POST BIODIVERSITY FRAMEWORK EU SUPPORT 2020

TOWARDS POST-2020 EXPERTISE ON #11

BIODIVERSITY FOOTPRINT: A KEY INSTRUMENT IN THE TRANSITION TO A GREEN ECONOMY

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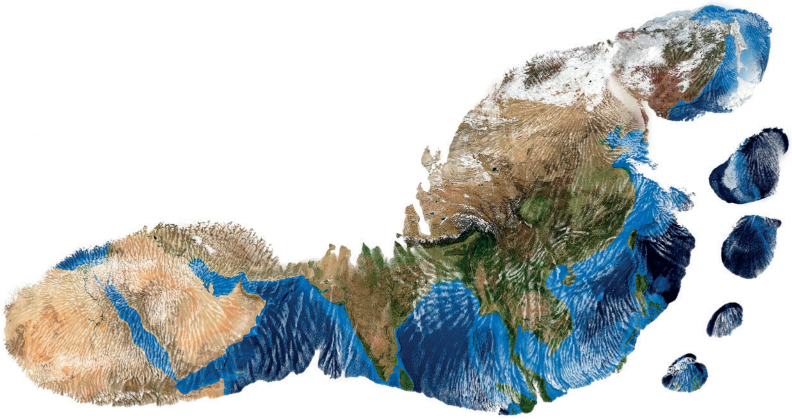

To guide the transition to a green economy, assessing all environmental impacts of products and activities is essential. Biodiversity impacts are difficult to incorporate and often omitted in the Life Cycle Analysis (LCA) framework. Integrating biodiversity indicators into it appears strategic for the transition towards a green economy.

"LIFE CYCLE ASSESSMENT IS A CRUCIAL PART OF THE TRANSITION TO A GREEN ECONOMY, AND THE PRIVILEGED METHOD FOR CALCULATION OF ENVIRONMENTAL IMPACTS."
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The environmental impacts of economic activities are beginning to threaten the foundations of human well-being, and a transition towards a green economy is now accepted to be indispensable. Life Cycle Assessment (LCA) has been developed over the past decades and could guide such a transition.
It consists of several impact category indicators, e.g. CO_2 equivalents, water consumption, cumulative energy demand, and toxic emissions. These provide a comprehensive cradle-to-grave accounting of energy and material use, emissions, and waste during manufacturing, operation, and decommissioning of a product. LCA can guide production pathways towards environmental impact reduction and can be aggregated into comprehensive natural capital accounting.
LCA works best with material influxes (e. g. energy, water, resources) and effluxes (e. g. waste, wastewater, greenhouse gases). Land conversion and accompanying biodiversity effects cannot be expressed in such terms and therefore are difficult to integrate. Land use for a particular product may have a multitude of biodiversity effects on many levels and scales, and complexity reduction is essential. Methods and metrics have been proposed, but to date, none of them appears sufficiently general. The metapopulation concept may be a tool to overcome these obstacles, supporting a universal model to assess the biodiversity impacts of production.

A night view of chemical factories in Yeosu Korea @PilMo Kang.

1. THE CASE AND CHALLENGES FOR ENVIRONMENTAL ACCOUNTING OF BIODIVERSITY

THE LIFE CYCLE ASSESSMENT ACCOUNTING FRAMEWORK

LCA is defined as the "compilation and evaluation of the inputs, outputs, and potential environmental impacts of a product system throughout its life cycle" [1]. Within a product chain, LCA can be used to identify areas with high environmental impact or inefficiencies to optimise the production pathway. Among competing products, it contributes to determining those with the lowest environmental impact. Among competing technologies, such as mobility with combustion engine versus electric propulsion, environmental benefits are compared against each other and gauged against higher production costs. The LCA methodology consists of four phases:
(1) Scoping defines the system boundaries.
(2) An inventory of inputs and outputs across the entire life cycle is compiled.
(3) The actual impact assessment is performed, including conversion of the results into equivalents of specific environmental impacts, e.g. CO_2 equivalents.
(4) Interpretations of the results, e.g. ranking of production alternatives and sensitivity analyses, are essential components of this final phase and operationalising the LCA outputs into the product chain.

