

Core initiative on Biodiversity

One Planet Program on Sustainable Food Systems

Technical report on existing methodologies & tools for biodiversity metrics

Zurich, July 2018

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List of authors

Guillaume Neveux & Suzanne Rabaud (I Care & Consult), Anne Asselin (Sayari), Simon Attwood, Roseline Remans (Bioversity International), Gerard Bos & Jerome Duramy (IUCN), Kristina Bowers & Llorenç Mila i Canals (UN Environment), Gemma Cranston, Liam Walsh (CISL), Marion Hammerl & Stefan Hörmann (GNF & Lake Constance Foundation), Stefanie Hellweg (ETH Zurich), Urs Schenker (Nestlé).

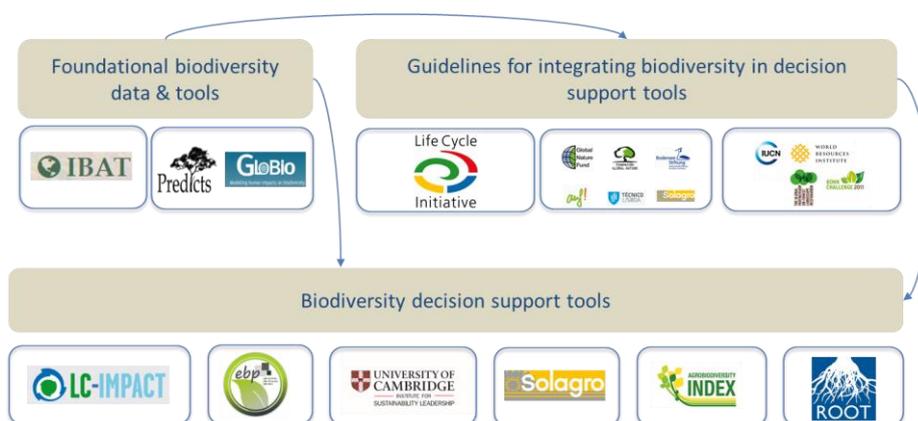
Executive Summary

The core initiative on Biodiversity is a project of the One Planet Program on Sustainable Food Systems¹. It aims to demonstrate the feasibility of taking biodiversity considerations into account in business decisions and policymaking.

This report has been compiled by experts on biodiversity assessments from academic institutions, civil society organizations, and the private sector. The **first section** of this report provides a **description** of key existing methodologies and tools to evaluate biodiversity, and the **second section** provides an **analytical mapping** of these methodologies and tools. The report is complemented by a link to an external compilation of case studies (**third section**), which illustrates applications of the methods described. In the **last section**, we evaluate required next steps to make the included biodiversity assessments operational.

3 complementary types of initiatives have been reviewed (cf. Figure below):

- **Foundational biodiversity data & tools:** those initiatives provide inventory or modeled databases on biodiversity state, available at global scale, with a robust and homogeneous method. Those data & tools are often used by the other initiatives as input data or elements of method. The key foundational data & tools presented here are internationally recognized as ones of the best in the world for their scientific robustness and because they are periodically checked and updated with new field inventory data.
- **Guidelines for integrating biodiversity in decision support tools:** those initiatives aim to develop guidance and consensus on which quantitative or qualitative indicators are best suited to quantify and monitor man-made impacts on biodiversity. The two Initiatives regrouped in this category give some recommendations for standards and label (initiative “biodiversity in Standards and Labels”) and for Life Cycle Assessment (initiative “land use impacts on biodiversity in LCIA”).
- **Biodiversity decision-support tools:** those initiatives develop indicators or frameworks of indicators to evaluate man-made impacts on biodiversity.



Key initiatives studied in this report.

¹ <http://www.oneplanetnetwork.org/sustainable-food-system>

Two **decision support tools** are based on “**life cycle assessment**” methods: ESD “Potential species loss from land and water use” and “Product Biodiversity Footprint”. They both are based on the same guideline on “Land Use Impacts on Biodiversity in LCA”. Although not fully assessing the life cycle, a third initiative, the CISL “Biodiversity Impact Metrics” is also **using the same logical framework** (pressure × impact intensity × ecosystem sensitivity). The Agrobiodiversity Index also evaluates a complementary aspect of biodiversity by looking at the diversity of a diet (rather than, as most other initiatives, only looking at the biological diversity next to the field). The Solagro tool aims to assess biodiversity management on a farm over time and to proof continuous improvement (or not) and not to compare different types of crops and farms.

The development **of all those initiatives are all still going on**, none of them being fully deployed except for the IUCN data and tool (but the collection of data continues and the tools are regularly updated). However, all tools have moved beyond the research and development phase, being tested in pilot projects or deployed to end users.

Those initiatives are all focusing on the intrinsic value of biodiversity, rather than on ecosystem services. They have in common to use approaches that are at least partly based on species counts, probably because this data is more easily accessible and has frequently been collected in the past. However, some initiatives also use genetic or habitat approaches in addition to species approaches.

Those initiatives have also in common to assess at least the impact of land use on biodiversity. In addition to land use impact, some of these initiatives aim at covering all impacts on biodiversity (climate change, pollution, etc..).

By the diversity of their approaches (objectives, evaluation scale, level of expertise required, ...), these initiatives are complementary and represent a useful and quite extensive toolkit for businesses and organizations who aim to integrate biodiversity criteria in their decisions. The applicability of the methods developed is illustrated in the case study collection, which will be built over the coming months, as the methods evolve to become applied in practice. The online appendix to this report will be updated over time to reflect the ongoing development in these methods.

The consortium of organizations involved in the present report also intends to continue working on biodiversity assessment approaches, in particular with regards to making data more widely available and facilitate the adaptation and conversion of data for the different biodiversity assessment methods.

A complementary version of this report, “Biodiversity Assessment Initiatives: Guide for Decision Makers” is available on the website of the One Planet Network. While the current technical report is mostly intended for an expert audience, the complementary report is shorter, and better suited for business and policy decision makers.

I. Introduction / Background

The One Planet Program on Sustainable Food Systems (SFS) is a multi-stakeholder initiative that aims to promote sustainability all along the food value chain, from farm to fork². The Program brings together existing initiatives and partnerships working in related areas, highlighting good practices and success stories, and builds synergies as well as cooperation among stakeholders to leverage resources towards mutual objectives, by example:

- Education programme, like “Designing Food Value Chains to Foster the Agenda 2030 for Sustainable Development”
- Innovation and research, like “New products based on cereals and pseudocereals from organic farming systems”
- Formulation and promotion of innovation strategies and policy options, like “Towards Food Sustainability: Reshaping the coexistence of different food systems in South America and Africa”

The Sustainable Food Systems (SFS) Program was launched in October 2015, as a multi-stakeholder program to promote SCP patterns in the area of food and agriculture. It is being co-led by South Africa, Switzerland, Hivos and WWF, with the support of a Multi-stakeholder Advisory Committee (MAC) with 23 members from five different stakeholder clusters. For more information, refer to dedicated web site: <http://www.oneplanetnetwork.org/sustainable-food-system>

Biodiversity loss is one of the principal global challenges in pursuit of the Sustainable Development Goals, with SDGs 14 and 15, in particular, being directly concerned with biodiversity. However, many other SDGs and their Targets are also either highly influential or dependent upon biodiversity, including SDG 2 (Zero Hunger), SDG 6 (Clean Water), and SDG 12 (Responsible Consumption and Production). Food systems, and in particular agricultural production and wild fisheries, are key drivers of biodiversity loss, but are also fundamentally dependent on biodiversity and ecosystem services. Addressing this challenge requires sound metric systems to monitor both ongoing loss of biodiversity and success of conservation measures. Yet there is currently no generally accepted, reliable, and actionable biodiversity system of metrics. Such system of metrics is needed if biodiversity should be assessed alongside more established environmental impacts, for instance for greenhouse gas emissions. In addition, communicating on biodiversity is more challenging due to its intrinsic complexity and the lack of simple units, such as CO₂-eq for carbon footprint. Furthermore, biodiversity needs to be assessed across multiple levels and spatial and temporal scales to yield meaningful results – this includes the landscape level for which there are many current tools and methods but an apparent lack of cohesion or compatibility among methods, landscape types and taxa.

In this context, a **core initiative on Biodiversity** has been launched in order to collate and improve methods and measures (deliverable 1), valuation methods (deliverable 2), and standards (deliverable 3) for agricultural, fishery and wild biodiversity, as well as identifying how these can be adapted to measure impacts on biodiversity at the landscape level. Furthermore, the initiative aims to motivate

² <http://www.oneplanetnetwork.org/sustainable-food-system>

companies, developers of standards and other actors to use those tools and methods in order to increase the biodiversity performance of the food sector.

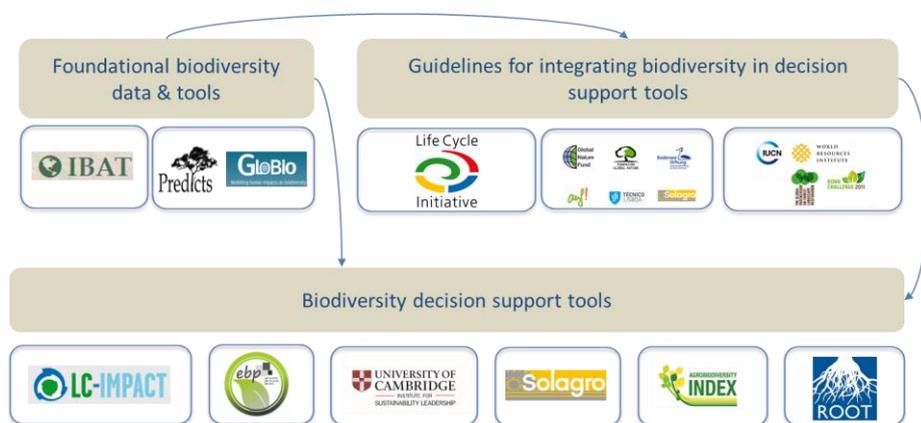
The current report summarizes the findings of the workgroup around deliverable 1 of this core initiative on Biodiversity, the inventory, description, and mapping of biodiversity assessment methods. In addition to the authors of this report (listed on the first page), the following organizations have contributed to the Core Initiative on Biodiversity and provided feedback to deliverable 1 on methodologies: WWF, INRA-Rennes, SIG, IFOAM, IISD, and FEFAC, Government of Costa Rica.

The vision for our core initiative is to demonstrate the feasibility of taking biodiversity considerations into account in business decisions and policymaking. The first deliverable of our core initiative is this report about existing methodologies and tools to evaluate biodiversity. The **first section** of this report will provide a **description** of key initiatives led by the partners, and the **second section** will provide an **analytical mapping** of these initiatives. The report also provides a link to an external overview and brief description of relevant case studies that have been compiled using the methodologies assessed in the current overview. The final section provides an outlook of what next steps are required to move the methods further into the operational phase.

II. Focus on key initiatives

The members of this project have identified 11 key initiatives to be reviewed. Those “initiatives” can be any resource, methodology, tool, guidance, or approach that is relevant to biodiversity measurement and valuation. These key initiatives can be regrouped into three main categories:

- **Foundational biodiversity data & tools:** those initiatives provide inventory or modeled databases on biodiversity state, available at global scale, with a robust and homogeneous method. Those data & tools are often used by the other initiatives
- **Guidelines for integrating biodiversity in decision support tools:** those initiatives aim to develop guidance and consensus on which quantitative or qualitative indicators are best suited to quantify and monitor man-made impacts on biodiversity.
- **Biodiversity decision support tools:** those initiatives develop indicators or framework of indicators to evaluate man-made impacts on biodiversity.



3 types of initiatives in the core initiative

Other initiatives on biodiversity metrics are ongoing but have not been included in this first release of the report. However, they are listed in the table below:

Complementary Biodiversity Assessment Methods not included in the current report

Initiative	Organism	Objective	Link/documents
Global Biodiversity Score	CDC Biodiversité	Measure a company's biodiversity footprint	http://www.mission-economie-biodiversite.com/wp-content/uploads/2017/11/N11-TRAVAUX-DU-CLUB-B4B-INDICATEUR-GBS-UK-BD.pdf
Livestock environmental assessment and performance partnership	FAO	Review of indicators and methods to assess biodiversity	http://www.fao.org/3/a-av151e.pdf
Ex-ACT tool project – biodiversity indicator	FAO & AFD	Enhance the existing tool Ex-ACT (carbon balance tool) by integrating an agriculture biodiversity indicator	http://www.fao.org/tc/exact/ex-act-home/en/
Biodiversity Return on Investment Metric (BRIM)	IUCN	Measure the contribution that investments can make to reducing species extinction risk (for finance industry and investors).	https://www.iucn.org/regions/washington-dc-office/our-work/biodiversity-return-investment-metric

1. Foundational biodiversity data & tools

A wide range of tools and ecological data, including geographically referenced biodiversity datasets combined with site surveys, are available. These can be used to scope out, identify and assess risks and opportunities associated with biodiversity, particularly in relation to the food industry (See [Natural Capital Protocol toolkit](#) for many examples).

1.1 Integrated Biodiversity Assessment Tool (IBAT)

Objective

The Integrated Biodiversity Assessment Tool (IBAT) provides key decision-makers with access to critical information on biodiversity priority sites to inform the decision-making processes and address any potential biodiversity impacts. IBAT is a central database for globally recognised biodiversity information including:

- The IUCN Red List of Threatened Species™, which assesses the risk that species will become extinct;
- The IUCN Red List of Ecosystems, a global standard for assessing the status of the conservation of ecosystems;
- Protected Planet, an online visual interface for the World Database on Protected Areas (WDPA); and The World Database of Key Biodiversity Areas™ (KBA), which hosts data on key areas of biodiversity based on a new global standard. All information can be accessed through a simple online interface, provide dynamic georeferenced maps and respond to specific queries.

Method

Supported by a partnership between Birdlife International, Conservation International, IUCN and United Nations Environment, and World Conservation Monitoring Centre (UNEP-WCMC), IBAT is designed to help businesses incorporate biodiversity considerations into key project planning and management decisions, including screening potential investments, siting an operation in a given region, developing action plans to manage biodiversity impacts, assessing risks associated with potential sourcing regions and reporting on corporate biodiversity performance.

Deliverables

The use of IBAT can help answer questions such as:

- Identification and prioritisation of sensitive areas for company operations or supply chains during screening processes and baseline surveys, which will highlight areas of high biodiversity value and inform Environmental and Social Impact Assessments (ESIAs);
- Support in implementing the mitigation hierarchy (avoidance, minimization, restoration and rehabilitation, and offsets), especially the avoidance phase and the initial stages of offset design;
- Compliance with environmental standards, certification schemes and biodiversity safeguard policies, such as identification of critical habitats and sustainable production standards (e.g. International Finance Corporation Performance Standard 6, or the Forest Stewardship Council standard);
- Support for the implementation of companies' biodiversity management systems including biodiversity action plans;
- Providing key information for reporting company's environmental footprint, by following, for example, the Global Reporting Initiative's sustainability reporting guidelines.

