



Summary Record

OECD International Expert Workshop

The Post-2020 Biodiversity Framework: Targets, indicators and measurability implications at global and national level

26 February 2019
OECD Headquarters, Paris, France

Purpose of the workshop:

To bring together a range of experts and stakeholders from the policy, scientific, and NGO community, to share and exchange views on the development of the post-2020 biodiversity framework with the aim to better understand the measurability implications, at global and national levels, of possible targets. While the Aichi Targets and its indicator set are a considerable improvement on the previous framework, the post-2020 process offers an opportunity to enhance the measurability of the new framework. The workshop will examine whether and how new structures can be leveraged to create more quantifiable targets, how currently available data and indicators can be used to inform target creation, where the priorities lie and where the key gaps remain.

Specific aims:

- ◆ to share lessons from the existing Aichi Biodiversity Targets and the indicator framework used to monitor progress towards these;
- ◆ to consider options to improve on the existing structure and measurability of the targets;
- ◆ to understand how the data available today at global and multi-country level and associated indicators could be used to help inform possible future targets in the post-2020 framework;
- ◆ to identify key gaps in the indicator suite, the feasibility of addressing these gaps and the implications of this for creating SMARTer targets in the post-2020 framework.

Workshop participants:

More than 70 participants attended the workshop, including government representatives from the OECD member countries and key partners such as Costa Rica, Indonesia as well as Egypt; international organisations such as UN Environment-WCMC, IPBES, UNDP BIOFIN, UNSD; environmental NGOs such as WWF, IUCN, BirdLife International and IDDRI; as well as representatives from business and civil society. The participants list is available [here](#).

A background paper had been prepared for the workshop to help inform participants and guide discussions. Excerpts from the background paper are provided in the Annex to this Summary Record.

Further information, including the presentations, is available here: oe.cd/post-2020-biodiversity-workshop

Key messages from the workshop

- The current Aichi Biodiversity Targets have ambiguous language – several advocated for greater simplicity and well-defined targets in the post-2020 global biodiversity framework which would allow for a more consistent interpretation of targets, their indicators and necessary actions.
- The post-2020 biodiversity target and indicator framework should build on the elements of the existing framework that were effective, and be developed in parallel, in an iterative way. This should be based on indicators that are currently available, or that would be feasible to develop (and to mobilise data for) in the near future.
- The NGO proposal for the pyramid structure on the foundations and elements of a post-2020 biodiversity framework is complementary to introducing potential *categories* of indicators, including a sub-set of headline indicators, as proposed in the OECD background paper. The criteria for the headline indicators would be that it is measurable and comparable across countries. Such an approach could help to sequence and prioritise efforts on a smaller set of pressure, state and response indicators that are most important to measure in a comparable way across all countries.
- A number of multi-country datasets already exist, covering biodiversity-relevant pressure, state and response indicators, that would enable assessment of progress towards a post-2020 global biodiversity framework in such a way so that it is measurable and comparable across countries. In some cases these are indicators built up from national data; in others they are global datasets that can be disaggregated to national scale in a comparable and consistent way.
- That further work and analysis is needed on indicators - they are the cornerstone of the post-2020 biodiversity framework.
- Mainstreaming biodiversity (both in terms of targets and indicators) needs greater attention in the post-2020 biodiversity framework.
- Further analysis by the OECD to help inform the development of the post-2020 process was welcomed, in particular with regard to the targets and indicators, notably the pressures and responses. Mainstreaming and resource mobilisation were highlighted as well. It was also noted that the next iteration of the OECD report should also link more closely with the SDGs.
- It was noted that the summary record of the workshop should be used to inform the regional consultation on the post-2020 biodiversity framework and other international events such as the Trondheim Conference.

Opening session

Simon Buckle (OECD) welcomed the participants to the workshop and provided opening remarks. He underscored the scale of the biodiversity challenge and the importance of adopting a robust post-2020 framework, with specific, measurable, ambitious, realistic and time-bound targets (SMART). He outlined the objectives for the workshop, emphasising it was intended to focus on the *specific* and *measurable* elements of SMART, and that it was intended to be a technical expert workshop - not about national positions. Dr. Buckle then introduced the other speakers in the opening session: Laure Ledoux (European Commission), Moustafa Fouda (Egypt), as well as Basile van Havre (Co-Chair of the OEWG) who provided a recorded message via video. Dr. Buckle congratulated Egypt on their successful presidency of the CBD COP14 and thanked the European Commission for its financial support for the OECD programme of work on the post-2020 global biodiversity framework.

Laure Ledoux (European Commission) stressed the importance of SMART targets and a sound indicator framework to monitor progress towards the post-2020 biodiversity targets. Dr. Ledoux highlighted the potential for Parties to submit voluntary commitments under the new post-2020 biodiversity framework to help build momentum national level actions, and that the biodiversity vision should be quantifiable and communicable if it is to garner broad support. Further, Dr. Ledoux emphasised that discussion of the review and implementation of the new framework must take place at the highest political level if the post-2020 framework is to succeed.

