

## **Integrating Heterogeneous Data for Soil Biodiversity Assessment: A Modular Framework**

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Soil biodiversity plays a fundamental role in ecosystem functioning and in supporting decision making across environmental and productive systems, where it is increasingly recognized as a critical component. However, its assessment remains fragmented, context-dependent, and difficult to standardize across sites and scales. Current approaches often rely on single indicators or non-harmonized methodologies, limiting comparability and constraining their use in structured monitoring frameworks, particularly in light of increasing demands for consistent biodiversity assessment within environmental monitoring and policy contexts. Biodiversity for Soil (B4Soil) is a methodological framework developed to address this gap by integrating multiple dimensions of soil health into a structured and reproducible assessment system. The framework is organized into four thematic areas, Fertility, Climate, Water, and Biodiversity, and combines laboratory analyses, satellite data, field sampling, and biological indicators (including QBS-ar) into a composite index (0–100). Rather than reducing ecological complexity, the approach aims to structure it, enabling the aggregation of heterogeneous data into a coherent, traceable, and comparable output. Within this architecture, the biodiversity component is designed to capture soil biological quality through biological metrics that are both scientifically grounded and applicable across different contexts. A key feature of the framework is its modular design, which allows the integration of new parameters and methodological updates over time, ensuring adaptability while maintaining consistency and comparability of results. This supports repeated measurements and facilitates alignment with emerging monitoring needs. By providing a structured approach to integrating diverse ecological data, B4Soil contributes to ongoing efforts toward more harmonized, scalable, and operational methods for soil biodiversity assessment.