Specific IBAT deliverables include:

- Data sets that can be incorporated into company systems
- Proximity reports which detail protected areas and Key Biodiversity Areas within 50 km of a given location, and a list of globally threatened species that, given suitable habitat, may be found at or near to the given location.

The above knowledge products have been used in different ways by different agricultural companies (see Biodiversity for Business for more detail on the case studies).

- Nespresso used IBAT to identify 4,104 (9.5%) of their source farms in Colombia are within 2 km of protected areas and/or KBAs.
- UNEP-WCMC developed an approach for Nestlé which allowed different components of biodiversity sensitivity to be assessed based on globally available data, so as to inform potential priority sites for further investigation and action.
- FFI supported Oil palm and logging companies in Indonesia to meet their Roundtable on Sustainable Palm Oil commitments to protect HCV within and around concession areas, through using IUCN Red List of Threatened Species data and protected area information to inform HCV assessments.
- Portucel Soporcel group, a forestry company used knowledge products formed the basis of a conservation strategy that has been integrated into the group's forest management model,

as they provide crucial information for developing Environmental and Social Impact Assessments as part of pre-project restriction analyses and for supporting annual conservation and restoration programmes.

Status

During 2017, IBAT underwent a business model review and is implementing different pricing levels for commercial access. IBAT will be fully remodelled in 2018 with additional functionality including automatic “pay as you go” data and report requests and options for polygons to be used in addition to point and linear data.

Additional information/resources:

IUCN (2014). *Biodiversity for Business: A guide to using knowledge products delivered through IUCN*. Gland, Switzerland: IUCN. 48pp

IUCN 2017. *The IUCN Red List of Threatened Species. Version 2017-2*. <http://www.iucnredlist.org>.

The Integrated Biodiversity Assessment Tool for business (IBAT) <https://www.ibatforbusiness.org/>

IUCN Conservation Tools - <https://www.iucn.org/resources/conservation-tools>

[Natural capital protocol: sector supplement on food and beverage](#)

[Natural capital protocol toolkit www.naturalcapitaltoolkit.org](http://www.naturalcapitaltoolkit.org)

1.2 The PREDICTS project and the Local Biodiversity Intactness Index (LBII)

Objective

PREDICTS³ - Projecting Responses of Ecological Diversity In Changing Terrestrial Systems - is a collaborative project aiming to use a meta-analytic approach to investigate how local biodiversity typically responds to human pressures such as land-use change, pollution, invasive species and infrastructure, and ultimately improve our ability to predict future biodiversity changes.

Evaluating progress towards the CBD's 2010 target revealed several limitations in the existing indicators being used to monitor biodiversity. PREDICTS is designed to meet the need for next-generation biodiversity indicators, providing:

- **Broad taxonomic and geographic scope:** Addressing biases in existing indicators towards certain taxonomic groups (e.g. birds) and geographic areas (e.g. the developed world). Not all species respond equally to human pressures, and these pressures vary dramatically between regions.
- **Reflecting community and ecosystem properties:** Addressing previous focus on species-based indicators. Single species may not be meaningful representatives of entire ecosystems – and it is the ecosystems upon which we rely for ecosystem services.

³ <http://www.predicts.org.uk/>

- **Transparent, peer-reviewed science:** recognising the importance of publishing full descriptions and results in peer-reviewed scientific journals to maximise credibility.

Method

The PREDICTS project is collecting data from scientists worldwide in order to produce a global database of terrestrial species' responses to human pressures.

Thanks to generous contributions from researchers, and a great deal of hard work by students and staff at the Natural History Museum and UNEP-WCMC, the project now has over 2.5 million biodiversity records from over 21,000 sites, covering more than 38,000 species.

The Local Biodiversity Intactness Index⁴ (LBII) is based on this Predicts database of local biodiversity surveys combined with high resolution global land-use data. The index provides estimates of human impacts on the intactness of local biodiversity worldwide, and how this may change over time.

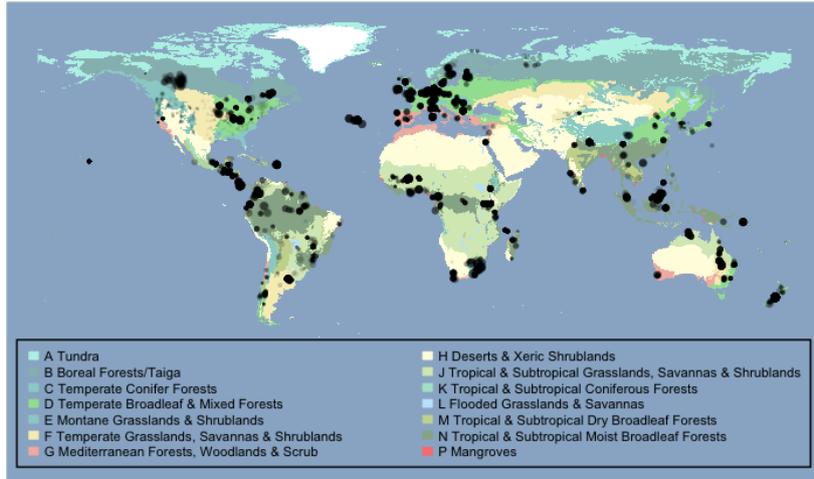
The Local Biodiversity Intactness Index estimates how much of a terrestrial site's original biodiversity remains in the face of human land use and related pressures. Because LBII relates to site-level biodiversity, it can be averaged and reported for any larger spatial scale (e.g., countries, biodiversity hotspots or biomes as well as globally) without additional assumptions. Building on research published recently in *Science*⁵, and repurposing existing biodiversity survey data, it combines scientific rigour with affordability. The LBII is particularly relevant for Aichi Targets 12 (Preventing Extinctions) and 14 (Essential Ecosystem Services). Existing indicators for these targets lack a broad biodiversity perspective; in particular, they are heavily biased towards vertebrates, which make up only 0.5% of the world's species and relate to only simple biodiversity measures. The LBII can report on both species-richness and mean abundance, and is being developed further to also report on geographic range rarity (endemism) and phylogenetic diversity. LBII's focus is on average local biotic intactness, which reflects species' persistence within the landscape and the local ecosystem's ability to provide many ecosystem services.

Deliverables

Locations from which PREDICTS currently has diversity measurements are shown below:

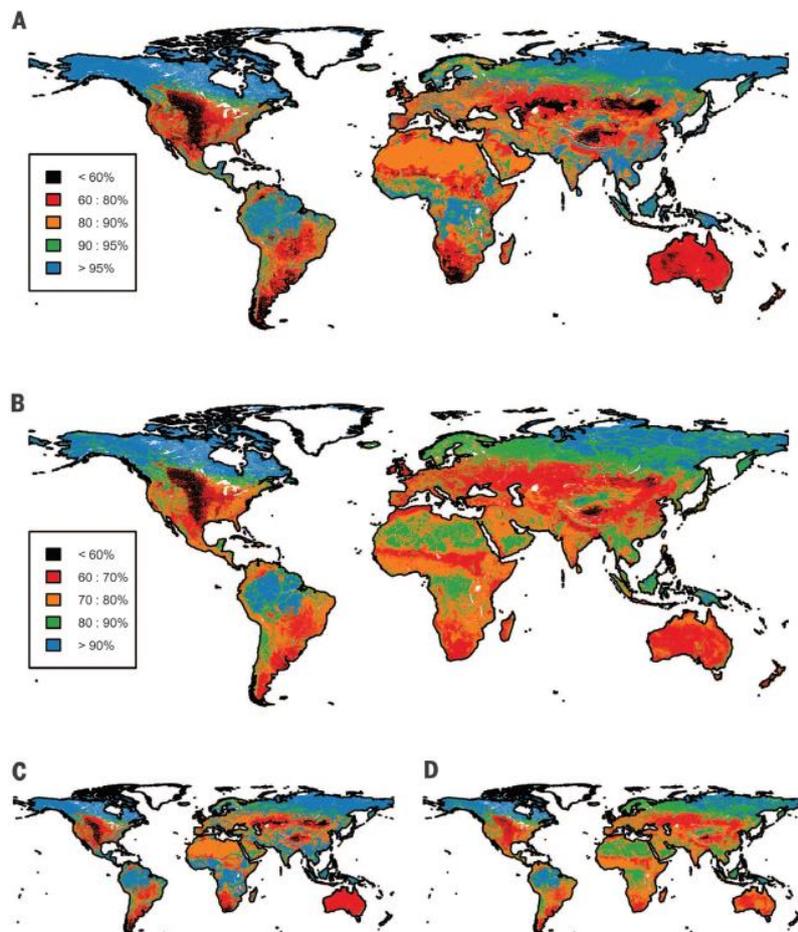
⁴ <http://www.predicts.org.uk/pages/policy.html>

⁵ Newbold et al. 2016, Has land use pushed terrestrial biodiversity beyond the planetary boundary? A global assessment. *Science* **353**, 289-291.



Locations from which PREDICTS currently has diversity measurements (Source: Predicts website, 2018).

Newbold et al. (2016) in *Science*, present fine-scale (~1 km²) global estimates of how land-use pressures have affected the numbers of species and individuals found in samples from local terrestrial ecological assemblages with BII (see figure below):



Biodiversity intactness of ecological assemblages. (A) Total abundance of species occurring in primary vegetation (BII). (B) Richness of species occurring in primary vegetation. (C) and (D) correspond to (A) and (B), respectively, and have the same legend values but include species not present in primary vegetation (Source: Newbold *et al.* 2016).

Status

The PREDICTS project is collating data from published papers, but ecologists and conservationists often hold more substantial and detailed data than there is room to publish in standard papers.

With the new phase of PREDICTS the objective is to collate biodiversity data from temporal comparisons, where terrestrial sites have been surveyed over time. There is particular interest in obtaining before-after-control impact studies but are also looking for before-after comparisons (which do not have control sites) and control-impact studies that sample for several years at known times after a land-use change.

1.3 GLOBIO initiative and mean species abundance

Objective

GLOBIO is a modelling framework to calculate the impact of environmental drivers on biodiversity for past, present and future.

The GLOBIO modelling framework consists of a model for terrestrial ecosystems and a model for the freshwater environment. The Sea Around Us Project of the University of British Columbia (UBC) has developed a similar model for marine ecosystems: EcoOcean.

Method

GLOBIO is based on cause-effect relationships, derived from the literature. To use GLOBIO no detailed species data are needed. Instead, the model uses spatial information on environmental drivers as input. This input is mainly derived from the Integrated Model to Assess the Global Environment (IMAGE).

GLOBIO includes the following drivers:

- Land use
- Atmospheric nitrogen deposition
- Infrastructure
- Fragmentation
- Climate change

Impacts on biodiversity are captured in terms of the biodiversity indicators **Mean Species Abundance (MSA)** and Ecosystem extent⁶. They can be considered applications of the CBD indicators ‘trends in abundance and distribution of selected species’ and ‘trends in extent of selected biomes, ecosystems, and habitats’, respectively.

MSA is an indicator of naturalness. It is defined as the mean abundance of original species relative to their abundance in undisturbed ecosystems. An area with an MSA of 100% means a biodiversity that

⁶ <http://www.globio.info/what-is-globio/how-it-works/impact-on-biodiversity>

is similar to the natural situation. An MSA of 0% means a completely destroyed ecosystem, with no original species remaining. MSA can be expressed in percentages, but also in fractions.

The MSA is calculated by:

1. Calculation of MSA per driver, using the cause-effect relationships, per grid cell of the map
2. Combining the MSA value of all drivers to a total MSA per grid cell
3. Aggregation across grid cells, e.g. towards global or regional MSA values

The output resolution depends on the input maps. For global analyses the resolution is 0.5 by 0.5 degree (nearly 55*55 km near the equator). For national analyses often 1 by 1 km is used.

Deliverables

The Global Biodiversity model GLOBIO is an operational tool for policy support on the global to national scale. It can be used to assess:

- Impacts of human induced environmental drivers on land biodiversity in past, present and future
- The relative importance of the environmental drivers
- Trends under future scenarios
- Effects of policy response options, such as climate change mitigation, plantation forestry and protected areas

Status

Since 2002 the model has been extensively used for environmental assessments on the global to national scale, by example for the Global Biodiversity Outlook 2 of the Convention on Biological Biodiversity.

Over the last years, partners have collaborated intensively on the further development of the GLOBIO model. The empirical underpinning of the model has been improved and novel applications have been developed by using GLOBIO for biodiversity footprinting. Over the next few years, the representation of land use in GLOBIO will be improved and the model will be extended with additional indicators of biodiversity. Partners will also explore other biodiversity-related topics that are scientifically challenging as well as policy-relevant, such as direct and indirect effects of climate change.

2. Guidelines for integrating biodiversity in decision support tools

2.1 Land Use Impacts on Biodiversity in Life Cycle Impact Assessment

Objective

In order to enhance consensus on environmental life cycle impact assessment indicators, the Life Cycle Initiative (<http://www.lifecycleinitiative.org/>) launched a global process in 2013 to provide global guidance on indicators and methods for the assessment of biodiversity impacts from land use in Life Cycle Impact Assessment (LCIA).

Despite substantial contributions to address land use impacts on biodiversity in Life Cycle Assessment in the last decade, no clear consensus exists on the use of a specific impact indicator, thus limiting the application of existing models as well as comparability of results. With the overall goal to provide a measurable and simple indicator or guidance on how to assess potential impacts due to land use on biodiversity, the main objective of this work was to (1) describe the impact pathway and review the potential indicators, (2) select the best-suited indicator based on well-defined criteria and develop the method to quantify them on sound scientific basis, (3) provide characterization factors with corresponding uncertainty and variability ranges, (4) apply the indicators to a common case study to illustrate its domain of applicability, (5) provide recommendations in term of the indicators' applicability.

In summary, it was concluded that the most common pathway assessed was the direct, local degradation and conversion of habitats. Most of the current models are based on compositional aspects of biodiversity, namely species richness followed by species abundance. While different spatial scales of assessment have been used, ecoregion was considered to be the one with the highest potential for consensus.

Deliverables

The following recommendations resulted from the assessment:

- The global average characterization factors (CFs) based on the method developed by Chaudhary et al. (2015)⁷ are suitable to assess impacts on biodiversity due to land use and land use change.
- The suggested name for the indicator is **Potential Species Loss from Land Use**. The indicator can be applied both as:
 - a regional indicator (PSLreg) which includes changes in relative species abundance within the ecoregion;
 - a global indicator (PSLglo) which includes the threat level of the species on a global scale is also included.