A parallel approach to LCA is the emerging and expanding family of footprints, e. g. the carbon, water, or material footprint. Footprints have become more popular than the quite technical LCA approaches. However, the concepts of LCA and footprints are tightly linked. While for some environmental effects, the accounting methods differ, in many cases the discrepancies are merely terminological or a matter of perspective. For example, the carbon footprint is essentially identical to the single-indicator accounting of CO_2 equivalents in LCA methodology. As such, a specific footprint indicator could also be incorporated into a multi-indicator LCA model.
Even if LCA originally became famous for greenhouse gas (GHG) emission accounting, the methodology is by no means restricted to the quantification of climate change effects. Its wide scope needs to encompass a broad set of impact indicators. Omission of substantial environmental impacts (including those related to biodiversity loss) may lead to wrong and misleading conclusions. A product scoring well in one LCA impact category may nonetheless bring about detrimental effects in another category. By contrast, multi-indicator LCA (corresponding to the simultaneous consideration of many footprints) provides comprehensive information regarding the environmental risks associated with a product.

"IT IS ESSENTIAL THAT COMPANIES HAVE ACCESS TO CREDIBLE BIODIVERSITY MEASUREMENT METHODS AND METRICS."
Lammerant et al. (2019), Assessment of biodiversity measurement approaches for businesses and financial institutions. Update Report 2

CHALLENGES OF BIODIVERSITY INTEGRATION

Biodiversity depletion is one of the most troubling adverse environmental results of modern civilisation—rivalling or even surpassing climate change impacts. Consequently, omission of biodiversity effects from LCA calculations may lead to disastrous conclusions.

For example, if rainforests are cleared for biofuel production in view of fighting GHG emissions from energy consumption, the biodiversity loss effects may already outweigh any potential carbon reduction benefit from alternative fuels. On the other hand, integration of biodiversity into LCA is by no means straightforward, as:
+ **Biodiversity is multidimensional**: it can be measured at several organisational levels and on multiple scales. Crystallisation into a single, comparable metric is thus fraught with difficulties.
+ **Biodiversity usually cannot be expressed in additive inputs and outputs**, which are both the material for LCA impact indicator inventories or corresponding footprint calculations.

Biodiversity effects of production pathways are usually triggered by land use change. For example, a particular good may require a certain amount of agricultural area to be produced. At some point in time, this agricultural area had to be recruited by clearing original forest or some other kind

[1] Hellweg, S., Milà i Canals, L. (2014): Emerging approaches, challenges and opportunities in life cycle assessment. *Science*, 344: 1109–1113.

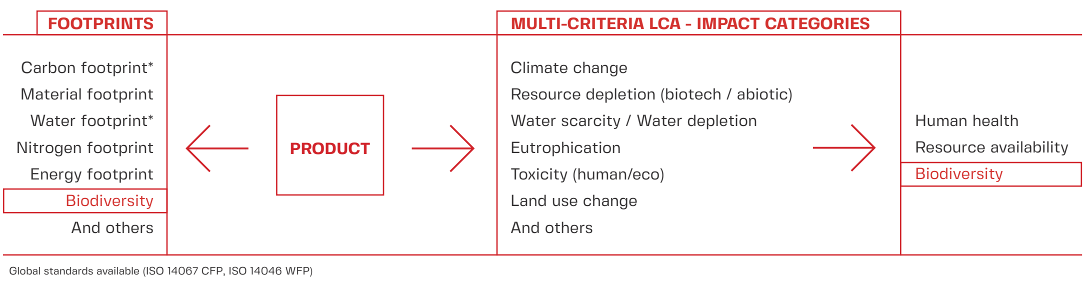

Figure 1:

The environmental impacts of a product can be quantified by multi-criteria LCA (right) or a set of footprints (left). For many impact categories, the approaches correspond closely. For example, the carbon footprint (left) and the LCA impact category "climate change" (right) are essentially identical.
Biodiversity impacts are usually triggered by land use changes, but other impact categories, such as climate change or eutrophication, might impinge on biodiversity as well. In contrast to other impact categories, biodiversity effects cannot be quantified by simply compiling inputs or outputs.

Man carries freshly harvested tea at the only tea plantation in Europe.

of natural biotope. Conversion of such type generates biodiversity impacts; e. g. populations of forest species disappear; species of arable land are fostered.

