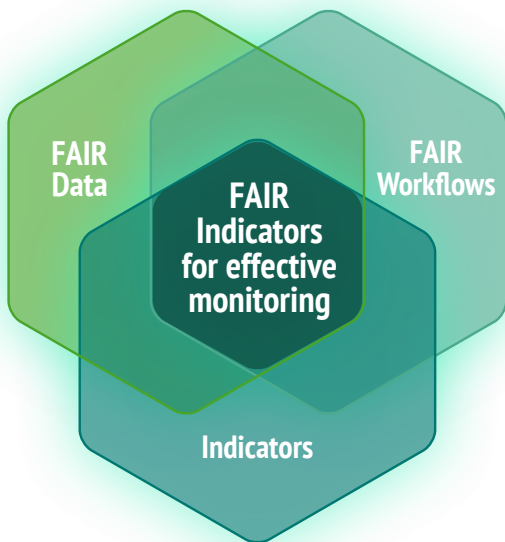


Figure 1: FAIR data-workflows-indicators approach supported by guidelines for reproducing each step and standardised metadata to facilitate interpretation of indicator results. Each component should be Findable, Accessible, Interoperable, Reusable, and Open. We refer to **Data** as the primary data (e.g., raw observations) required to calculate indicators. **Workflows** include all methods and models used to process the input data to derive indicators. **Indicators** are the metrics used to report biodiversity change for policy and management (e.g., indicators defined in the GBF and other agreements).

Context

The monitoring framework of the GBF goes a long way in facilitating the consistent tracking and reporting of progress towards the goals and targets. Parties have agreed on the headline indicators and the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) of the CBD formulated metadata and guidelines on how to calculate them. **Yet, a documented, FAIR and openly shared approach is still needed for a consistent uptake, use, and reuse of indicators to track common goals (Fig 1).**



By including **proper documentation** (e.g., standardised metadata and guidelines), the headline indicators demonstrate the value of using standards, shared methodologies, and data flows. Now, we need to take a step forward where the **full workflows to calculate indicators, including the input data, should be FAIR and shared in collaborative spaces** for all Parties to access new developments and insights, thereby reducing the time required to keep the indicators up to date.

However, having FAIR data and workflows may not be enough to alleviate the reporting burden for Parties. Continuous **support for the use of indicators** (i.e., capacity-building and technical and scientific cooperation) is required. This includes the development of more user-friendly interfaces to facilitate broader adoption across multiple countries and to ensure standards are applied consistently. In this sense, the Global Knowledge Support Service for Biodiversity, which will support national monitoring efforts, along with the CBD's list of regional and subregional Technical and Scientific Cooperation support centres, that will promote and facilitate cooperation among Parties and relevant organisations, could provide critical support for the successful implementation of GBF.



Policy Recommendations

When proposing new indicators to enhance the coverage of goals and targets in the GBF, we advocate for:

IMPLEMENTATION

-  **Data and workflows to follow Open and FAIR principles.**
-  **Development of standards for indicators metadata**, documenting data requirements, protocols, and result interpretation.

INFRASTRUCTURE

-  **Increased support for initiatives that can function as repositories for data, workflows, and indicators.** Each registered indicator should also provide a standard interpretation.
-  **Development of an interconnected data and informatics infrastructure** that leverages national, regional, and international initiatives supporting data and workflows to calculate indicators at different scales.

Policy Implications

SBSTTA's guidelines on indicators¹ are a major turning point in how we monitor progress towards biodiversity goals. This effort should be followed in future indicator development, accompanied by **a comprehensive data and informatics infrastructure grounded in a policy of open collaboration**. Such infrastructure is needed to support the collection and harmonisation of biodiversity data and the sharing of workflows and models to calculate indicators at national and global levels^{2,3}. Several components already exist under the auspices of the Group on Earth Observations Biodiversity Observation Network (GEO BON; Fig 2) and the United Nations Environmental Programme (UNEP; Fig 2). We encourage their promotion, inter-relatedness, and sustainable long-term functioning, ensuring transparency and full accessibility for Parties and society.

We argue that for the monitoring framework of the GBF to be effective and successful among the Parties, the standardisation of metadata and the implementation of FAIR principles are needed:



Standardisation of metadata for data, workflows, and indicators would streamline data needs, avoid misleading interpretations, promote a proper classification of indicators based on what they are measuring, increase their re-usability and provide full credit to the authors.



FAIR and Open data, workflows, and indicators with clear guidelines for the entire process will enhance the discoverability of indicators, their applicability and validity, and the transparency of the workflows and the underlying data.