⁷ Chaudhary, A., Verones, F., De Baan, L., & Hellweg, S. (2015). Quantifying Land Use Impacts on Biodiversity: Combining Species-Area Models and Vulnerability Indicators. *i*, 49(16), 9987–9995.

The Global Guidance for Life Cycle Impact Assessment Indicators, as well as accompanying characterisation factors, can be accessed here <http://www.lifecycleinitiative.org/training-resources/global-guidance-lcia-indicators-v-1/>.

Method

The model covers six different land use types (intensive forestry, extensive forestry, annual crops, permanent crops, pasture and urban land) as well as five taxonomic groups (birds, mammals, reptiles, amphibians and vascular plants). The taxonomic groups can be analysed separately or be aggregated to represent the Potentially Disappeared Fraction (PDF) of species.

Status

At this point, the indicator is recommended ad interim and to be only used for hotspot analysis in Life Cycle Assessment (i.e. the analysis of critical environmental impact areas (hotspots) in a product system or within an organisation). In order to move to full recommendation, characterisation factors for additional land use types (intensity classes) and further case studies testing the indicator are required. When used internally for product comparisons, the indicator should not be used in isolation without further assessment of the specific biodiversity risks and potential management options.

2.2 Biodiversity in Standards and labels for the Food Sector (Lake Constance Foundation und Global Nature Fund)

Objectives

Standards and labels for the food industry help qualify certain attributes of a product and the process of production itself. Besides requiring certain certifications, many food companies have their own sourcing guidelines for suppliers and farmers and implement their own audits to control compliance. In combination with the agricultural sector, food producers and retailers have a great impact on biodiversity. Unfortunately, biodiversity protection is still not considered with the adequate importance by the sector.

This European wide initiative supported by the EU LIFE program is directed at standard setting organizations and companies with individual sourcing requirements. The main objective is to improve the biodiversity performance of the food industry by

- supporting standard-setting organizations to include efficient biodiversity criteria into their schemes; and by motivating food processing companies and retailers to include biodiversity criteria into sourcing guidelines (Recommendations for effective criteria and Biodiversity Performance Tool)
- providing training for farm advisors and standard certifiers as well as persons in companies responsible for the purchase of commodities and product quality.
- implementing a monitoring system for biodiversity used by all standards and food companies.
- close communication and the dissemination of results to the food sector.

The creation of a European initiative on “Biodiversity Performance in the Food Sector” will be supported, in order to continue working on the described aspects after the project ends in 2020.

Method

Lake Constance Foundation led the development of the Baseline Report which was published in April 2017. The project partners assessed 54 standards and labels of relevance for the European food market. 1 250 criteria used by existing standards and labels were analysed according to their transparency, verifiability and effectivity related to biodiversity. The interest in the Baseline Report has been high. All screened standards and companies received individual feedback from the project partners. So far, we are in intense contact with about 40 standards and food companies interested in the improvement of their criteria.

Baseline report: <http://www.business-biodiversity.eu/en/biodiversity-criteria-in-standards>

Based on the results and conclusions of the Baseline Report, many studies and the input of representatives of standards, food companies, scientific institutes, NGOs and administrations, **recommendations for effective biodiversity criteria in standards and sourcing requirements of companies** have been developed. The recommendations are available in five languages. English version for download: <http://www.business-biodiversity.eu/en/recommendations-biodiversity-in-standards>

They are directed primarily at standard organizations as well as companies of the food sector with own sourcing requirements. Cooperatives and associations of the food sector are invited to use the recommendations as an orientation for a more biodiversity compatible agricultural production processes and to promote their implementation. Furthermore, political decision makers should take the recommendations and related measures in consideration in funding programs and as requirements for subventions for the agricultural sector. This would be an important step towards a more biodiversity friendly agricultural framework and would support farmers applying biodiversity compatible practices.

The recommendations are addressing degradation and destruction of ecosystems, overexploitation of natural resources and invasive, alien species. Climate change as further driver for the loss of biodiversity is not considered, because most of the standards and sourcing requirements include criteria on climate protection. The recommendations have three big chapters:

- Biodiversity in the policy and strategies of standards and companies
- Sound biodiversity management to protect existing biodiversity and create potential for the increase of biodiversity
- VERY good agricultural practices to reduce the negative impact on biodiversity

With this extensive catalogue of recommendations, the authors present the full range of criteria and measures for protecting biodiversity. It is important that standard organizations and companies compare their criteria and requirements with the recommendations, identify the potential for improvement, and take effective steps to continually improve their biodiversity performance. This includes the implementation of the recommendations for the standard or company policy and for the strategic orientation.

Further deliverables and status

- GNF and LCF developed an “Action Plan” for the German Environmental Ministry on how to include sound biodiversity criteria into the “Green Public Procurement” for food and catering. The action plan includes recommendations for the improvement of criteria of standards as well as criteria for calls for tenders. The plan is currently under discussion with units responsible for public procurement, European Commission (GPP criteria), standard organizations etc. If the inclusion of biodiversity criteria into GPP will be successful, an important business case for biodiversity friendly produced food would be achieved.
- The French partner Solagro analysed 20 existing tools and indicators and developed a first concept for a Biodiversity Performance Tool (see below).
- The project team elaborated two concepts for biodiversity training of advisors of certified farms and certifiers and for training of product and quality managers of food companies. Furthermore, a training concept for trainers and smallholder farmers of Fairtrade Africa was developed. The training has been implemented in July 2017 and lessons learned will be considered in the preparation of the concepts for trainings as well as the results of a training which was held for procurement managers of the retailer Kaufland in Germany.
- Pilot projects to increase the biodiversity on certified farms have been started and the first hotspot analysis have been implemented. So far 76 farms are involved in the pilots covering arable crops, fruit and vegetable production, dairy and meat production.
- The activities on the monitoring system started earlier than scheduled. First discussions between project partners were held in order to harmonize the monitoring framework with the Biodiversity Performance Tool. The elaboration of an overview on existing monitoring sustainability tools has been started. LCF contacted ISEAL, Rainforest Alliance, Cool Farm Tool organizers, MANUELA Tool organizers and Fibl, as responsible organization for the SMART Tool, for a more intense exchange on monitoring.

Dissemination activities have started and resulted in first articles about the project. The project partners presented the project at fairs (e.g. Biofach) and conferences at national, EU and international level to establish contacts with and raise awareness among representatives of target groups. The website www.food-biodiversity.eu on the EBBC portal, project flyers, notice boards and roll ups are used in the communication with the target group. Media databases are installed and a professional media data broker contracted to reach out for sector specific press.

The Easy Guide on Biodiversity in Standards has been published in January 2018 and is available for download⁸. This Guide is particularly designed for quality and procurement managers of companies that are responsible for purchasing food products. The guide provides insights into the status quo of biodiversity criteria and measures in policies of standards and company requirements as well as an overview of formulations for effective biodiversity criteria.

The Recommendations for effective biodiversity criteria were officially presented on the 1th of March in Brussels during the conference “Sourcing while respecting biodiversity: the case of food” organized the Belgian Federal Public Service for Health, Food Chain Safety and Environment, Université

⁸ <http://www.business-biodiversity.eu/en/publications>

Catholique de Louvain, IPES-food and Global Nature Fund. During this event – attended by more than 90 participants – a *Basic Set of Biodiversity Criteria* for the food sector – out of the range of the Recommendations and a sector initiative “Biodiversity Performance in the Food Sector” was discussed.

An important part of the activities in 2018 focus on the dissemination of the recommendation and on supporting standards and companies to revise their schemes and requirements. Currently the project team is working with more than 10 standards (e.g. Fairtrade, UTZ, Global GAP, Quality Standard Baden-Württemberg, Naturland, UEBT and various regional standards in France, Spain and Portugal), with companies such as Nestle, Kaufland, REWE, Symrise, Albgold and more than 10 producer cooperatives.

2.3 Guidelines for Biodiversity in Forest Landscape Restoration Assessments (IUCN) and the Restoration Opportunities Assessment Methodology.

Objective

The Biodiversity Guidelines for Forest Landscape Restoration (FLR) Assessments (Beatty et al. 2018) are intended to provide more context, more resources, and fresh perspectives on the ongoing global interaction between biodiversity conservation and forest landscape restoration, especially within the Restoration Opportunities Assessment Methodology (ROAM) (IUCN and WRI 2014). With hundreds of millions of hectares of degraded and deforested land committed to restoration through the Bonn Challenge, these guidelines provide FLR practitioners with tools and knowledge to translate between biodiversity conservation goals and FLR objectives and to utilize effective assessments and information on biodiversity in designing FLR assessments and strategies at national and sub-national scales.

Method

The Restoration Opportunities Assessment Methodology provides a flexible and affordable framework for countries to rapidly identify and analyse areas that are primed for forest landscape restoration (FLR) and to identify specific priority areas at a national or sub-national level. ROAM has been applied in over two dozen countries, most of whom have made significant commitments to restoration of degraded and deforested landscapes to support increased ecological functionality and human well-being. ROAM is predicated on a multi-stakeholder, inter-sectoral assessment of the objectives of landscape restoration, the drivers and extent of degradation, and the expected short-term and long-term costs and benefits of landscape restoration. This includes comprehensive assessments with national, international, and local stakeholders on policies, laws, and institutions relevant to restoration of degraded lands. It also includes a strong analytical component of spatial and economic analysis on priority areas and/or where restoration is possible and feasible, assessment of the enabling conditions for FLR, quantifications of potential carbon sequestration or co-benefits for restoration, and an analysis of funding sources and economic pathways for large-scale transformational change in the support of sustainable and functional landscapes.

Deliverables

ROAM itself delivers knowledge, tools, and capacities surrounding the biophysical, social and economic components of degraded landscapes and the costs and benefits of landscape restoration. Generally, these are in line with national or subnational development and conservation objectives, such that the output of a ROAM process includes assessments of the opportunity for landscape restoration to help address objectives such as increased food security, resilience to climate change and natural disasters, economic growth and the sustainable use of natural resources, and the restoration or conservation of biodiversity. Apart from the maps, cost-benefit analysis, and carbon sequestration potential that are included in nearly every assessment, ROAM builds a platform for inter-sectoral and inter-ministerial discussion and action surrounding the sustainable use of landscapes and the restoration of degraded land to support productivity and human livelihoods.

The Guidelines for Biodiversity in Forest Landscape Restoration Assessments provide specific guidance to FLR practitioners and policy-makers on the role that biodiversity plays in landscapes and in the assessment of landscape restoration assessments. Furthermore, these Guidelines deliver resources that will help ensure that biodiversity information and consideration can be found and integrated into each step of the iterative ROAM process, and not simply as an additional consideration. Ultimately, the Guidelines ensure that biodiversity information is integrated into the assessment of all relevant policies within an FLR landscape, including developmental, economic, and social policy in addition to existing environmental policy. These guidelines point to relevant data on biodiversity and species and provide recommendations on how they can be included in the analytical components of ROAM. At its core, increasing ecological productivity, for agriculture or other ecosystems, is based on the resilience and functionality of ecosystems. The Guidelines for Biodiversity in FLR assessments help reinforce biodiversity as the core consideration for long-term success of global restoration efforts and initiatives.

Status

Since its release in 2014, ROAM has expanded from fewer than 4 assessments to over two dozen – some at large national scale and some at smaller sub-national scales. The 2014 version of ROAM was intended as a “Road Test” version and an updated version of the Assessment Methodology is expected in the near future. This will include additional knowledge, tools and capacities that have proven instrumental in the successful assessment of FLR opportunities and in the implementation of resulting strategies.

The Guidelines for Biodiversity in Forest Landscape Restoration Assessments will form a component of this new version, but components of these guidelines have already been deployed in practice in many of the countries or regions that have undertaken a ROAM process. Additionally, the Guidelines will form the basis for ongoing collaboration with IUCN’s Commission on Ecosystem Management and the broader FLR community to ensure that the implementation of forest landscape restoration strategies generates positive outcomes for species and biodiversity. They will also act as an important bridge document between national focal points for the Convention on Biological Diversity and FLR technical working groups – reducing redundancies in effort and synchronizing parallel and complementary national FLR and biodiversity conservation processes.

Additional Resources/Information:

Beatty, C.R., Cox, N. A., and M. E. Kuzee (2018). *Biodiversity Guidelines for Forest Landscape Restoration Opportunities Assessments*. Gland, Switzerland: IUCN. [in layout]..

IUCN, WRI, 2014. A guide to the Restoration Opportunities Assessment Methodology (ROAM): Assessing forest landscape restoration opportunities at the national or sub-national level. Road-test edition. (Working Paper). IUCN, Gland, Switzerland.

Ministry of Natural Resources, Energy and Mining - Malawi (2017). Forest Landscape Restoration Opportunities Assessment for Malawi. NFLRA (Malawi), IUCN, WRI. xv + 126pp. <https://portals.iucn.org/library/sites/library/files/documents/2017-029.pdf>

3. Biodiversity decision support tools

3.1 Potential species loss from land and water use – a method for quantifying global species extinctions from land use (LC Impact / ETH Zurich)

Objective

This life cycle impact assessment method was published from the European LC-IMPACT project. Biodiversity loss is quantified in terms of fraction of global species lost. The following impact pathways are covered:

- land use and stress
- water consumption and stress
- climate change
- terrestrial acidification
- freshwater eutrophication

This method provides two indicators, one for global species extinctions and another one for regional extinctions (Chaudhary et al. 2015, Verones et al. 2017)⁹. The former indicator gives a measure of global (permanent, irreversible) species loss, while the latter addresses regional species loss and is needed to assure that all ecosystems keep functioning, even if they are not of unique ecological value.

The application of the method is straightforward: In the case of land and water stress, land use (in m² or m²*years) of a particular land use category (annual, permanent crops, pasture, urban, extensive and intensive forestry) and water use (in m³) at a particular location is multiplied with so-called “characterization factors”. These characterization factors are provided on the ecoregion level for land use (specific factors for 804 ecoregions) and on the (sub-)watershed level for water consumption, with

⁹ Verones et al. 2017. LCIA framework and cross-cutting issues guidance within the UNEP-SETAC Life Cycle Initiative, *Journal of Cleaner Production*, vol. 161.

Chaudhary et al. 2015. Quantifying Land Use Impacts on Biodiversity: Combining Species– Area Models and Vulnerability Indicators, *Environ. Sci. Technol.* 2015, 49, 9987–9995.

global coverage. They quantify the regional and global extinctions that are “committed to extinction”, i.e. the number of species lost in the ecoregion or globally as a consequence of land use at steady state. Characterization factors are provided for four animal taxa (birds, amphibians, mammals, reptiles) and vascular plants. Taxon-aggregated characterization factors (with an equal weighting of plant and animal taxa) are also provided. For the latter, the aggregation is done using the unit of potentially damaged fraction of global species, i.e. dividing the projected number of extinctions with the globally known number of species.