Moustafa Fouda (Egypt) highlighted the actions undertaken by Egypt (in its role as CBD COP14 Presidency) to promote biodiversity on an international stage, including the inaugural African Biodiversity Ministerial summit, and the Egyptian initiative aimed at enhancing synergies across the Rio Conventions. Dr. Fouda also called for biodiversity ambassadors to champion the cause of the post-2020 and Aichi Biodiversity Targets in their own countries, highlighted the need for goals and targets that are easily communicated to end users and the wider public, and underscored the importance of biodiversity to cultures around the world. Dr Fouda outlined key principles to guide the development and implementation of the post-2020 framework, including transparency, accessibility, engagement of all stakeholders and a commitment to not leave anyone behind.

Basile van Havre (Co-Chair, OEWG on the post-2020 biodiversity framework), in a video message, outlined the process leading up to the negotiations of the post-2020 biodiversity framework at CBD COP 15 in China. [link to video – TBC]

Session 1 Lessons from the Aichi Biodiversity Targets and indicators - and potential structures for the post-2020 targets

Markus Lehmann (CBD) provided an overview of the current indicator framework under the Convention on Biological Diversity (CBD), noting that there is a combination of generic and specific indicators and that some Aichi Targets still lack indicators for monitoring progress. Dr. Lehmann outlined the process for developing the post-2020 framework and stressed the importance of considering links with other international processes and mechanisms. Finally, he encouraged participants to submit their views on the CBD [discussion paper](#) on the Post-2020 Global Biodiversity Framework by 15 April, 2019.

Francis Ogwal (Co-Chair, OEWG on the post-2020 biodiversity framework) addressing the participants remotely via video conference, noted the issues that have hampered progress under the Aichi targets and re-enforced the need for SMARTer targets under the post-2020 framework, including close linkages between the targets and the indicators. He further noted how the political nature of the negotiations leading up to the current framework had resulted in a mission statement that is too long to be communicated easily and the need for the post-2020 framework to integrate the Nagoya and Cartagena Protocols.

Anna Chenery (UN Environment-WCMC) presented on the lessons learned from the Biodiversity Indicators Partnership (BIP), including insights into the current indicators and the features that make them

successful, such as institutional support. She also noted that the uptake of indicators from the BIP at a national level had been limited. She emphasised the need for the post-2020 targets and indicators to build on existing work, to be developed in parallel through an iterative process, and to work across different scales to ensure greater measurability of the post-2020 biodiversity framework. Ms Chenery also highlighted that new technologies could help track and communicate progress on the targets (e.g. indicator visualization platforms and model-based scenarios).

Katia Karousakis (OECD), drawing on the OECD background paper prepared for the workshop, highlighted some of lessons learned, including successes and challenges, from the current Strategic Plan for Biodiversity and the Aichi Biodiversity Targets as well as the current indicator suite (see Annex). Dr. Karousakis highlighted how the current pressure-state-response target and indicator framework fit together with the theory of change in terms of the responses: inputs, process, output, outcomes, and impacts (see Figure 1 in the Annex). Highlighting the numerous indicative indicators in Dec XIII/28 and those under the BIP, she proposed the possibility of introducing potential categories of indicators in the post-2020 biodiversity framework, including headline indicators for pressure, state and responses (see Figure 3 in the Annex). The criteria for a headline indicator was proposed to be quantifiable and comparable across countries in a consistent way. She noted that such a structure on categories for indicators might help to prioritise, and converge efforts towards, the indicators that most need to be monitored.

Gunter Mittlacher (WWF) presented the proposed pyramid structure for the foundations and elements of a post-2020 framework, submitted by a consortium of NGOs to the CBD¹. He provided further detail on what each layer of the pyramid could include, focussing predominantly on the objectives for the state of biodiversity. He suggested several indicators to monitor progress towards the ‘apex’ which track different dimensions of the state of biodiversity. These indicators are: the living planet index (abundance), species habitat index (distribution), biodiversity intactness index (composition) and the IUCN Red List index (extinction risk). He suggested that marine indicators, such as the Ocean Health Index, should also be included alongside the list of terrestrial indices. He highlighted the need to define, in advance, the regularity of monitoring, quantified target values and baselines against which progress is to be monitored.