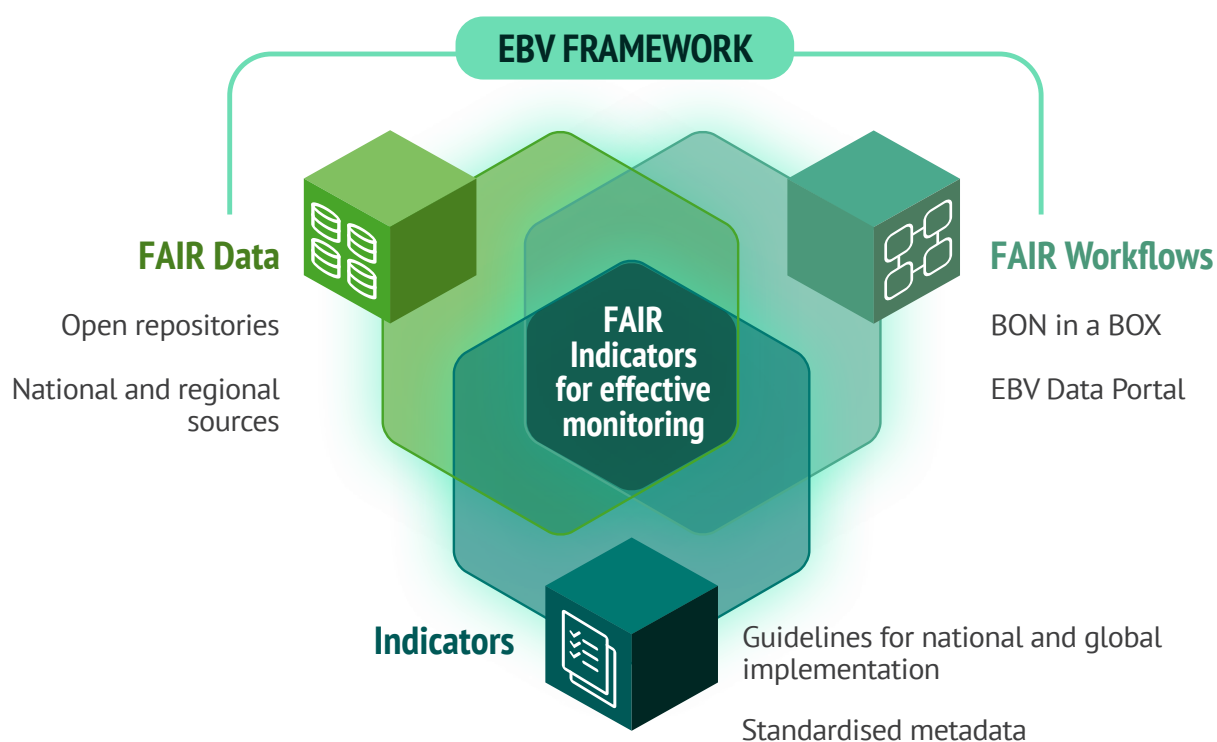


Figure 2: Potential implementation of the FAIR data-workflows-indicators approach taking advantage of current initiatives that already support the implementation of FAIR indicators but have yet to be widely adopted. Following the Essential Biodiversity Variables⁴ (EBV) framework and under the auspices of the Group on Earth Observations Biodiversity Observation Network (GEO BON), the [EBV Data Portal](#)⁵ could host formatted and harmonised datasets. [BON in a BOX](#)⁶ can centralise and store workflows that calculate indicators or any intermediary products, such as EBVs, from primary data. A global registry for indicators providing up-to-date guidelines on their usage and metadata is required. The Biodiversity Indicators Partnership (BIP) could act as such. The [Global Knowledge Support Service for Biodiversity](#)⁷ and the CBD's recent identification of [regional and subregional Technical and Scientific Cooperation support centres](#)⁸ can play a key role in interconnecting existing tools and networks for the successful implementation of this FAIR data-workflows-indicators approach.

Background

Tracking progress towards environmental goals requires robust metrics of nature that can take the form of indicators⁹. A major improvement towards achieving the GBF's goals and targets is the key role of the monitoring framework, which includes a set of indicators that Parties can use to monitor and report their progress. All headline indicators have available metadata and most have established calculation methods described in CBD documents² or scientific articles. **Yet, many Parties reported limited capacity and insufficient resources to produce them³. Open and FAIR indicators can help facilitate this process.**

To fully address all the goals and targets of the GBF, Parties will need to incorporate additional indicators¹⁰, including component and complementary indicators, binary, and national indicators. This may prompt scientists and Parties to develop new metrics and propose new indicators adding to the already overwhelming amount of metrics and indicators available in the literature¹¹. Unfortunately, it is not easy to identify and explore existing ones mainly because: i) they are not easily findable (there is no updated catalogue of developed metrics), ii) they may not be properly documented, lacking clarity regarding what is being measured and how it can be used to track policy goals, and iii) their calculation may be technically complex, with inadequate guidance on the required input data and methodology¹¹. **An updated and comprehensive registry of metrics and indicators** with clear documentation for tracking policy goals can alleviate the indicator selection process and facilitate the reuse of available indicators for other environmental agreements.

References

¹ CBD/SBSTTA/26/INF/14

² Kim et al., 2023 DOI:10.32942/X2130Z

³ Gonzalez et al., 2023 DOI:10.1038/s41559-023-02171-0

⁴ Pereira et al., 2013 DOI: 10.1126/science.1229931

⁵ <https://portal.geobon.org/home>

⁶ <https://boninabox.geobon.org/>

⁷ <https://gkssb.chm-cbd.net/>

⁸ <https://www.cbd.int/tsc/tscm>

⁹ Tittensor et al., 2014 DOI: 10.1126/science.1257484

¹⁰ CBD/SBSTTA/26/INF/19

¹¹ B-Cubed reports available at <https://www.b-cubed.eu/library>

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B-Cubed is an EU-funded project that aims to standardise access to biodiversity data, empowering policymakers to proactively address the impacts of biodiversity change.

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