For the emission-related impacts the application is similarly simple. Emissions (e.g. kg CO₂-emissions) are multiplied with the respective characterization factors (e.g. climate change characterization factors in the case of CO₂). The spatial resolution of the characterization factors depends on the impact category and is summarized in the following table, along with the taxonomic groups considered in the assessment.

environmental mechanism	Spatial resolution characterization factor	Taxonomic groups considered	Link to method description
climate change	global	mammals, birds, frogs, reptiles, butterflies and plants	Steinman Z, Huijbregts MAJ., Climate change, 2016, http://www.lc-impact.eu/downloads/documents/LC-Impact_report_SEPT2016_20160927.pdf
photochemical ozone depletion	country level	tracheophyta	van Zelm R, Preiss P, van Goethem T, Verones F, Van Dingenen R, Huijbregts MAJ, Photochemical ozone formation, 2016, http://www.lc-impact.eu/downloads/documents/Chapter5_Photochemical-ozone-formation.pdf
terrestrial acidification	2° x 2.5°	tracheophyta	Azevedo LB, Roy PO, Verones F, van Zelm R, Huijbregts MAJ, Terrestrial acidification, 2016, http://www.lc-impact.eu/downloads/documents/Terrestrial_Acidification_20160926.pdf
freshwater eutrophication	0.5° x 0.5°	fish	Azevedo LB, Verones F, Henderson AD, van Zelm R, Jolliet O, Scherer L, Huijbregts MAJ, Freshwater eutrophication, 2016, http://www.lc-impact.eu/downloads/documents/Chapter8_Freshwater-eutrophication.pdf

Spatial resolution and taxonomic groups considered within the emission-related impact categories contributing to biodiversity loss within the LC-IMPACT method¹⁰.

The characterization factors can be directly applied, e.g. to land-use maps in the case of land stress, to quantify the number of species that will go extinct as a consequence of anthropogenic land/water use and emissions. For land stress, the difference between two points in time represents the number of species lost as a consequence of land-use change. However, in Life Cycle Assessment (LCA), a distinction is made between land occupation and transformation, weighting the species loss with the recovery time of ecosystems in the particular ecoregion in the case of land-use change. The unit of the resulting impact, multiplying land occupation (in m²*years) or land transformation (m²) with the

¹⁰ Verones F et al., 2016, LC-Impact Version 0.5, A spatiallyspacially differentiated life cycle impact assessment approach, retrieved from http://www.lc-impact.eu/downloads/documents/LC-Impact_report_SEPT2016_20160927.pdf, 2016

characterization factors then results in a unit which does not have an intuitive meaning any more (species*years), but still represents a unit of global, irreversible extinctions and regional extinctions, for the global and regional version of the method, respectively.

Method: Background methodology for the calculating characterization factors

For land use

The method summarized in the following was used for the calculation of characterization factors. It is intended as background information, but is not needed for the application. In the application, characterization factors simply need to be multiplied to areas of land use of a particular land-use type at a specified location. Details of the method are documented in Chaudhary et al. (2015) and UNEP-SETAC (2016)¹¹.

The modeling was done in four steps:

1. *Local* species richness of different land use types was compared with the (semi-)natural regional reference situation (de Baan 2013, Koellner 2013)¹². Based on a literature review and existing databases (GLOBIO (Alkamade et al. 2010)¹³ and the Swiss biodiversity monitoring (BDM 2004)) response ratios were quantified for six land use types and five taxa in different biomes (global coverage). These response ratios are the ratio of species richness in the land used divided by the species richness of a (semi-)natural reference ecosystem within the same region.
2. The response ratios for local species loss are fed into the ‘Countryside species area relationship (SAR) model’ (Pereira et al. 2014)¹⁴ to calculate regional species extinctions due to land use. The countryside SAR considers species loss in the surrounding ecosystems as a consequence of a reduction in natural land area as well as the species loss on the land that is used (weighing this land use with the local response ratios). In contrast to the classical SAR, it therefore considers that some species also survive in the new land uses.

$$S_{lost,j}^{countryside} = S_{org,j} \cdot \left(1 - \left(\frac{A_{new,j} + \sum_{i=1}^n h_{i,j} \cdot A_{i,j}}{A_{org,j}} \right)^{z_j} \right), \quad h_{i,j} = \left(\frac{S_{i,j}}{S_{ref,j}} \right)^{1/z}$$

$S_{lost,j}$ number of species lost in ecoregion j
 S_{org} number of species occurring in the original habitat area

¹¹ Chaudhary, A.; Verones, F.; de Baan, L.; Hellweg, S. Quantifying Land Use Impacts on Biodiversity: Combining Species– Area Models and Vulnerability Indicators, *Environ. Sci. Technol.* 2015, 49, 9987–9995. UNEP-SETAC Life Cycle Initiative. (2016). Global Guidance for Life Cycle Impact Assessment Indicators - Volume 1.

¹² de Baan, L.; Alkamade, R.; Koellner, T. Land use impacts on biodiversity in LCA: a global approach. *Int. J. Life Cycle Assess.* 2013, 18 (6), 1216–1230.

Koellner, T., de Baan, L., Beck, T., Brandão, M., Civit, B., Goedkoop, M., ... Wittstock, B. (2013). Principles for life cycle inventories of land use on a global scale. *The International Journal of Life Cycle Assessment*, 18(6), 1203–1215.

¹³ Alkamade, R., Van Oorschot, M., Miles, L., Nellemann, C., Bakkenes, M., & Ten Brink, B. (2009). GLOBIO3: A framework to investigate options for reducing global terrestrial biodiversity loss. *Ecosystems*, 12(3), 374–390.

¹⁴ Pereira, H. M.; Ziv, G.; Miranda, M. Countryside Species–Area Relationship as a Valid Alternative to the Matrix-Calibrated Species– Area Model. *Conserv Biol.* 2014, 28 (3), 874–876.

- A_{new} remaining natural habitat area
- A_{org} original habitat area
- h_i habitat affinity (land use i);
- $s_{i,j}$ empirical plot-scale species richness of land use I in region j

Species loss is calculated for each ecoregion and allocated to land use types. The result is a map/list of taxa-specific characterization factors (CF) for regional species loss in the unit ‘regional species lost per unit of land used’, in 804 terrestrial ecoregions and for six land-use types.

3. The regional CFs treat all species equally, whether the species present in an ecoregion are critically threatened or widely distributed. To calculate global extinctions, CFs are weighted with a factor VS according to Verones et al. (2013)¹⁵ to derive *weighted CFs* in the unit ‘global species eq. lost per unit of land occupied or transformed’ in 804 terrestrial ecoregions. Ecoregions which host endemic and threatened species have a high weighting factor VS, as land use in those ecoregions lead to a higher risk of global species loss. For example, if an ecoregion only contains endemic species with are highly threatened, VS is equal to 1 (in this case regional species loss is equal to global species loss), while otherwise global species loss will be smaller than regional loss.

Note that if the TL term is cancelled in the below equation, we end up with the concept of “endemic richness”.

$$CF_{global,j} = CF_{regional,j} \times VS_j, \quad VS_j = \sum_{p,j} \frac{\sum_{k=1}^m \frac{TL_k \cdot RA_{k,p}}{\sum_p RA_{k,p}}}{m}$$

- $RA_{k,p}$: habitat range area (RA) of species k
- TL_k : IUCN threat level of species k (scaled between 0 and 1)
- m: number of species
- p: cell/pixel

4. The modelled number of species lost for each taxon are aggregated to derive the ecosystem quality loss in the final endpoint unit- global fraction of potentially disappeared species (PDF).

For water use

The method for water consumption only considered impacts on wetlands. A very similar procedure as the one for land use above is followed, but a prior step is needed to translate water consumption into wetland area loss. This “fate” factor depends on the location of water abstraction and also whether the wetland is surface-water or groundwater dependent. The details are documented in Verones et al. (2013). After having assessed wetland area loss, the quantification of regional and global species lost is again based on the species-area relationship and a weighting with the rarity and threat level of species (see Verones et al. 2013 and 2017 for details).

For all emission-related impact categories

In contrast to the methods for land and water use, for the emission related impact categories no factor VS has been applied to derive weighted CF (see Section land use, point 3), due to missing data. Therefore, a conversion factor is needed to apply the emission-related characterization factors

¹⁵ Verones, F.; Saner, D.; Pfister, S.; Baisero, D.; Rondinini, C.; Hellweg, S. Effects of consumptive water use on biodiversity in wetlands of international importance. *Environ. Sci. Technol.* 2013, 47 (21), 12248–12257.

together with the land and water related characterization factors. In the LC-IMPACT method, the characterization factors for land and water use include this conversion factor, which scales the impacts of land and water use to units which are comparable to the emission-related categories.

The impact pathways of the emission related categories and the mathematical models used are described in the LC-IMPACT documentation (and the table in the *Objective* section above) and the literature quoted here in.

Status

This method for land use has been recommended as best practice for Life Cycle Impact Assessment of land use (UNEP-SETAC 2016)¹⁶. Meanwhile, it has been applied within various LCA studies of products as well as global analysis of the land-use related biodiversity impacts of agriculture, pasture and forestry (Chaudhary et al. 2016)¹⁷ and international trade (Chaudhary et al. 2016¹⁸). Further ongoing applications include the assessment of resource consumption by the UN Environment International Resource Panel (International Resource Panel 2017g), case studies by FAO and the assessment of future land-use scenarios.

3.2 Product Biodiversity Footprint Project (I Care & Consult - Sayari)

Recent methodological developments, both in LCA and ecological fields, have improved integration and evaluation of biodiversity aspects in the past few years. Thus, in order to reinforce the relevance of biodiversity loss assessment in LCA, the Product Biodiversity Footprint (PBF) project was launched in 2016 involving experts from LCA and ecological fields. The objective of the project is to develop a methodology and a tool crossing biodiversity studies and companies' data to quantify the impact of a product on biodiversity all along the product life cycle in order to provide recommendations for improvement. This project is a major step in helping companies to determine, improve and monitor the impacts on biodiversity of their products.

Objectives

The PBF project aims to answer the lack of specific tool to assess the impact of different products on biodiversity. In order to do this, baseline principle of the PBF project is to **co-develop a method and a tool** crossing biodiversity studies and companies' data to quantify the impacts of a product on biodiversity **all along the product's life cycle stages** in order to provide recommendations for changes. PBF project brings together all existing available data and provide quantitative results for decision making processes regarding product strategy (risks analysis, purchasing strategy, eco-design...). In more detail, the objectives of the project are threefold:

¹⁶ UNEP-SETAC Life Cycle Initiative. (2016). Global Guidance for Life Cycle Impact Assessment Indicators - Volume 1

¹⁷ Chaudhary, A.; Pfister, S.; Hellweg, S.; Spatially Explicit Analysis of Biodiversity Loss Due to Global Agriculture, Pasture and Forest Land Use from a Producer and Consumer Perspective. *Environ. Sci. Technol.* 50, 7, 3928-3936.

¹⁸ Chaudhary, A. & Kastner, T. Land use biodiversity impacts embodied in international food trade. *Global Environmental Change* 38, 195–204 (2016).

Discriminating capacity:

The main objective of the project is to improve environmental performance of a product by identifying environmental hotspots that can be improved and support eco-design approaches. In order to have such a capacity the PBF should have a strong **discriminating capacity**: the method aims to identify between the variants of a product the one with lowest impacts on biodiversity.

The LCA framework is used to calculate **the relative differences between the variants of a product**. In the long term, it will also allow to compare different products or different sectors at larger scales.

Integrating biodiversity in LCA ecosystem

To be easily adopted by companies for product assessment, the method has to be integrated in the LCA ecosystem, meaning it has to be **connected to LCA database** and be compatible with the **LCA assessment framework**, so that this additional biodiversity assessment can be seen as an **add-on to LCA global assessment**. Therefore, the choice made for PBF method is to include biodiversity knowledge in the LCA framework

Covering a large scope of impacts

The method aims to cover the 5 pressures on biodiversity identified in the Millennium Ecosystem Assessment (2005): **land use (habitat change), pollutions, climate change, invasive species, overexploitation of species**.

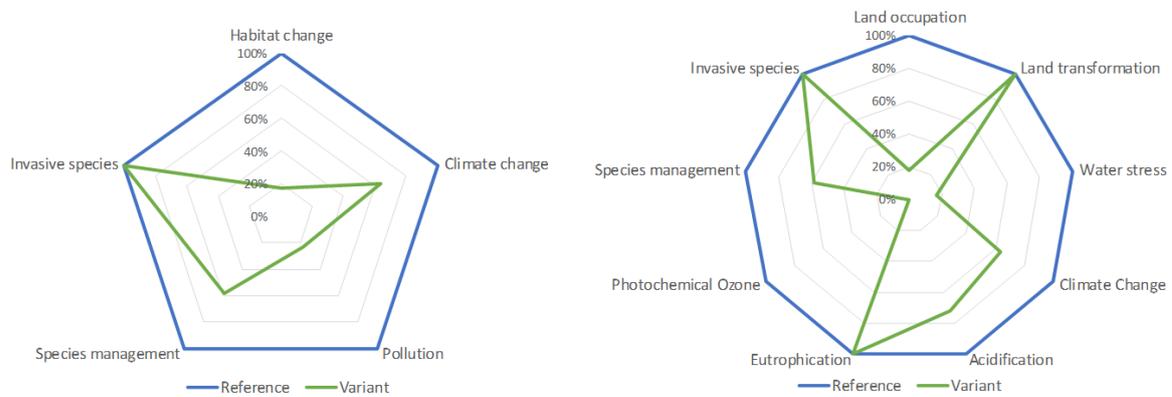
Biodiversity knowledge included in the LCA framework is based on **ecological publications** specific for each pressure and on **available global biodiversity database** to assess the state of biodiversity.

Deliverables

Results will be presented in different layers (see figure below):

- (a) A first level will display relative comparison the 5 axes of MEA pressure, also displaying related confidence indexes; the 100% value will be assigned to the Reference scenario;
- (b) The second level will provide details for each MEA pressure. For pressures that are quantitatively assessed through M1 and M2, absolute quantification of each the related impact pathways and related confidence indexes will be displayed.
 - **Change of habitat** is detailed in
 - land occupation impact on biodiversity
 - land transformation impact on biodiversity
 - water stress impact on biodiversity*For the two first categories, impacts on both Regional biodiversity and on Global Biodiversity will be displayed.*
 - **Pollution** is detailed in:
 - terrestrial acidification,
 - freshwater eutrophication
 - photochemical oxidation*For those three categories, impacts on Regional biodiversity will be displayed.*

- **Climate change** is displayed in Regional biodiversity. Impacts will also be supplied in the usual unit of kg CO₂eq, according to IPCC 2013 (Stocker et al., 2013) 100 year factors.