Plenary discussion

- Participants highlighted how information about the national uptake of indicators is available from national reports, but seems to suggest it has been limited so far. It was suggested that this could stem from national level agencies being worried about being made to look bad if indicators had declined, and more work is need to address this challenge.
- Some participants noted SMART targets are essential as they allow the monitoring of progress, whereas others highlighted that SMART targets tend to be narrow as they are exclusively limited to components that can be measurable. Consequently, by over-committing to SMART targets, some important components needed to address the biodiversity crisis, which are not measurable might be missed.
- Participants also highlighted that indicators can be used in a variety of ways (e.g. to monitor a trend or a distance to a certain threshold) and that in many cases they may not provide the complete story of progress towards targets.
- There was general agreement that the enabling conditions, such as financing and data mobilisation for the post-2020 indicators and targets are very important and more effort is needed to track progress in their development.
- Several participants noted that international trade should be considered in the post-2020 biodiversity framework
- Increases in the engagement of other stakeholders, particularly non-state actors, was seen as important and more communicable goals and indicators which can be decomposed by economic sector may help.
- Finally, close integration of the SDGs (particularly 14 and 15) with the post-2020 framework and their targets and indicators was considered to be essential.

¹ <https://www.cbd.int/doc/strategic-plan/Post2020/postsbi/birdlife2.pdf>

Panel session on the structure of the post-2020 framework and their measurability implications

Andy Purvis, Natural History Museum, U.K. Prof. Purvis highlighted the three indicators proposed in the paper “Aiming Higher to Bend the Biodiversity Curve”², and how they could be used to measure the progress of the post-2020 framework. He indicated that we will be unable to reverse biodiversity declines by 2020, given the time it takes biological systems to respond and that the post-2020 targets must serve as milestones towards an ambitious longer term vision for 2050. Finally, he discussed the importance of understanding the linkages between the state of biodiversity, pressures and policy responses suggesting more effort is needed to understand how policy responses are linked to changes in pressures and states in order to identify effective interventions. He noted that the structures proposed and presented by WWF and the OECD were very useful. He also noted that national circumstances across countries vary hugely and that the post-2020 framework thus also need to ensure flexibility.

Tom Brooks (IUCN) highlighted a few points that were not covered in the OECD background paper, notably the CBD mission and whether it will be inherited in the post-2020 framework. He emphasised the importance of discussing the post-2020 mission, and noted that proposals on the formulation of the mission that were submitted to CBD tend to converge on some common themes. Dr. Brooks suggested that the mission could comprise elements that could be disaggregated in multiple ways, such as by elements of biodiversity (e.g. species or ecosystems), sectors driving declines (e.g. agriculture) or geographically (e.g. by country). He stressed the importance of considering the impacts and opportunities associated with international co-operation and trade in particular, suggesting the OECD may be well placed to support work in this area. To conclude, Dr. Brooks noted the upcoming IUCN World Conservation Congress which will take place in June 2020 in Marseille, France.

Anne Teller (European Commission) highlighted the links between targets and indicators and stressed the importance of developing them in parallel. She noted that a lack of indicators should not be a constraint on the ambition of the targets. She also noted that while the five current strategic goals for biodiversity are not quantified and measurable, that they were intended to be aspirational in nature and hence any post-2020 biodiversity goals may also not need to be quantifiable. She indicated that concepts such as “bending the curve” can be helpful for communicating to a wider audience, but that we must remember that while these goals can and should be informed by science, their formulation is ultimately a political process. Ms. Teller pointed out the potential trade-offs between level of ambition and uptake/ownership of targets. As an example, she asked participants whether for agriculture and biodiversity it would be best to develop targets and indicators in the biodiversity community (with the risk that they are not recognised in the agriculture sector), or take an indicator from SDG 2.4.1, which has already agreed by agriculture ministers. She also noted that a hierarchical framework for the structure of the post-2020 biodiversity framework implies different levels of importance, and that this should perhaps be avoided.

Other key points that were raised in the plenary discussion following this included:

- That we need to engage with sectors – to ensure targets and indicators adequately cover the biodiversity mainstreaming agenda.
- Structuring and compiling data according to a set of standardised principles, such as the SEEA, helps ensure that the resulting biodiversity data are comparable with countries’ macroeconomic statistics from national accounts (SNA). The SEEA can be a useful tool for understanding trade-offs, synergies and impacts across economic and environmental domains.

² <https://www.nature.com/articles/s41893-018-0130-0>

Session 2 [Plenary]: Enhancing the measurability of the post-2020 biodiversity framework

Katia Karousakis, Will Symes and Edward Perry (OECD) provided an overview of the pressure-state-response framework for indicators, and highlighted existing multi-country datasets and indicators for tracking these three elements (see Tables 2 and 3 in the Annex) . They invited participants to share information on other existing datasets or datasets under development that could be useful in tracking progress towards biodiversity conservation and sustainable use, and data gaps they may be important to fill. They highlighted the key questions for the break-out groups to consider, namely:

- What Pressure-State-Response (PSR) indicators can we measure today at multi-country level?
- What PSR data/indicators would we *really* like to be able to measure at global and national level for headline indicators?
- What can we not measure today at multi-country level that might be useful for targets?

Session 2 [Break-out groups]: Enhancing the measurability of the post-2020 biodiversity framework

The break-out groups were intended to allow for a more focussed and in-depth discussion on the types of indicators available, whether they are available at multi-country level in a comparable way, and whether they could therefore serve as ‘headline’ indicators.