2. BIODIVERSITY METRICS

CURRENT METRICS, ALIGNMENT, AND UNIFICATION

The Convention of Biological Diversity [2] (CBD) defined biodiversity as a multilevel entity, encompassing variability from genes to ecosystems. Biodiversity integration in the LCA framework requires prior complexity reduction, just as for the carbon footprint, whose inputs are expressed as CO_2 equivalents. Several methods for such a complexity reduction have been proposed.

Early approaches have used plant alpha diversity as the biodiversity metric owing to the availability of global plant species richness data. The basic idea is to compare species richness in transformed versus regional-average plots.

More refined recent approaches have used a countryside species-area relationship [3] to gauge the impact of land use transformation, also taking the International Union for the Conservation of Nature (IUCN) Red List threat category of the species into account.

An alternative to the use of species metrics are abundance metrics, e.g. mean species abundance (MSA). MSA measures the mean abundance of original species relative to their abundance in undisturbed ecosystems. The concept is closely related to the WWF Living Planet Index [4], which monitors the abundance of vertebrates compared to the abundance in a reference year.

Other contributions have addressed the ecosystem dimension of biodiversity using quality indicators, e.g. based on scarcity, vulnerability, and biodiversity conditions of forest ecosystems.
All of these metrics are:
+ **Sometimes difficult and laborious to apply,**
+ **Limited by data availability**,
+ **Often constrained regarding geography**, **impact type, or ecosystem.**

Typically, they do not allow for global comparisons across ecosystems and impact types. At present, universal routine application of any of these metrics to evaluate production processes in a standardised protocol seems difficult.

A METAPOPULATION [5] APPROACH FOR A UNIFIED BIODIVERSITY METRIC

A universal biodiversity metric should meet several requirements: It should scale linearly with land use area, be applicable at all levels and spatial scales and for all types of land use impacts, and be aligned with currently accepted conservation targets, e.g. the protection of extinction-prone species. Since production chains—even for simple products—have become global, a biodiversity metric must be applicable in all geographical regions of the world.

The metapopulation concept could guide the way. The relationship between production, land use change, and the number of populations affected is linear, which is a prerequisite for accounting and does not require complicated transformations. The relation between population change and metapopulation survival probability can be quite complex, but approximations are available.

In effect, the IUCN Red List risk assessment for the categorisation of threatened species has used such approximations for decades, which have proven their advantages. All kind of impacts affecting populations within a metapopulation can be accommodated, and owing to the generality of the metapopulation concept, no limitations regarding ecosystem type, geographical region, or taxonomical group apply. Data requirements may be high, but they are met as long as global Red List assessments are available for the organism group in consideration.

An assessment framework based on metapopulation theory is in development at Environment Agency Austria. It consists of four steps:
+ **Assessing the probability** that a particular population of a species is affected by land use change required for a product.
+ **Assessing the population change** associated with the land use change.
+ **Assessing the change in metapopulation survival** probability due to the population change.
+ **Aggregation of results** across species.

3. FROM THEORY TO PRACTICE: THE MULTIPLE APPLICATIONS OF BIODIVERSITY FOOTPRINT ASSESSMENTS

Biodiversity footprint assessments' use in product evaluation and impact reduction has already been described, but information about a product's biodiversity impacts is also important for the consumer and the politician. A uniform sustainability label displaying the environmental costs of a product in addition to the monetary price could be used, but it requires adequate input information, in particular on biodiversity. Environmental impact assessment of particular local projects or interventions can be viewed as a special case of a biodiversity footprint

[2] Biological diversity means 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 part: this includes diversity within species, between species and of ecosystems." CBD Convention, Art. 2. https://cutt.ly/sgt1Aqk

[3] Chaudhary, A., Verones, F., de Baan, L., Hellweg, S. (2015): Quantifying land use impacts on biodiversity: combining species-area models and vulnerability indicators. *Environmental Science and Technology*, 49: 9987–9995.

[4] Loh, J., Green, R. E., Ricketts, T., Larnoreux, J., Jenkins, M., Kapos, V., Randers, J. (2005): The Living Planet Index: using species population time series to track trends in biodiversity. *Philosophical Transactions of the Royal Society* B, Biological Sciences 360: 289–295.

[5] "Metapopulations" are sets of populations of the same species living in a certain region, with individual populations interconnected by infrequent recolonisation events. In the past decades, metapopulation concepts have become the standard paradigm for the description of species survival in fragmented landscapes.