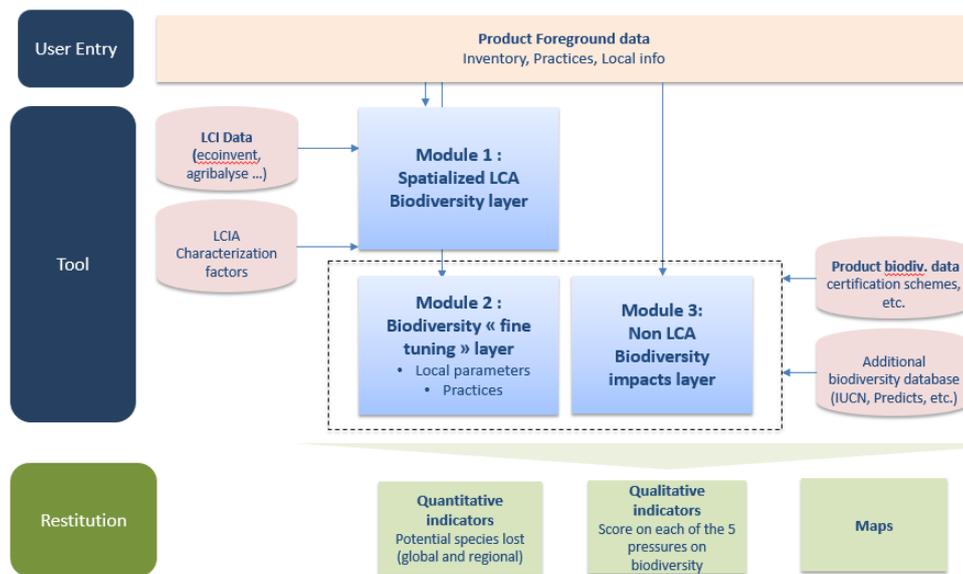


PBF two main outputs: two different levels of results aggregation, to assess the biodiversity impact of two variants of one product (fictive product).

Method: three modules based on LCA methodologies and ecological knowledge

The methodology includes three elements, as described in figure below:

- **Module 1** computes lifecycle impact assessment, with spatial differentiation for the main impact categories evaluated. Characterization factors used for computation are the ones currently available in published LCA methodologies. This first module enables the user to visualize the hotspots of the product footprint both geographically and along the whole value chain.
- **Module 2** treats specific information regarding the practices and the local context, that would enable to adjust impact computations based on information entered by the users. The development of criteria and rules to quantify the changes in impact computations are defined per type of land use (e.g. arable crops, perennial crops, grassland, mining, forest, urban....) and/or per sector (livestock, transport, electricity, construction....). Results of modules 2, additionally to the results of the Module 1, enable the user to visualize and quantify the benefits of a chosen practice/location, and compare various scenarios for a given product.
- **Module 3** assesses qualitatively 2 aspects that are not part of any LCA model, namely 'invasive species' and 'species management', this last one encompassing 'overexploitation' aspects of the Millennium Ecosystem Assessment, such as hunting, poaching or overfishing, but going beyond as it also includes positive actions (e.g. installation of pollinators, use of various breeds, follow up of endangered species...).



Architecture of PBF methodology

Biodiversity impacts are assessed independently for the 5 MEA pressures. At this stage, we did not combine the 5 pressure scores into a single biodiversity score, to avoid issues of scales and weighting between indicators.

Quantitative indicators cover the 3 pressures 'Change of habitat', 'Pollution' and 'Climate Change' of the MEA. At this stage of the project, pollution impact on ecosystem quality and biodiversity is evaluated through the following cause-effect chains: freshwater eutrophication, terrestrial acidification and photochemical ozone; note that ecotoxicity is not included in this first version of PBF.

For those pressures, the comparison of products is made on an indicator reporting the potential loss of species. The indicator is expressed in the so called "potential disappeared fraction of species within a year" or PDF*yr. This indicator is applied on Terrestrial and Freshwater species, depending on the impact pathway. For example, Terrestrial Acidification or Land stress occupation impact Terrestrial species, and Freshwater Eutrophication impacts Freshwater species. PDF quantifies the potential for species disappearance rather than exact disappeared species numbers.

The indicator can be applied both as a regional and global indicator, as recommended by the UNEP SETAC 2016 guidance:

- Regional indicator ($PDF_{reg} * yr$) quantifies the potential for disappearance of species at regional level; region is understood as an ecologically homogeneous area, practically identifies as ecoregions for terrestrial ecosystems, and the water basins for freshwater ecosystems).
- Global indicator ($PDF_{glo} * yr$) quantifies the potential for global extinction of species, accounting for their vulnerability at global level.

Status

PBF is currently tested in three agricultural sectors: goat wool, vegetal oil, palm oil. A second phase will be launched in February 2018 to test the tool on new products and sectors.

3.3 Biodiversity Impact Metric (CISL)

Objectives

Investors and companies alike want to create long-term value by mitigating risks and improving their impact on the natural environment. Company productivity is dependent upon a resilient environment and reducing impacts is beneficial to both nature and business. Opportunities exist for investors and companies to demonstrate positive impacts and show they are reversing the trend of natural environment degradation. The challenge is to identify metrics that are relevant for businesses' decision making process, whilst being simple and practical for investors to use.

The Cambridge Institute for Sustainability Leadership (CISL) convene the Natural Capital Impact Group (NCIG), a global network of companies working collaboratively to determine how business can sustain the natural world and its resources through its strategies and operating practices. NCIG members have prioritised the development of a set performance measures, or metrics, to address their impact and dependencies on natural capital.

To date, many initiatives have developed a series of metrics related to natural capital; however, no single metric related to impact (not policies or risks) which is simple and influential to decision making across corporates and investors has been established. A plethora of methodologies, standards and tools exist that help investors and businesses understand their interaction with the natural environment. However, these only offer guidance and do not provide specific information for companies to measure and demonstrate impacts upon the natural environment in a consistent way. Until consistent, context based metrics are developed natural capital measures will continue to be misunderstood and disregarded, and will not become mainstream in decision-making.

CISL and members of the Natural Capital Impact Group are working together to codevelop a *Healthy Ecosystem Metric* that has sub-components on biodiversity, soil and water. This project will develop a proof of concept for such a metric, and test it with companies and investors in real business contexts.

Deliverables

The objective of this project is to bring together companies and investors who want to understand their impacts and co-develop metrics that are influential in decision making, practical to use and meaningful across the value chain. The metric development builds upon work from the Investment Leaders Group on [measuring impact](#) and the Natural Capital Leaders Platform's advances on [biodiversity metrics](#), while remaining relevant across business sectors and other players in the value chain.

With robust metrics, companies and investors will be equipped to catalyse change and transition their approach to natural capital from a 'tick-box' exercise to one which considers both short- and long-term implications of the impacts and dependencies between business and the natural environment.

The project will support the development of sub metrics for biodiversity, soil and water.

Method

A conceptual framework has been developed for the Biodiversity Impact metric which has been discussed in a published [working paper](#). This was developed in collaboration with a number of companies, including Kering, Nestlé, Asda and Mars, as well as leading experts and NGOs.

The impact of businesses on biodiversity can be characterised by weighting the size of a company’s land area requirements according to their effect on quantity of biodiversity loss and biodiversity importance.

The metric is currently undergoing refinement to determine the most appropriate data sets underpinning it and testing it with companies.

It is proposed to represent the impact on biodiversity based on land area required for production, weighted by its impact on biodiversity quantity and importance (Equation 1):

<p><i>Biodiversity impact</i> = land area × quantity of biodiversity loss × biodiversity importance × impact on biodiversity quality</p> <p>Equation 1</p>
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Status

This project will:

- Bring together corporates and investors to develop a set of metrics that can quantify companies’ and investors’ impact on the natural environment,
- Support the development of metrics for soil, water and biodiversity.
- Result in a Biodiversity Impact Metric that will help companies to measure the impact that their raw material supply chains have on biodiversity across the globe
- Test the metrics in corporate and investor contexts
- Provide credible, primary impact data that can be used to engage suppliers and improve performance over time.

3.4 Agrobiodiversity Index (Bioversity International)

The Agrobiodiversity Index (ABD Index) is being designed and developed by Bioversity International to **measure commitment, actions, and status of agricultural biodiversity**¹⁹ by i) national governments, ii) prominent agri-food corporations, and iii) individual projects and products within the agri-food sector. The ABD Index has been developed & designed in consultation with a variety of stakeholders including representatives of national governments, agri-food corporations, NGOs, and investors.²⁰ The ABD Index will inform, guide, and positively influence immediate end users, and will also inform and

¹⁹ Across diversity in: 1) markets & consumption, 2) production, and 3) genetic resources base

²⁰ Bioversity International 2017. Mainstreaming Agrobiodiversity in Sustainable Food Systems: Scientific Foundations for an Agrobiodiversity Index. Bioversity International, Rome, Italy.

guide investors in the areas of sustainable consumption, production and conservation of agricultural biodiversity. By moving the dial in these areas, the intent is to influence the way that food is produced, conserved, and consumed.

Objectives

Currently, there is no consistent and holistic way for governments, corporations and investors to **assess agrobiodiversity across food systems**, or **track changes in both food production and consumption**. Such knowledge gaps also extend to measuring how agrobiodiversity is delivering progress to meet multiple interconnected global targets including the Sustainable Development Goals (e.g. SDG1, SDG2, SDG12, SDG15) and Aichi Targets of the Convention on Biological Diversity (e.g. Target #13).

Bioversity International's ABD Index is a consistent, long-term monitoring tool to measure and manage agrobiodiversity across three pillars: consumption, production and genetic resource base. It allows: 1) policy makers to take informed decisions on how to promote diverse and sustainable food systems; 2) private decision-makers – agri-food investors and corporations, farmers and consumers – to ensure that food systems are more diverse, resilient and sustainable, and 3) evidence-based consumer communication.

For more information, please visit: <https://www.bioversityinternational.org/abd-index/>

Deliverables

The ABD Index will deliver a range of outputs, including:

- Composite scores for each pillar of the ABD Index (consumption, production, genetic resources base)
- Composite scores for each level, namely commitment (to agrobiodiversity use and conservation), actions (in relation to agrobiodiversity management), status (of various aspects of agrobiodiversity)
- Scores for each individual indicator across domains/pillars and elements of the ABD Index

These will all be presented as incrementally updated scorecards and periodic reports.

Method

A range of indicators are to be included in the ABD Index. Several of these relate specifically to impacts on land use, dietary diversity and multiple aspects of biodiversity distribution, conservation and use, including:

- Multiple measures of the status of agricultural biodiversity e.g. species richness and/or diversity of crops from national and company statistics
- Land use and land use change, and how this relates to specific elements of biodiversity, and, in turn, ecosystem services. For example, we will use land use and pollinator habitat extent remote-sensed data, link this to the PREDICTS modelling work on pollinator abundance and diversity conducted by the Natural History Museum, and ultimately use this to estimate pollination ecosystem service provision for specific locations where production is located.
- Management actions undertaken in production systems, for example conservation tillage, climate-smart agriculture, intercropping, and rotations. While there are some national

statistics around particular agricultural management actions and uptake, this may be most suitable where fine scale data are available, such as for individual projects and products within companies.

Among the indicators identified for the ABD Index, not all will be included in the first functional version. Furthermore, to arrive to an operational version within an accelerated timeframe, secondary source data will be used to the extent feasible.²¹ The following diagram illustrates the indicators currently used. The colour scheme used in this schematic represents the availability and global coverage of data for each indicator (and hence its feasibility of application in the immediate term). Green = relatively available and consistent, with good coverage; yellow = some data availability, but needs considerable work to render into useable form for the ABD Index; red = data highly scattered and/or inconsistent, or simply not available yet in a useable form. This latter category represents priorities for future research, data development and synthesis.

Category	Indicator	Markets & Consumption	Production	Genetic resources	Source
Status	Species diversity	↓	↓	↓	Public and private datasets, evidence-base modelling, remote sensing, crowdsourcing
	Varietal diversity	↓	↓	↓	
	Functional diversity	↓	↓	↓	
	Underutilized/local species	↓	↓	↓	
	Soil biodiversity		↓		
	Pollinator biodiversity		↓		
	Landscape connectivity		↓		
	Areas under farm varieties			↓	
	Crop wild relatives index			↓	
Enrichment index			↓		
Actions	Practices	↓	↓	↓	Reports
	R&D	↓	↓	↓	
	Capacity building	↓	↓	↓	
	Marketing	↓	↓	↓	
Commitment	Strategies	↓	↓	↓	Policies, strategies, declaration
	Policies	↓	↓	↓	
	Declaration	↓	↓	↓	
	Guidelines	↓	↓	↓	

Status

The ABD Index has been published in a first version in June 2018. This version will be refined, revised and scaled in increments in a cycle of continuous development and improvement.

3.5 Biodiversity Performance Tool (Solagro)

The background of the Biodiversity Performance Tool (BPT) provides the EU Life Project “Biodiversity in Standards and labels for the Food Sector” (See chapter 2.2). The BPT is being developed by the French Non-for-profit organisation Solagro who already developed and successfully implements Dialecte, a comprehensive and rapid tool to assess the environmental performance of farms. The BPT aims at supporting informed decision making on biodiversity management at farm level and implementation of effective biodiversity criteria from standards, labels and companies in the food industry.

²¹ Future versions may include primary data

Objective

Solagro conducted a screening exercise of 20 existing tools that have a relation to biodiversity. While these set of tools show meaningful approaches, many of them are limited to quantity aspects or have a limited informative value on biodiversity due to a fragmentary set of associated parameters. Especially the quality aspect, which relates to ecological structures, is lacking.

The BPT is characterised by an independent biodiversity module compatible with existing tools, transparent in the compilation of the calculations, web-based and free, targeted to advisors with their farmers but also to certifiers. The objective of the BPT is to be able to assess biodiversity management on a farm by revealing risks and opportunities to reduce negative impacts and to create more potential for biodiversity within the farming system and its adjacent landscape. The output of the BPT, which describes the current biodiversity performance of a farm both in quantity and quality aspects at a certain point in time, forms the basis for an informed decision making which is appropriate to translate into an individual Biodiversity Action Plan.

The BPT is designed to be suitable for European agro-climatic zones and for all systems of production (arable crops, livestock farming system, vegetables and permanent crops, mixed farms) – with the exception of aquaculture.

Method

The BPT assesses the current biodiversity performance of a (certified) farm based on an online questionnaire.