Break-out group 1: Targets, indicators and their measurability for the state of biodiversity

Chair: Stuart Butchart (BirdLife International)

Facilitator: Will Symes (OECD)

Participants in the break-out group on *state* indicators for biodiversity noted that:

- There is a general lack of indicators on ecosystem services, which are very important but currently not adequately captured.
- There is also a lack of indicators on ecosystem functioning (and functional connectivity) and the stocks and flows of ecosystem services are important.
- Genetic diversity is very important, but how and what to measure to develop indicators is still a work in progress. Participants noted however that there is currently some work looking at gene/seed banks, which is promising for the development of future indicators
- Having individual nationally-disaggregated and nationally-comparable data on the state of biodiversity may not be as necessary (i.e. thus for headline indicators), as the state of biodiversity does not conform to national boundaries. Instead, data collected nationally for the specific domestic biodiversity context may probably be more useful in many cases.
- There are many ways indicators are used at national level and thinking about this only from a compliance perspective could be unhelpful.
- Understanding the mechanistic links between the state of biodiversity and the pressures is key to setting the appropriate level of ambition for the targets.
- It was noted that the recently developed Biodiversity Intactness Index (BII) is subject to ongoing debate as to its utility and limitations, including in relation to its policy relevance, the plausibility of reported values, and links to drivers. Recent developments are addressing some of these issues.
- From a policy perspective and in the lead up to 2020, the relevant data needs to be available already today or very soon, otherwise it is unlikely to be able to feed into the post-2020 process. Focussing on the indicators available today and how to improve them is therefore imperative.
- The current biodiversity indicator suite is still heavily focussed on terrestrial diversity, with larger data gaps for marine and freshwater ecosystems.

The breakout group examined the key questions and noted the following:

What *state* indicators can we measure today (or soon) at national scale across multiple countries?

Ecosystem extent/condition

Wetland Extent Trends Index (+Ramsar party reported trends)
Area of tree cover loss
Percentage natural habitat extent
Area of mangrove forest cover*
Percentage live coral cover*
Glacial mass balance (mm water equivalent)*
Mean polar sea ice extent*
Vegetation biomass
Biodiversity habitats index
Extent of primary habitat
Proportion of land that is degraded

Species abundance

Wild Bird Index (& various thematic disaggregations)*
Living Planet Index*
Species habitat index
Fish biomass for predatory fish*

Extinction risk/species status

Red List Index (& various thematic disaggregations)
Proportion of fish stocks within safe biological limits*
Percentage of terrestrial domesticated animal breeds at risk

Community structure/composition

Marine trophic index*
Percentage change in local species richness*
Biodiversity Intactness Index
Mean species abundance

*only available for subset of countries or at regional scale

Which biodiversity variables are most important to measure at global and national scale for headline indicators?

Extinction risk/rate (e.g. Red List Index for species)
Population trends (e.g. Living planet index, Species Habitat index etc)
+
Biotic integrity (e.g. Biodiversity intactness index, Mean species abundance)
Genetic diversity (No indicators currently available)
Ecosystem extent and condition (various indicators)

What additional indicators and data* are needed? What can we not measure today that might be useful?

Trends in genetic diversity (global genome initiative, gene banks, barcoding)
Trends in risk of ecosystem collapse
Trends in ecosystem function
Marine, especially deep water

Freshwater

Functional connectivity

*expanded and re- assessments of extinction risks (sampling strategy)

*expanded systematic population abundance monitoring to feed into LPI and extend beyond vertebrates

*links between state, pressures and responses

Other points:

- Benefits/ecosystem services indicators excluded –IPBES identified indicators for 15/18 classes of Nature’s Contributions to People
- Some indicators are not always straightforward to define as state/pressure/response
- For marine indicators, the national scale is less relevant
- Need better joining up/streamlining of indicators for different policy processes (SDG/Aichi etc)
- Build on work of Biodiversity Indicators Partnership, which vets potential indicators and assesses fitness for purpose. Cross-reference this list to the BIP list.
- Linkages between state, pressure and response indicators are important – in some cases there is a need for supplementary data to facilitate this.

Break-out group 2: Data and indicators for tracking pressures and responses

Chair: Hesiquio Benitez

OECD Facilitator: Katia Karousakis

Participants in the break-out identified the range of pressure and response targets and indicators in the current Aichi framework and began by discussing Aichi Target 3 on incentives. They noted the work of the OECD on tracking economic instruments and finance for biodiversity, including that OECD Policy Instruments for Environment (PINE) database collects information on what sectors the instruments apply to, and for the biodiversity-relevant taxes, that information is also collected on whether the revenue is earmarked. It was noted that the OECD would soon begin to collect data on Payments for Ecosystem Services and on Biodiversity Offsets, and that this would be available in time for the post-2020 biodiversity framework.