Habitat integrity has been compromised in many parts of the world. Incorporating biodiversity into LCA or biodiversity footprinting are ways to take stock of the influences of human activity on nature. © Angelika Cenkl, WaterPIX /EEA

assessment with impact locality and impact type precisely specified. At a strategic level, calculation of a biodiversity footprint may support the evaluation of policy decisions and implications of legal changes. Once large sets of biodiversity footprint assessments become available, they may contribute to wider natural capital accounting studies at a national scale. In biodiversity monitoring, the method is conducive to aggregating the changes in the abundance of many observed species into a single value representing overall biodiversity modification during the monitoring period.

CONTRIBUTION TO THE EUROPEAN GREEN DEAL

The European Green Deal [6] is a comprehensive strategy to reduce the threats emerging from climate change and biodiversity loss. One of its major cornerstones is the transformation of industrial processes into a circular economy, underpinned by a 'sustainable products' policy. Such a policy aims at reducing material input, avoiding waste [7] and fostering recycling. At every step, biodiversity implications need to be taken into account.

A sector with large-scale biodiversity impact is agriculture. Here, the EU Farm to Fork Strategy aims at reducing the environmental impacts of modern agriculture, by reducing pesticide, fertiliser, and antibiotic input and by a substantial enlargement of the organic farming area. The effects of such a transition can be monitored using biodiversity accounting.

CONTRIBUTION TO THE POST 2020 GLOBAL BIODIVERSITY FRAMEWORK

The Zero Draft of the Post 2020 Global Biodiversity Framework, first published in January 2020 by the CBD Secretariat [8] and substantially updated on 17 August 2020 [9] to be the guiding document towards COP15, proposes four overarching long-term goals to safeguard biodiversity by 2050:
(a) An increase in area, connectivity, and integrity of natural ecosystems and a reduction in the number of threatened species,
(b) An enhancement of nature's contributions to people,
(c) The benefit-sharing of genetic resources,
(d) The availability of implementation means.

These goals are accompanied by corresponding milestones, to be achieved by 2030, and a set of twenty so-called action targets. Goals and action targets require indicators to be monitored.

Obviously, goal (a) would benefit substantially from the availability of a uniformly applicable biodiversity measure; in fact, such a metric may be a key prerequisite for its implementation. In practice, goal (a) implies that ecosystem area losses for development projects must be overcompensated by ecosystem restoration elsewhere.

However, 'area' is a very poor ecosystem quality indicator, and 'integrity' requires a measurement specification. A biodiversity metric as laid out above can combine area and integrity into a single number to be used in comparisons of losses and gains and thus facilitate monitoring of progress towards this goal, but also the implementation of local measures to avoid habitat destruction. Such a metric can be used in addition to the indicators already proposed for monitoring.

Additionally, a biodiversity measure could benefit action target 13 (mainstreaming biodiversity) to integrate biodiversity considerations into all kinds of planning processes. Furthermore, a biodiversity footprint measure is indispensable for the practical implementation of target 14, aiming at a reduction of at least 50% in negative impacts on biodiversity in production and supply chains. A biodiversity footprint measure could also facilitate the implementation of action target 17 by identifying harmful biodiversity-adverse subsidies and by evaluating the biodiversity effects of beneficial subsidies.

"ASSESSMENT METHODS FOR SUPPORTING SUSTAINABLE CONSUMPTION AND PRODUCTION FOR GREENING THE MARKET NEED TO BE SCIENCE-BASED, SYSTEMIC, AND BUILT UPON GLOBAL PARTNERSHIPS. THE ENVIRONMENTAL FOOTPRINT AS LCA-BASED METHOD IS A GREAT FOUNDATION FOR A GREEN MARKET!"
Tim Kasten – Deputy Director, Economy Division UNEP, 23rd April 2018, Final Conference of the Environmental Footprint Pilot Phase, Brussels

[6] https://cutt.ly/7fLqna5

[7] Read Expertise on Economic Growth Paradigm (#12) and Expertise on Biotrade (#17)

[8] https://cutt.ly/FfLwNcC

[9] https://cutt.ly/HfLw5bZ

Cover page photo
Without a bold green strategy to reverse biodiversity depletion, the sun will go down on many endangered species. © Grzegorz Zimny, WaterPIX/EEA.

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IN PARTNERSHIP WITH

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