Within the BPT, all input parameters are organized hierarchically so that those at higher levels of the hierarchy depend on those at lower levels. It thereby aggregates farm data from the basic attribute level (e.g. diversity of production, preservation of ecological infrastructures, composition of ecological infrastructures, grazing intensity, soil fertility etc.) to higher aggregated layers (e.g. pesticide management, management of Semi-natural habitats, livestock management, etc.) which are then summarized into three top layers:

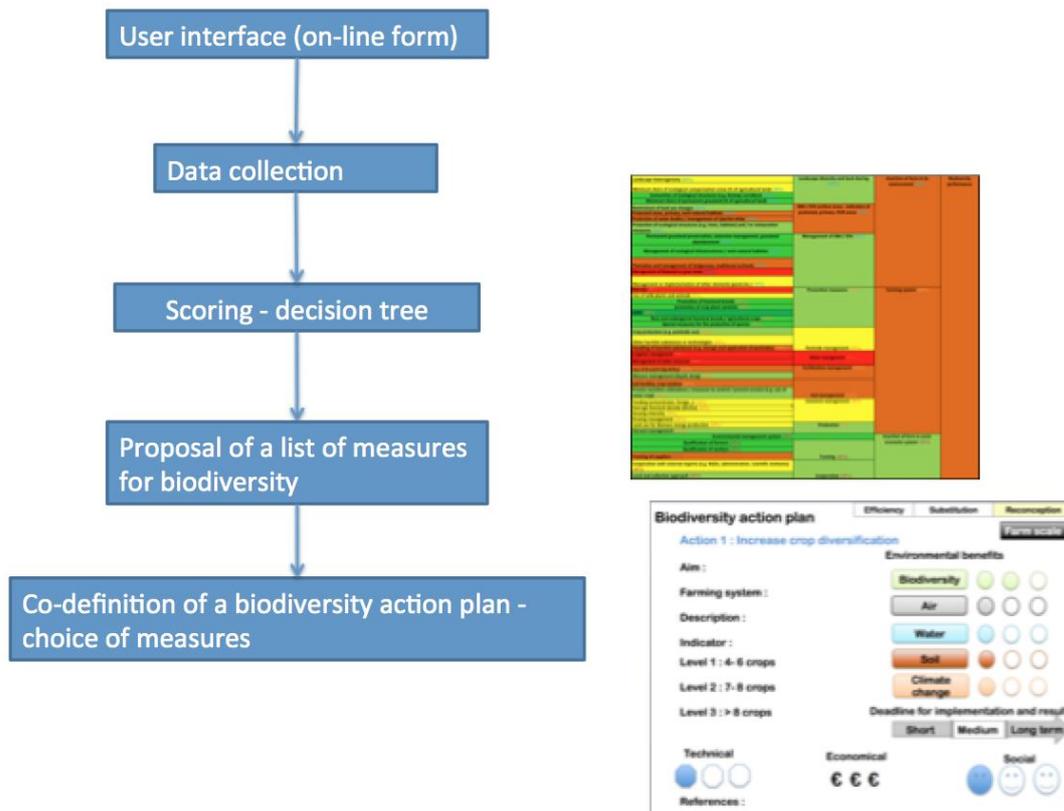
- Insertion of the farm in its environment (landscape, semi-natural habitats)
- Farming system
- Insertion of the farm in its socio-economic system

The advantage of this approach is the possibility to break a decisional problem (e.g. Type of chemical pesticides used) down into smaller, less complex subproblems represented by variables or attributes (e.g. herbicide, fungicide, insecticide, other).

Each basic attribute thereby has a range of threshold values. The actual attribute value thereby determines the allocated category marked by a colour code from red to green, indicating basic (low score), essential (medium score) or advanced (high score) performance for each basic attribute. A decision-tree with weighting coefficients for all input criteria defines then the scoring and aggregates the basic criteria, into the upper hierarchical categories. Starting from the individual input

criteria, there are five levels of hierarchical aggregation including the continuous weighting coefficient system, on each level, resulting in the final biodiversity performance score of a farm.

The described concept above is designed in a web-based user interface as a step-by-step and clear questionnaire with all the calculations running in the backend of the BPT module.



Biodiversity Performance Tool: The Multi- criteria decision tree approach.

Deliverables

The BPT calculates a farm’s biodiversity performance that is based on a comprehensive set of agro-environmental and socio-economic attributes to help certified farmers to develop a **Biodiversity Action Plan** in **short, medium and long term**. Furthermore, the BPT output supports certifiers to verify if standard criteria related to biodiversity have been implemented with a good quality. Thirdly the BPT contributes to overall biodiversity monitoring over time by providing data time series enabling a continuous improvement process.

Status

In the first quarter of 2018, the BETA Version of the BPT will be available and approved and then tested on about 50 pilot farms in Germany, France, Spain and Portugal. The final version will be available for free in early 2019.

3.6 The Restoration Opportunities Optimization Tool (ROOT)

The Restoration Opportunities Optimization Tool (ROOT) is a spatially explicit decision-support tool that helps those with the rights to manage land optimize their management of- and investments in restoration of landscapes for the provision of ecosystem services for identified beneficiary groups or outcomes. ROOT permits multiple ecosystem services to be considered within one analysis and to optimize the trade-offs that exist in the generation of ecosystem services from landscape management or restoration scenarios or strategies.

Objective

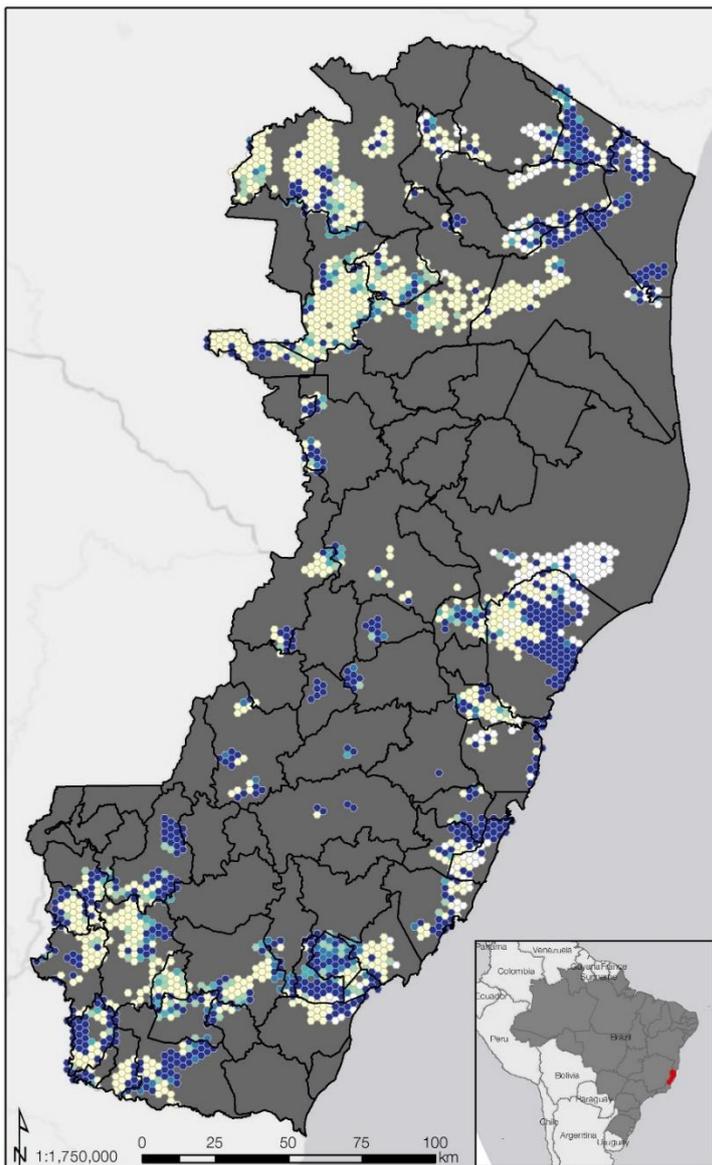
ROOT was designed to support both high-level decision-making and technical benchmarks surrounding the restoration of landscapes to support increased ecological productivity and to enhance human livelihoods. Its use has primarily focused on applications within the Restoration Opportunities Assessment Methodology (ROAM) (IUCN and WRI 2014) which provides a flexible and affordable framework for countries to rapidly identify and analyse areas that are primed for forest landscape restoration (FLR) and to identify specific priority areas at a national or sub-national level. Forest landscape restoration assessments are complete for dozens of countries at both national and subnational levels. Though, currently applied in restoration scenarios, ROOT is agnostic to data inputs and could easily optimize areas based on investment or opportunity cost, or any other spatial consideration and/or estimated economic, social, or biophysical trade-off.

Method

Designed in partnership with The Natural Capital Project, ROOT utilizes an integrated linear optimization algorithm to model trade-offs in the provision of multiple ecosystem services weighed by their quantified delivery to specific beneficiary groups. The model utilises changes in the provision of an ecosystem service that result from the proposed restoration strategy and then spatially optimizes the benefits of this scenario for multiple ecosystem services combined with the magnitude of benefits to people. Additionally, beneficiary weights within the optimization are randomized based on a multivariate normal distribution within many iterations of the scenario to provide confidence in the identification of optimal areas.

Deliverables

The outputs of ROOT include data tables on the provision of ecosystem services that can be used to provide estimates of specific ecosystem services provision for areas of interest. It also includes an “agreement map” which demonstrates the frequency with which the model agrees that an area is an optimal spot for restoration to both improve the biophysical provision of ecosystem services and the socio-economic beneficiary components (such as reduction in reliance on unsustainable natural resource use, projected impacts on disadvantaged or marginalized groups, or areas prone to the impacts of climate change or disasters, for example). ROOT can also provide decision-makers with intelligence on where payments for environmental services (PES) schemes could be implemented to improve the ecosystem services of choice in areas where those most impacted by environmental changes may live, as in the case of Espirito Santo state below where extensive drought had significant impacts on rural farmers:



**Restoration Opportunity
Optimization of
Ecosystem Services for
Landscape Restoration**

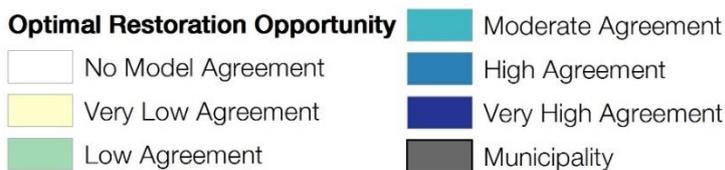
**ESPIRITO SANTO STATE
BRAZIL**

**Ecosystem Services:
Sediment Retention
Water Yield**

**Beneficiaries:
Priority Watersheds
Low Income**

This map shows where investments in restoration could be made where the gains in multiple ecosystem services would be optimized throughout 80,000 hectares of potential opportunity area in Espirito Santo State, Brazil. These opportunity areas were identified as a part of the statewide forest landscape restoration assessment using the Restoration Opportunities Assessment Methodology (ROAM)(IUCN and WRI, 2014) and meet Espirito Santo's commitment to the Bonn Challenge.

Areas identified in dark blue indicate a high agreement among 50 unique iterations of the optimization model. They indicate that restoration in these areas will have optimal benefits for achieving benefits in both sediment retention and water yield while also considering the optimal locations for restoration where these services may positively impact priority watersheds and in municipalities where incomes are lowest. Hexagons are 1000 hectares large.



Prepared by Craig R. Beatty, International Union for Conservation of Nature (IUCN) August 2017. Data Provided by State of Espirito Santo, World Resource Institute Brazil, and IUCN Brazil. Model prepared using the Restoration Opportunity Optimization Tool (ROOT) co-developed by IUCN and University of Minnesota Natural Capital Project. Projection: WGS 1984 UTM 24S.

Status

ROOT was released by The Natural Capital Project in September 2017 on its website <https://www.naturalcapitalproject.org/root/> and continues to receive operational and technical support. Current applications of ROOT include at the State of Espirito Santo in Brazil, at the municipality level in six urban areas in Colombia, and national-scale applications in Myanmar, Malawi, and Costa Rica (IUCN 2018) Additionally, ROOT is emerging as a key new tool in forest landscape restoration assessments (Chazdon and Guariguata 2018) and will also be added to the Natural Capital Protocol Toolkit. Several additional publications are currently in review and will be released in 2018.

Additional Information/Resources

Chazdon, R.L. and M.R. Guariguata. 2018. Decision Support Tools for Forest Landscape Restoration: Current Status and Future Outlook. Occasional Paper 183. Bogor, Indonesia: CIFOR.

Taking ROOT: The Launch of a New Restoration Tool. 2017.
<https://www.iucn.org/news/forests/201709/taking-root-launch-new-restoration-tool>

www.naturalcapitalproject.org/root

Gourevitch, J.D., Hawthorne, P.L., Keeler, B.L., Beatty, C.R., Greve, M., Verdone, M.A., 2016. Optimizing investments in national-scale forest landscape restoration in Uganda to maximize multiple benefits. Environ. Res. Lett. 11, 114027. doi:10.1088/1748-9326/11/11/114027

III. Analytical Mapping of key initiatives

We developed an analytical mapping of key initiatives to help businesses and policy-makers to find the right tools to measure the impact of human activities on biodiversity. We do not aim at prescribing specific tools, approaches or methodologies to users, but to consolidate and map available initiatives.

6 criteria are used to guide users among initiatives:

- **Evaluation scales:** at what scale would you like to carry out an assessment?
- **Objectives of assessment:** what are the objectives you pursue?
- **Key features:** what outputs would best support your decision-making?
- **Biodiversity scope:** which kind of biodiversity would you like to assess?
- **Type of valuation:** what would you like to evaluate as “impacts” on biodiversity? Is it human pressures, biodiversity states and/or human responses (actions taken to improve biodiversity state)?
- **Scope of pressures:** would you like to assess one specific type of human activities pressure on biodiversity or several? And which one?