On data relevant to Aichi Target 11 on terrestrial and marine protected areas (already available by country in a comparable way), it was noted that it would be important to try to make progress on developing comparable data across countries on protected area effectiveness.

It was also noted that for some pressure indicators in the ocean/marine context, such as on proportion of fish stock within biologically sustainable levels (collected by the FAO), disaggregation at national level may not be required, and that regional and global level data might suffice.

It was noted that comparable cross-country data was particularly important for the response indicators (predominantly for the outputs and outcomes).

Break-out group 3: Data and indicators for tracking enabling conditions

Chair: Laure Ledoux

OECD Facilitator: Edward Perry

Participants reiterated the importance of enabling conditions to facilitate an effective biodiversity response, and the need for indicators to track progress. There was broad consensus that the enabling conditions that need to be considered include governance, capacity, finance, communication and awareness, and data, technology and information. Participants observed that these elements are interdependent, and it was suggested that the principle of ‘mutually exclusive and collectively exhaustive’ would be helpful when selecting indicators for enabling conditions. It was suggested that links be made with the indicators that exist, or will be developed, to monitor progress towards the Sustainable Development Goals.

Participants noted the importance of focussing not only on input and process response indicators, but also output and outcome response indicators. The example of NBSAPs was used to support this point: tracking the number of countries with an NBSAP is a simple indicator of enabling conditions but it does not provide any information on whether the NBSAP has been implemented, or whether capacity exists to do so.

One participant recalled the proposal for a suite (or package) of indicators to address any one element or theme. The example of Protected Areas (PAs) was provided whereby an increase in finance for PA's would represent an input response indicator, new legislation would represent an outcome response indicator, an increase in coverage of Protected Areas would represent an outcome response indicator, and an improvement in the number of species threatened would represent the eventual impact of the response. Some participants pointed out that the enabling conditions considered most important may differ between countries, hence the new framework should allow flexibility for countries to choose and report against their own indicators for enabling conditions.

Participants discussed the importance of improving quality and accessibility of biodiversity information. Several mentioned the need for targets and indicators that capture whether countries have publically available information on their biodiversity e.g. national biodiversity information facilities. One recommendation was to frame targets and indicators around the Voluntary Guidance to Improve the Accessibility of Biodiversity-related Data and Information adopted at CBD COP13.

It was suggested that resource mobilisation was an over-arching issue that merits its own target and indicator(s). It was pointed out that not all countries are yet tracking public biodiversity finance (e.g. direct expenditures) in a consistent and comparable way. It was noted that in the short term it would be feasible for countries to monitor and track the percentage of the Ministry of Environment's budget towards biodiversity or Protected Areas. Governments could aim to prioritise providing information on the percentage of public expenditure allocated to biodiversity or biodiversity finance as a percentage of GDP. Some countries already provide this information. In the future, it would also be important to track data (and develop indicators) on finance flows from the private sector and NGOs.

Closing session (including next steps)

Katia Karousakis (OECD) highlighted next steps proposed for the OECD project. She noted that the discussions and insights from the workshop would be incorporated into the next draft of the OECD background paper on *The Post-2020 Biodiversity Framework: Targets, indicator and measurability implications at global and national level*. In the meantime, a draft summary record of the workshop would be prepared, including key concepts from the background paper, circulated for review to the workshop participants, and made available in time for the next regional consultation workshop on the post-2020 biodiversity framework taking place on 19-21 March, 2019 in Bonn, Germany.

Markus Lehmann (CBD) highlighted a number of upcoming events relevant to the post-2020 biodiversity framework, notably the regional consultation workshops and the Trondheim Conference in July 2019.

Rodolfo Lacy (OECD Environment Director) provided closing remarks to the workshop. He reiterated the urgency of addressing the global biodiversity challenge, citing also the recently published study showing that 40% of insect species are threatened with extinction, as a case in point. Mr. Lacy highlighted the need for a representative and comprehensive indicator suite for monitoring progress towards the post-2020 biodiversity framework. He noted that key data gaps remain, particularly in relation to genetic diversity, oceans and the effectiveness of our policy responses to name only three. Mr Lacy thanked the participants for their constructive inputs, noting that the workshop was also intended to help foster a stronger science-policy interface, and encouraged further co-operation in advance of CBD COP15 when the post-2020 framework will be adopted.

**Annex: Excerpts from the OECD background paper on
*The Post-2020 Biodiversity Framework:
Targets, indicators and measurability implications
at global and national level***

1. THE 2011-2020 AICHI BIODIVERSITY TARGETS AND THE TRANSITION TO THE POST-2020 BIODIVERSITY FRAMEWORK

1.1. The current and evolving international context under the CBD

The 2011-2020 Aichi Biodiversity Targets are a set of 5 strategic goals and 20 targets that Parties to the UN Convention on Biological Diversity (CBD) are intended to use as a guiding framework for their national commitments towards biodiversity conservation, sustainable use and the equitable sharing of its benefits arising from the use of genetic resources. As these Targets will expire in 2020, Parties to the CBD will need to adopt a revised suite of targets for the post-2020 global biodiversity framework. Agreement on this is also likely to have implications for two of the Sustainable Development Goals (SDGs), namely SDG 14 on Life under Water and SDG 15 on Life on Land, as several of the targets therein come directly from the Aichi Biodiversity Targets, and are therefore also due to expire in 2020.

The 2011-2020 Strategic Plan for Biodiversity was a significant improvement to the one preceding it. The Aichi Biodiversity Targets set out a flexible framework that Parties are encouraged to use at the national level, *inter alia*, to guide their National Biodiversity Strategies and Action Plans (NBSAPs). These 20 targets resulted in the need to re-convene an Ad-Hoc Technical Expert Group (AHTEG) on indicators for the Strategic Plan, in order to provide guidance on global and national indicators needed to measure progress towards the achievement of the Aichi Targets.³ This process led to the adoption of CBD COP Decision XIII/28, in 2015, on Indicators for the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets⁴.

While the global biodiversity indicators are improving⁵ and efforts are underway to address the remaining data gaps through initiatives such as the Biodiversity Indicators Partnership (BIP), it remains inherently difficult to measure progress towards the Aichi Targets at national level in a consistent way. This is in contrast to, for example, the UN Framework Convention on Climate Change and the recent Paris Agreement, through which an international climate goal has been set (i.e., to keep global temperature rise in this century well below 2 degrees centigrade) and Parties are required to put forward Nationally Determined Contributions (NDCs). The NDCs therefore create a bottom-up approach, to complement the top-down approach, helping to bridge the two and therefore also serve to provide transparency on whether the aggregated NDCs are sufficient to achieve the international goal. Such a framework could arguably also be useful in the context of the CBD.

While efforts to mitigate climate change, however, can be measured in a single unit of tCO₂e, efforts to mitigate biodiversity loss and degradation cannot be adequately captured in a single indicator. Measuring performance therefore requires multiple different indicators (e.g., reduce forest loss, reduce the number of threatened species). Additionally, the agreed goals and targets of the post-2020 biodiversity framework will have implications for their measurability at both a global and national level. Further consideration needs to be given to how the actual objectives of any post-2020 framework for biodiversity will enable an assessment of their progress and the contributions that individual nations are making towards the

³ UNEP/CBD/ID/AHTEG/2015/1/3

⁴ [CBD/COP/Decision XIII/28](#)

⁵ Both in terms of the comprehensiveness of what is being monitored (for the 2011-2020 Aichi Targets) and the means of monitoring.

international goals. Ideally, all targets would be specific, measurable, ambitious, realistic and time-bound (SMART).

The post-2020 biodiversity framework will need to reflect the challenges encountered in 2011-2020 and how they can better be addressed, the relevant targets of the SDGs, among other issues. CBD COP14 in Egypt adopted a number of decisions relevant to the post-2020 biodiversity framework, which include:

- Decision 14/1: Updated assessment of progress towards selected Aichi Biodiversity Targets and options to accelerate progress.
- Decision 14/34: Comprehensive and participatory process for the preparation of the post-2020 global biodiversity framework.

Following a CBD invitation for views on the preparation, scope and content of the post-2020 global biodiversity framework, 95 submissions, from governments, international organisations, NGOs and others, were received⁶. A synthesis of views was made available on 24 January 2019 [CBD/POST2020/1/INF/1], together with a summary of the synthesis on 25 January 2019 [CBD/Post2020/PREP/1/1]. Para 9 (h) and (j) of this latter document state:

(h) The different elements of the post-2020 global biodiversity framework should be linked through a conceptual framework. Some have suggested that this should be based on the Strategic Plan for Biodiversity while others have suggested alternative approaches, including a pyramid approach with layers of objectives, actions and targets in support of an “apex goal” and combinations of outcome and output targets;

(j) The post-2020 global biodiversity framework should contain targets which are specific, measurable, ambitious, realistic and time-bound. These targets should be knowledge-based, including on scientific and traditional knowledge, address both desired outcomes and processes, be easy to communicate and be designed to galvanize action across society. There is support for using the Aichi Biodiversity Target as a starting point for discussing future targets. Some expressed the view that changes to the Aichi Targets should be kept limited. Others suggested more comprehensive changes, and numerous suggestions for additional or revised targets have been proposed;

1.2. Aims and objectives of this work

The objectives of this work are to take stock of the lessons learned from the current biodiversity framework, as these relate to targets and indicators, and to examine the measurability implications of possible new biodiversity (goals and) targets under the post-2020 biodiversity framework, at both global and national level. This background paper is intended to facilitate discussions on this issue, at the OECD workshop on February 26, 2019. This paper summarises lessons learned from the Aichi Biodiversity Targets to date, including the successes and challenges, as these relate to measurability, and explores opportunities for improvement in the post-2020 biodiversity framework. It provides an initial overview of multicounty datasets that could be used to help identify what type of targets and associated indicators could be developed so as to enhance measurability, at both global and national level, of the post-2020 biodiversity framework.