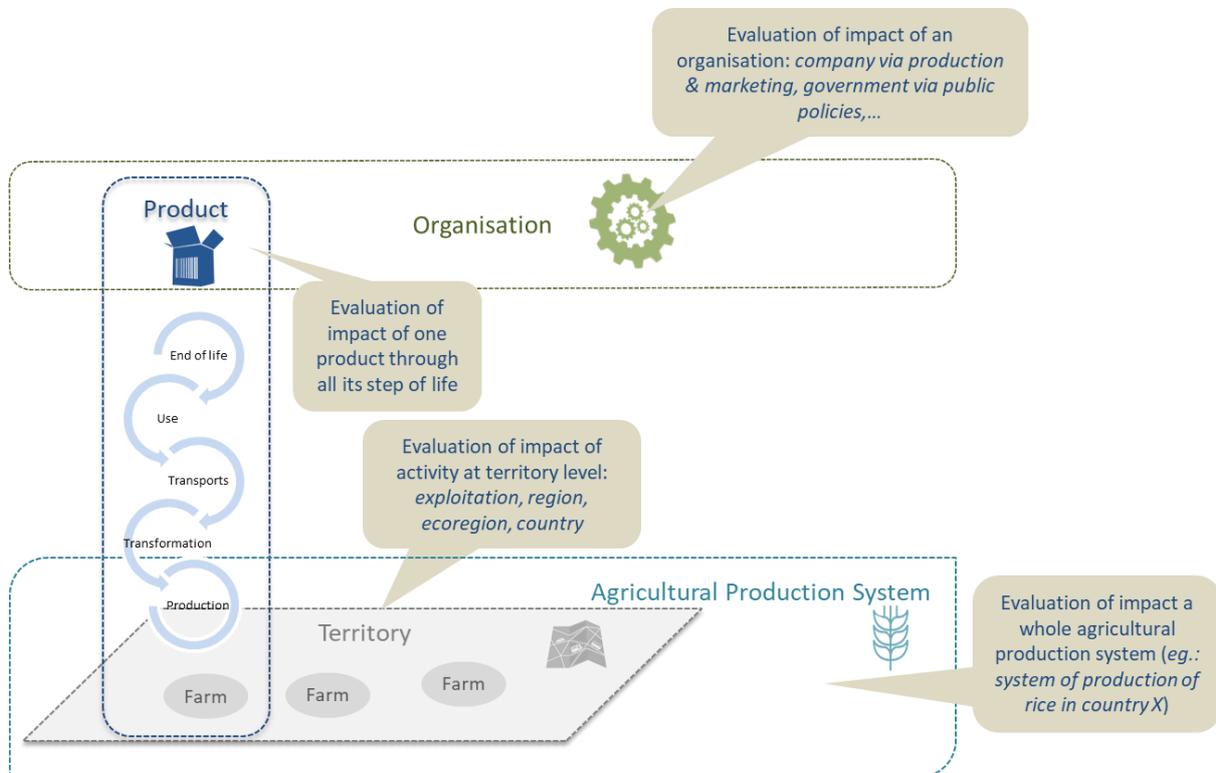
Those criteria were chosen both to be accurate to compare the key initiatives and to be consistent with existing platforms already comparing tools, like the Natural Capital Protocol Toolkit²² or the Eco4Biz guidance²³.

²² <https://www.naturalcapitaltoolkit.org/>

²³ WBCSD 2013, Ecosystem services and biodiversity tools to support decision-making.

1. Evaluation scales

1.1 Definitions



The initiatives reviewed focus on four different scales:

- **Product:** these initiatives aim to evaluate the impact of object or services created as a result of a fabrication, manufacturing, or production process. Those approaches are mainly based on life-cycle assessment (LCA), a technique to assess environmental impacts associated with all the stages of a product's life from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling. Designers use this process to help compare products alternatives. LCAs can help avoid looking at environmental concerns only within factory gates.
- **Territory:** these initiatives provide area specific information on the supply or value of biodiversity, as well as local assessments (e.g. a site and its surrounding area). This includes landscape approaches.
- **Agricultural production system:** these initiatives evaluate the impacts of an assemblage of components which are united by some form of interaction and interdependence and which operate within a prescribed boundary to achieve a specified agricultural objective on behalf of the beneficiaries of the system. They may include the agricultural practices, the agricultural phase of production of one or several products and an evaluation at the territory level.
- **Organisation:** these initiatives provide information in relations to all operations or some operations of a company, a government, an NGO, etc. They may include supply chain or public policies analysis.

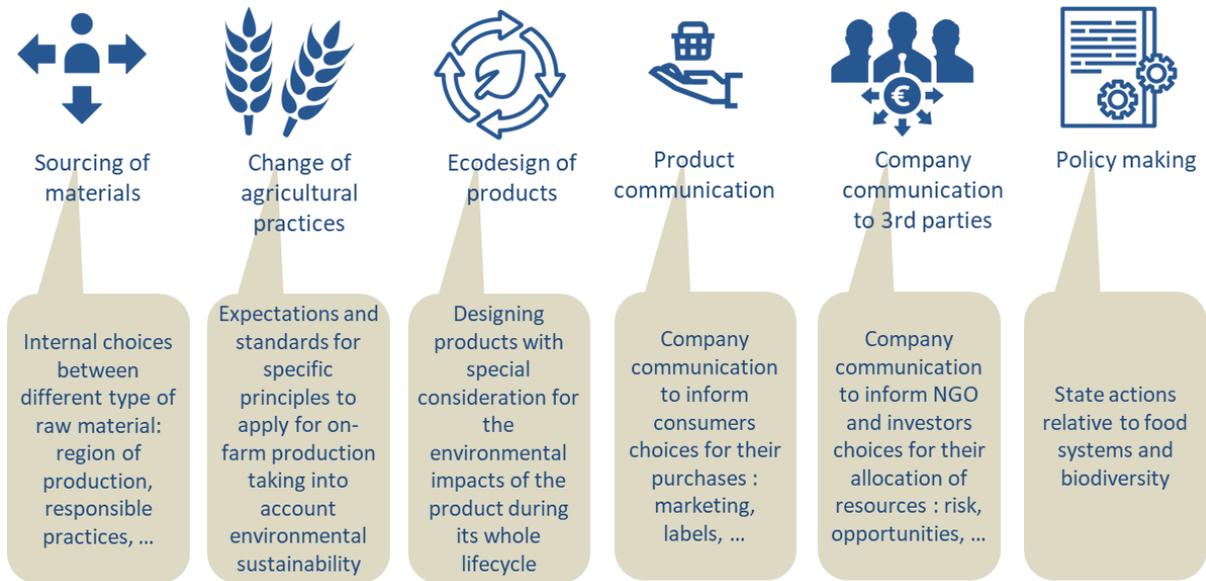
1.2 Analysis of initiatives

	 Territory	 Agricultural production system	 Product	 Organisation
IBAT 	<input checked="" type="checkbox"/>			
Models 	<input checked="" type="checkbox"/>			
Biodiversity in Standards and labels 	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>
Land Use Impacts on Biodiversity in LCIA 	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
Biodiversity in Forest Restoration Assessment 	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>
LC-METHOD method 	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Product Biodiversity Footprint 	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
Biodiversity Impact Metric 	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Biodiversity Performance Tool 	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Agrobiodiversity Index 	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
ROOT 	<input checked="" type="checkbox"/>			

- All initiatives are based initially on a territory scale but 7 of them are also applicable for the evaluation of **3 different scales**: agricultural production system, product and organisation.
- Land Use Impacts on Biodiversity in LCA, Potential species loss from land and water use, Product Biodiversity Footprint are **3 variations around Life Cycle Assessment**: guidelines, scientific research, and operational tool.
- Biodiversity in Standards and Labels, Biodiversity Impact Metric and Agrobiodiversity index focus on organisation and production system level.

2. Type of decisions

2.1 Definitions



Biodiversity metrics aim to be useful to decision-making, from the company to the citizen. From a decision-maker perspective (private or public), we have identified six main objectives for the biodiversity metrics

- Internal business decision-making
 - o Sourcing of materials
 - o Change of agricultural practices at farm level
 - o Eco-design of products
- Business external communication
 - o Product communication for customers
 - o Company communication to 3rd parties (NGOs and investors)
- Policy making

2.2 Analysis of initiatives

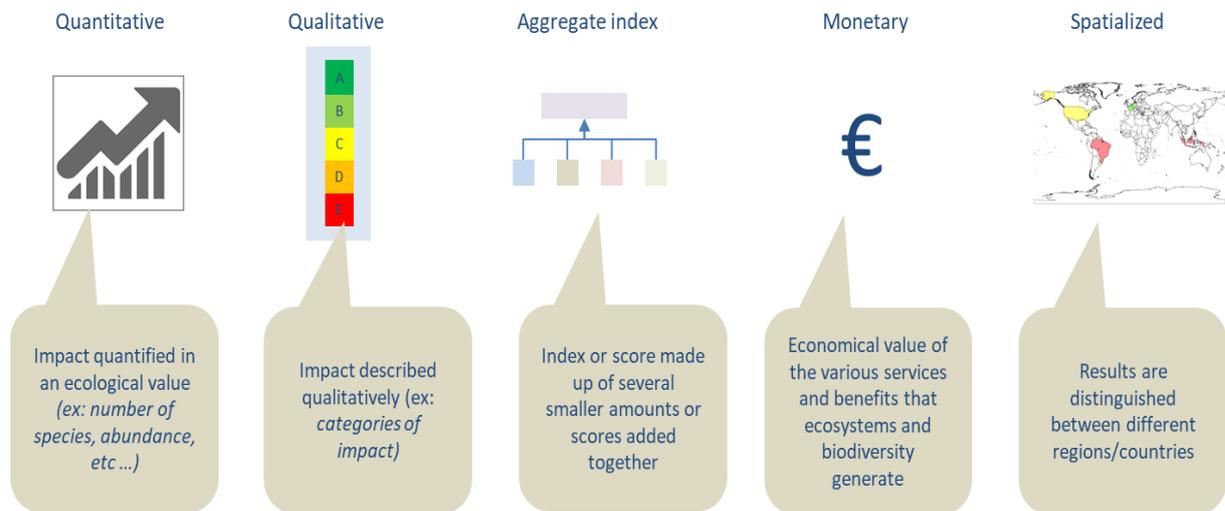
	 Sourcing of materials	 Change of agricultural practices	 Ecodesign of products	 Product communication	 Company communication to 3 rd parties	 Policy making
current planned						
IBAT 	✓				✓	✓
Models  						✓
Biodiversity in Standards and labels 		✓		✓	✓	✓
Land Use Impacts on Biodiversity in LCIA 	✓		✓	✓		
Biodiversity in Forest Restoration Assessment 		✓				✓
LC-METHOD method 	✓		✓			
Product Biodiversity Footprint 	✓	✓	✓	✓		
Biodiversity Impact Metric 	✓	✓			✓	
Biodiversity Performance Tool 		✓		✓		
Agrobiodiversity Index 	✓	✓		✓	✓	✓
ROOT 		✓				✓

➤ Reviewed Initiatives fulfil different objectives.

- Whereas some initiatives cover many different objectives, some are more focused on specific objectives
- **Sourcing of materials** is one of the objectives that most initiatives pursue, as biodiversity impacts of a given commodity vary significantly from one geography to another
- **Change of agricultural practices** needs tools that are precise enough to distinguish practices: this can be achieved at farm level (eg.: Solagro tool) or by assessing practices of suppliers (eg.: CISL or PBF)
- **Eco-design of products** needs a LCA approach: this is mainly achieved through the initiatives at product scale (UNEP SETAC, LCA Impact, PBF)
- **Product communication to consumers** needs labels or evaluation at product scale, some of the initiatives needing still more development to fully ensure the necessary robustness of product communication
- **Company communication to 3rd parties** can rely either on specific biodiversity information on activities (through UICN data toolkit for example) or on a global biodiversity assessment of the company itself, which is a goal not yet fully achieved at this stage
- **Policy making** relies mostly on foundational biodiversity data & tools, as well as guidelines initiatives

3. Key features

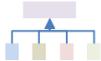
3.1 Definitions



5 types of key features were distinguished, depending on the main output of each initiative:

- **Quantitative output:** these initiatives determine quantitative indicators to evaluate the impact of activities on biodiversity.
- **Qualitative output:** these initiatives describe specific qualitative criteria to assess the impact on biodiversity, by example the intensity level of farming practices, the management plans to reduce impacts, etc.
- **Aggregate index:** these initiatives develop specific methodologies to aggregate different indicators together, in order to assess all impacts with one or a small number of indicators.
- **Monetary:** these initiatives develop specific methodologies to convert the impact on biodiversity in economic value.
- **Spatialized:** the initiatives develop methodologies taking into consideration that different localisation of activities may have different impact on biodiversity.

3.2 Analysis of initiatives

	 Quantitative	 Qualitative	 Aggregate Index	 Monetary	 Spatialized
current planned					
IBAT 	✓	✓			✓
Models 	✓		✓		✓
Biodiversity in Standards and labels 	✓	✓			
Land Use Impacts on Biodiversity in LCIA 	✓				✓
Biodiversity in Forest Restoration Assessment 		✓			✓
LC-METHOD method 	✓	✓			✓
Product Biodiversity Footprint 	✓	✓	✓		✓
Biodiversity Impact Metric 	✓	✓	✓		✓
Biodiversity Performance Tool 	✓	✓	✓		✓
Agrobiodiversity Index 	✓	✓	✓		
ROOT 	✓	✓	✓		✓

- All initiatives determine **quantitative results**, and almost all of them **qualitative results too**.
- Only Product Biodiversity Footprint, Biodiversity Performance Tool, Agrobiodiversity Index and ROOT are **aggregated index**, made up of scores or amounts added together.
- **9 initiatives are spatialized**, distinguishing different values of impact between different regions or countries: the 3 life cycle assessment initiatives, IBAT, Predicts and Globio models, Biodiversity Impact Metric, ROOT and Biodiversity in Forest Landscape Restoration Assessment.
- None of these tools define direct economic value of impacts on biodiversity.

4. Biodiversity scope

4.1 Definitions

Genetics



The variation in the amount of genetic information within and among individuals of a population, a species, an assemblage, or a community.

Species



Biodiversity at the species level, often combining aspects of species richness, their relative abundance, and their dissimilarity.

Habitats



Habitat means the place or type of site where an organism or population naturally occurs.

Ecosystem services



Benefits Human obtain from ecosystems. These include provisioning services; regulating services; supporting services; and cultural services and other non-material benefits.

The Convention on Biological Diversity defines biodiversity²⁴ as: *“the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems”*. To map initiatives, we used those three scopes for biodiversity: **genetics, species and habitat**. We consider here that habitat has the same meaning than “ecosystem”.

In addition to those intrinsic values of biodiversity, we added a fourth category: initiatives that measure **ecosystem services**, since biodiversity also underpins ecosystem function and the provision of ecosystem services.