To this end, the workshop is intended to provide a platform for discussion and exchange of views, notably as it relates to CBD Decision 14/34, para 12, a, b, c, j, to consider:

- (a) **Scope, elements and structure** of the post-2020 global biodiversity framework;
- (b) Considerations related to ambitious, realistic and, **where possible, measurable, time-bound targets and corresponding indicators**, reporting and monitoring frameworks and baselines to be developed in a coherent way;

⁶ <https://www.cbd.int/post2020/submissions/>

(c) Mechanisms for monitoring and reviewing implementation, including through the use of indicators and the alignment of national reporting under the Convention and its Protocols;

(j) Approaches, implications and opportunities for, **enhancing mainstreaming**;

The overarching objective of this project is to provide technical analysis to help to inform the post-2020 biodiversity decision-making process. This work does not intend to make any presuppositions with regard to the ambition of any possible targets.

1.3. Environmental targets and indicators: Principles, criteria, concepts

It may be useful, at the outset, to recall some general principles, criteria and concepts relevant to environmental targets and indicators, and how these have been related to biodiversity thus far. Environmental targets should, ideally, be specific, measurable, and time-bound. A set of criteria has been developed by the OECD to help guide the design of environmental indicators. It states that all indicators should be assessed/evaluated according to their (i) policy relevance, (ii) analytical soundness, and (iii) measurability (OECD, 1993). The CBD has also noted that the ideal indicator for measuring progress should be (CBD, Examination of the outcome-oriented goals and targets (and associated indicators) and consideration of their possible adjustment for the period beyond 2010., 2010):

“policy-relevant and meaningful, biodiversity relevant, scientifically sound, accepted by a broad public, lend itself to affordable monitoring and modelling, and be sensitive enough to detect changes in systems with in timeframes and on scales relevant to decision-making”

These criteria have also been put forward in the so-called “SMART” concept of targets which the CBD defines as (CBD, Examination of the outcome-oriented goals and targets (and associated indicators) and consideration of their possible adjustment for the period beyond 2010., 2010) :

- Specific
- Measurable
- Ambitious
- Realistic, and
- Time-bound.

The Pressure-State-Response model provides a commonly accepted framework for identifying and structuring indicators. It distinguishes indicators of environmental pressures (both direct and indirect), indicators of environmental conditions, and indicators of societal responses. Societal responses can be further disaggregated into those undertaken by government, households, and business (OECD, 2001). In this paper, responses focus more heavily on those by government. When designing the current biodiversity framework in 2010, the Parties to the CBD adopted a modified Driver-Pressure-State-Impact/Benefit-Response framework for applying the indicators to be consistent with Strategic Plan for Biodiversity and the Aichi targets (CBD, Examination of the outcome-oriented goals and targets (and associated indicators) and consideration of their possible adjustment for the period beyond 2010., 2010).

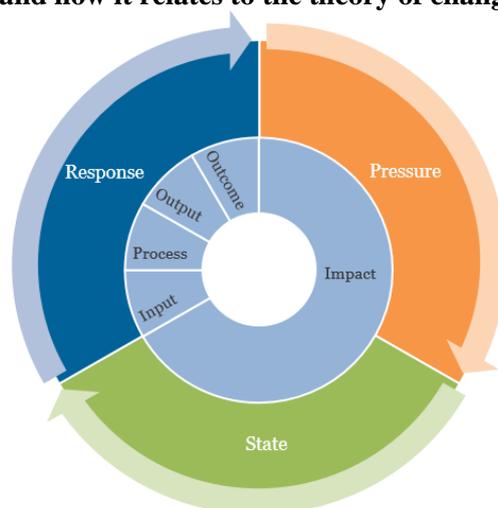
With this in mind, and following the literature on the theory of change, the types of response indicators can be further compartmentalised into inputs, processes, outputs, outcomes and impacts (Table 1). Thus, if the responses are effective (and lead, in the last stage, to positive impacts), they should manifest in an improvement in the *state* of biodiversity.