²⁴ Convention on Biological Diversity (1992) Convention on Biological Diversity. Secretariat of the Convention on Biological Diversity, Montreal, Canada

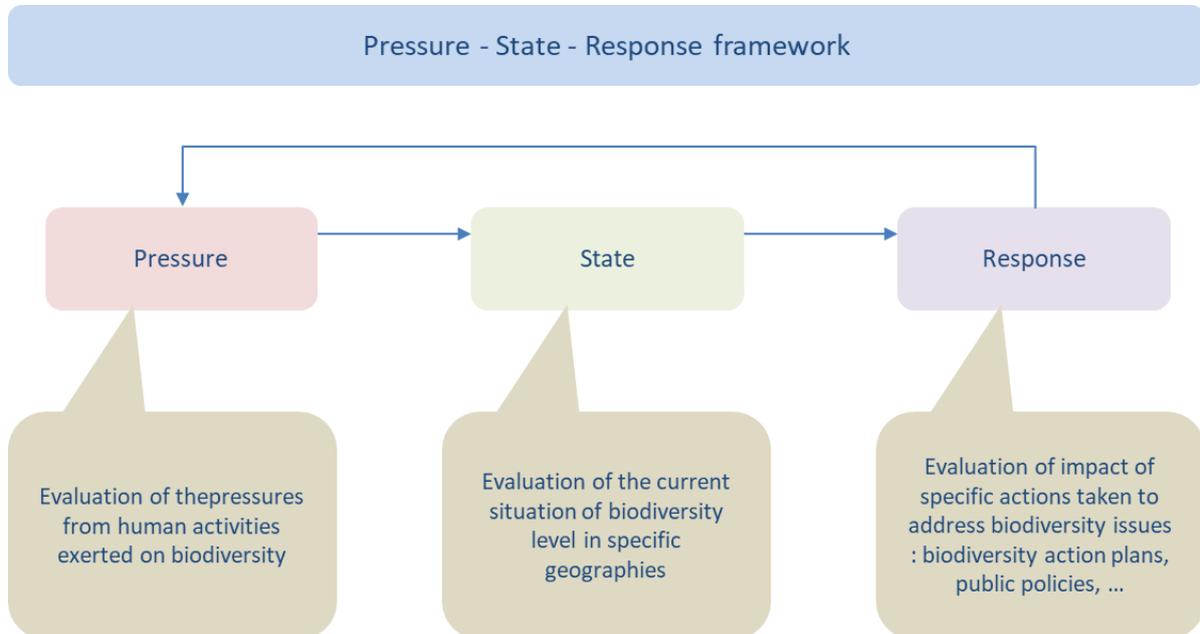
4.2 Analysis of initiatives

	 Genetics	 Species	 Habitats	 Ecosystem services
IBAT 		✓	✓	
Models  		✓		
Biodiversity in Standards and labels 		✓	✓	
Land Use Impacts on Biodiversity in LCIA 		✓		
Biodiversity in Forest Restoration Assessment 				✓
LC-METHOD method 		✓		
Product Biodiversity Footprint 		✓		
Biodiversity Impact Metric 		✓	✓	
Biodiversity Performance Tool 		✓	✓	
Agrobiodiversity Index 	✓	✓	✓	
ROOT 				✓

- All initiatives focus on species level, among them, **5 five initiatives also define results on habitat level.**
- Biodiversity Performance Tool and Agrobiodiversity Index have a **mixed approach: genetics, species and habitat.**
 - None of these tools evaluates ecosystem services, except ROOT from IUCN, which analyses and optimizes the trade-offs that exist in the generation of ecosystem services. Ecosystem service evaluations are generally based on approaches really different from species evaluations as in most of the initiatives described here, focusing on pollinator, soil quality, water, etc...
- Excepted IUCN data and Globio model, those initiatives included do not assess marine or freshwater biodiversity.

5. Type of valuation

5.1 Definitions



The Pressure-state-response (PSR) framework links pressures on the environment as a result of human activities, with changes in the state (condition) of the environment (land, air, water, etc.). Society then responds to these changes by instituting environmental and economic programmes and policies, to reduce or mitigate the pressures or repair the natural resource (OECD, 1993). This framework has been adopted by many OECD countries, by the World Bank for environmental reporting and by many scientific research programs on environmental issues. In the context of this analysis, state metrics are provided by “foundational biodiversity data and tools”, whereas “decision support tools” mostly provide pressure metrics, as well as response metrics when trying to assess the benefits of reducing the pressure.

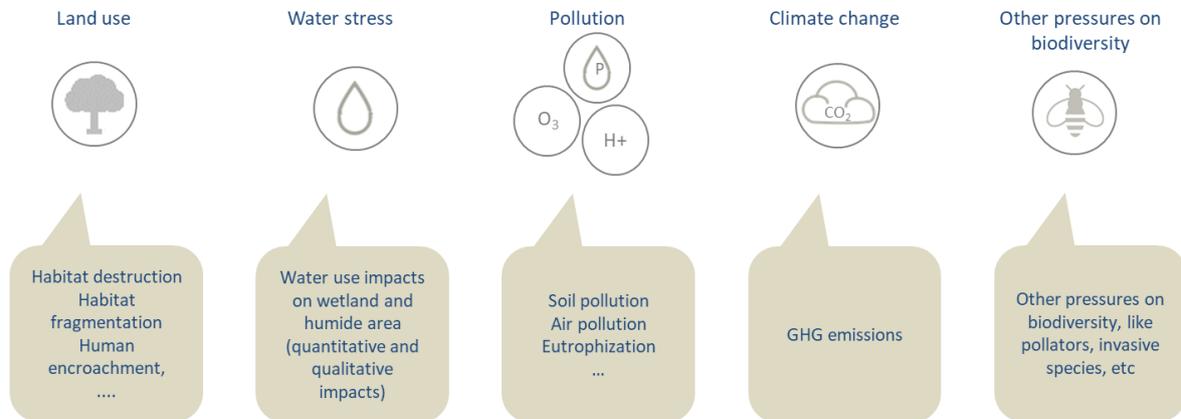
5.2 . Analysis of initiatives

	Pressure	State	Response
IBAT 		✓	
Models 	✓	✓	
Biodiversity in Standards and labels 	✓		✓
Land Use Impacts on Biodiversity in LCIA 	✓		
Biodiversity in Forest Restoration Assessment 		✓	✓
LC-METHOD method 	✓		
Product Biodiversity Footprint 	✓		✓
Biodiversity Impact Metric 	✓		✓
Biodiversity Performance Tool 	✓	✓	✓
Agrobiodiversity Index 	✓	✓	✓
ROOT 			✓

- IBAT describes state of biodiversity: the current situation of biodiversity. This data is used by other initiatives to evaluate the impact of human activities on biodiversity (pressure on biodiversity).
- Biodiversity in Standards and Label and Product Biodiversity Footprint evaluate pressures of human activities but also the actions taken to address those pressures.
- Agrobiodiversity index and Biodiversity Performance Tool aim at evaluating the full design pressure, state and response.

6. Scope of pressures

6.1 Definitions



According to the Millenium Ecosystem Assessment (2005)²⁵, the most important direct drivers of biodiversity loss and change in ecosystem services are habitat change—such as land use change, physical modification of rivers or water withdrawal from rivers, loss of coral reefs, and damage to sea floors due to trawling—, climate change, invasive alien species, overexploitation of species, and pollution. For all these drivers, and for most ecosystems where they have been important, the impact of the driver currently remains constant or is growing.

To take into consideration the specific pressures described by the initiatives, we divided the Millenium Ecosystem Assessment framework into five slightly different categories: **land use**, **water stress**, **pollution**, **climate change** and a mix category with **other pressures** (the ones only used by one or two initiatives).

²⁵ <https://www.millenniumassessment.org/documents/document.354.aspx.pdf>

6.2 Analysis of initiatives

	<div style="border: 1px solid green; padding: 2px;">current</div> <div style="border: 2px dashed blue; padding: 2px;">planned</div>	 Land use	 Water stress	 Pollution	 Climate change	 Other pressures
IBAT 		✓	✓	✓	✓	✓
Models  		✓		✓	✓	✓
Biodiversity in Standards and labels 		✓				✓
Land Use Impacts on Biodiversity in LCIA 		✓				
Biodiversity in Forest Restoration Assessment 		✓	✓		✓	✓
LC-METHOD method 		✓	✓	✓	✓	
Product Biodiversity Footprint 		✓	✓	✓	✓	✓
Biodiversity Impact Metric 		✓	✓			
Biodiversity Performance Tool 		✓	✓	✓	✓	✓
Agrobiodiversity Index 		✓				✓
ROOT 		✓	✓	✓	✓	✓

- All initiative address land use pressure. Land use is one of the most important pressures on biodiversity and frequently measured considering area metrics (by example area directly impacted by human activity: crops, deforestation, etc.).
- Only Product Biodiversity Footprint and ROOT assess the five-main pressure on biodiversity described by the Millennium Ecosystem Assessment (2005), which is an internationally recognised framework.
- Depending on initiatives, other pressures are sometimes assessed: fragmentation, pollinator, invasive species, overexploitation, etc..

III. Case study compilation

To illustrate the way the above biodiversity assessment approaches are applied in practice, we are compiling a list of case studies that have been performed based on the methods described above. At the publication of the current report, this list is still very short, given that most methods are still in the process of being developed. Therefore, the list is made available online and will be updated in the coming months, as the methods are tested on more case studies.

The collection of case studies can be accessed on the project website of the One Planet Program on Sustainable Food Systems. The collection is based on two different files:

- an Excel Table which can be filtered and sorted to find case studies based on specific criteria
- a PowerPoint slide deck with a somewhat longer description of each case study

IV. Outlook & Next Steps

The current report describes methods to assess biodiversity. The mapping of the methods shows that the different methods are partly based on the same input data, and often use similar approaches (e.g. most assess biodiversity at least at the species level). Yet, there are differences between the methods also, for instance with regards to the intended use of the results. This shows that there is both, a merit in continuing the development of several methods (to answer the needs of different stakeholders), and an opportunity to align in the development of some underlying data and methodological choices.

The next step in working on biodiversity assessments should be to make sure that the methods developed are applied in practical assessments - similar to other environmental impacts such as climate change or water scarcity. Currently, there is a perception that biodiversity is very complex and cannot reliably be assessed with a limited amount of effort.

To overcome this situation, the developers of biodiversity methods in this report have commonly developed a list of obstacles that prevent biodiversity methods to be used in a simplified context with limited amounts of resources. The following table gives an overview over the most important obstacles that need future development and rates the opportunity to advance on this aspect in a joint effort, as part of the Core Initiative on Biodiversity.

Obstacle	Description	Opportunity for common
Data availability	As compared to climate change or water scarcity, the availability of biodiversity data is still much lower. While land use data can generally be deducted from widely available yield data, information on land conversion is much more rarely available, in particular in emerging economies.	Low – we probably do not have the required competencies
Data on production practices	The biodiversity impact of different production practices is not very widely available, and often limited to different degrees of production intensity. The biodiversity impacts of specific actions on the ground (e.g. hedgerows) is rarely quantified.	Low – we probably do not have the required competencies
Data harmonization	Where data is available, it is often in “bits and pieces”, and the methodological equivalence of data from different sources is questionable. A conversion / alignment of data sources is missing.	Medium
Data format conversion	While raw data is often available, the application of biodiversity methods requires data to be available in a converted format that can readily be used. The conversion needs methodological as well as technical decisions which, if taken by individual researchers or consultants, might result in misalignments between studies performed by different teams.	High

The above list is not expected to be exhaustive, and other stakeholders might have different perspectives on required follow-up work on biodiversity. Therefore, we encourage interested stakeholders to reach out to the Biodiversity Core Initiative, and contribute to follow-up activities of the project team.

Annex: detailed analysis

1. Comparison of objectives

	Organism	Type of initiative		Target users		Evaluation scale			Type of decisions					Key features			Biodiversity scope					Type of valuation			Maturity level									
		Foundational biodiversity data & tools	Guidelines	Biodiversity decision support tools	Policy maker	Business	Territory	Agricultural production system	Product	Organization	Sourcing of material	Change of gricultural practices	Ecodesign	Product communication	Company to 3rd parties communication	Public Policy	Quantitative	Qualitative	Aggregate index	Monetary	Spatialized	Loss	Diversity	Genetics	Species	Habitats	Ecosysteme services	Pressure	State	Response	R&D Phase	Pilot phase	First deployment	Fully deployed
IBAT	IUCN	X			X	X	X			X				X	X	X	X				X	X			X	X			X					X
Predicts and Globio	2 consortiums	X			X		X								X	X		X			X	X					X	X				X		
Biodiversity Criteria in Standards and Labels	Lake Constance Foundation/ GNF		X		X		X		X		X		X	X	X	X	X				X	X			X	X			X		X	X		
Consensus indicator on land use biodiversity impacts	Life Cycle Initiative		X			X	X		X		X					X					X	X			X				X		X	X		
Biodiversity in Forest Landscape Restoration Assessments & ROAM	IUCN		X		X		X		X		X				X		X				X					X		X	X		X	X		

	Organism	Type of initiative			Target users		Evaluation scale			Type of decisions					Key features					Biodiversity scope					Type of valuation			Maturity level						
		Foundational biodiversity data & tools	Guidelines	Biodiversity decision support tools	Policy maker	Business	Territory	Agricultural production system	Product	Organization	Sourcing of material	Change of gricultural practices	Ecodesign	Product communication	Company to 3rd parties	Public Policy	Quantitative	Qualitative	Aggregate index	Monetary	Spatialized	Loss	Diversity	Genetics	Species	Habitats	Ecosysteme services	Pressure	State	Response	R&D Phase	Pilot phase	First deployment	Fully deployed
LC-IMPACT method	LC-IMPACT team			X	X	X	X	X		X		X				X	X				X	X					X				X	X	X	
Product Biodiversity Footprint	I Care & Consult/ Sayari			X		X		X		X	X	X	ne xt			X	X	X			X	X					X		X		X	X		
Biodiversity impact metric	CISL			X		X	X		X	X			ne xt		X	ne xt	ne xt			X	X			X	X		X		x	X	X			
Biodiversity performance tool	Solagro			X		X	X				X	X			X	X	X			X		X				X	X	X	X	X	X			
Agrobiodiversity index	Bioersity International			X	X	X	x	X		X	X	X	X	X	X	X	X	X				X	X	X	X		X	X	X	X	X			
ROOT	IUCN			X	X		X						X		X	X	X			X					X							X		

2. Comparison of methods

Initiative	Organism	Scope of pressures taken into account					Scale of analysis of biodiversity state			Zoom: Detailed Quantitative Biodiversity metrics (unit)				Level of precision for pressures			Level of details required by user		Level of expertise required for user	
		Land use	Water stress	Pollution	Climate change	Other pressures on biodiversity	Global	Regional	Local	Loss of species	Loss of Abundance	Diversity	Hectare	Detailed practices	Raw practices	Major land use types	Primary biodiversity data	Statistical biodiversity data	Standard	Expert
IBAT	IUCN	X	X	X	X	X	X	X	X	X		X				X	X	X	X	
Predicts and Globio	2 consortiums	X		X	X	X	X	X		X	X					X		X		X
Biodiversity Criteria in Standards and Labels for the Food Sector	Lake Constance Foundation/ GNF	X				X		X	X					X			X	X	X	
Consensus indicator on land use biodiversity impacts	Life Cycle Initiative	X					X	X		X	X					X		X		X
Biodiversity in Forest Landscape Restoration Assessments & ROAM	IUCN	X	X		X	X		X					X		X	X		X	X	
LC-IMPACT method	LC-IMPACT team	X	X	X	X		X	X		X						X		X		X
Product Biodiversity Footprint (PBF)	I Care & Consult/ Sayari	X	X	X	X	X	X	X		X				X			X	X		X
Biodiversity impact metric	Cambridge Institute of Sustainability Leadership	X					X	X					X		X			X	X	
Biodiversity performance tool	Solagro	X	X	X	X	X			X			X	X	X			X		X	
Agrobiodiversity index	Bioversity International	X				X	X	X	X			X		X				X		X
ROOT	IUCN	X	X	X	X	X			X				X		X	X		X	X	