Table 1. Types of Responses and the Theory of Change

| Indicator type | Definition | Examples |
|----------------|--|--|
| Input | Measure the material and immaterial pre-conditions and resources - both human and financial - provided for an activity, project, programme or intervention | <ul style="list-style-type: none"> • Budget allocated for biodiversity • Number of staff |
| Process | Measure the progress of processes or actions that use inputs and ways in which program services and goods are provided | <ul style="list-style-type: none"> • Establish an inter-Ministerial Committee for biodiversity |
| Output | Measure the quantity, quality, and efficiency of production of goods or services as a result of an activity, project, programme or intervention | <ul style="list-style-type: none"> • New legal or policy instruments • Studies such as National Ecosystem Assessments • Biodiversity and ecosystem values are integrated into national accounts |
| Outcome | Measure the intermediate broader results achieved through the provision of outputs | <ul style="list-style-type: none"> • Reduced pesticide use • Larger protected areas |
| Impact | Measure the quality and quantity of long-term results generated as a result of achieving specific outcomes | <ul style="list-style-type: none"> • Improved condition of biodiversity and sustainability of ecosystem services, such as number of threatened species |

Source: Adapted from OECD (Mainstreaming Biodiversity for Sustainable Development, 2018), Mainstreaming Biodiversity for Sustainable Development.

Figure 1: A schematic of the pressure-state-response indicator framework and how it relates to the theory of change



Source: OECD (2019), Presentation at the OECD workshop on February 26, 2019.

In the context of biodiversity, suggestions for target and indicator development are briefly summarised here. (Butchart, Di Marco, & Watson, 2016) argue that ideally, targets should avoid using ambiguous language, setting goals that are unquantifiable and introducing redundant or complex terms that are open to interpretation, and clear definitions of the terms used should be readily available with the targets themselves. They also state that specific, quantifiable targets, with an established timeframe create greater clarity and transparency surrounding the actions required.

Di Marco et al. (Global Biodiversity Targets Require Both Sufficiency and Efficiency, 2016) state: An important part of an efficient global plan for biodiversity conservation is the establishment of an efficient framework for monitoring progress toward targets. However, the set of indicators used for target monitoring is sometimes inadequate, hindering the ability to accurately monitor some of the targets (Shepherd, et al., 2016).

(Kuempel, Chauvenet, & Possingham, 2016) suggest that identifying a comprehensive set of indicators, which are able to represent the changing state of a study system (e.g., the threatened species of a country), is an important step to be taken every time new targets are being defined. For each indicator, it is important to clarify whether it refers to conservation outputs (e.g., new legislation for protected areas), outcomes (e.g., greater coverage of protected areas) and impacts (e.g. higher species abundance), what is the availability of baseline data, and what is the cost of collecting and maintaining new data.

2.THE AICHI BIODIVERSITY TARGETS AND THE CURRENT SET OF INDICATORS

2.1 The Aichi Biodiversity Targets: An overview and some characteristics

Table 2.1 summarises the characteristics of the Aichi Biodiversity Targets in terms of whether: (i) they reflect Pressure-State-Response variables; (ii) if a Response variable, whether they relate to inputs, processes, outputs, outcomes or impacts (see Table 2); and (iii) the target is quantitatively specific.

The Aichi Biodiversity Targets are therefore composed of 10 targets that contain elements referring to the state of biodiversity, 4 that refer to the pressures, and 12 on responses (where sometimes a target covers multiple elements). Of the Aichi targets that can be classified as ‘response’ targets, there are 2 focussing on inputs, 6 on processes, 5 on outputs and 5 on outcomes.

Table 2. Characteristics of the 2011-2020 Aichi Biodiversity Targets

| Aichi Target | Pressure-State-Response | Input-Process-Output-Outcome-Impact | Quantified or quantitatively specific target |
|--------------|---------------------------|---|--|
| 1 | State | | No |
| 2 | Response | Process | No |
| 3 | Response | Output | No |
| 4 | Response | Input, process (and outcome but not defined) | No |
| 5 | State (and Pressure) | | Partially |
| 6 | Response, Pressure, State | Output and outcome | Implicitly (100% target) |
| 7 | Response | Output | Implicitly (100% target) |
| 8 | Pressure | | Implicitly (100% target) |
| 9 | State, Response | Process and output | No |
| 10 | Pressure | | No |
| 11 | Response | Output | Yes, partially |
| 12 | State | Outcome | Implicitly and partially |
| 13 | State, Response | Process | No |
| 14 | State | Outcome | No |
| 15 | State, Response | Outcome | Partially (15% restoration) |
| 16 | Response | Process | Yes, binary |
| 17 | Response | Process | Yes, binary |
| 18 | State | | No |
| 19 | State | | No |
| 20 | Response | Input | No but yes in further decisions (i.e. doubling) |

Source: OECD (2019), The Post-2020 Biodiversity Framework: Targets, indicators and measurability implications at global and national level [Background paper prepared for the workshop].

2.2 The indicator suite for the Aichi Biodiversity Targets and the BIP

Decision XIII/28 of the CBD COP welcomed an updated list of indicators for the Strategic Plan for Biodiversity 2011-2020 and also emphasised that the list of indicators provides a flexible framework for Parties to adapt, as appropriate, to their national priorities and circumstances. The indicative list of indicators covers 98 specific indicators, 35 of which are highlighted as having potential for disaggregation to the national level (BIP, 2018). The BIP (2018) document also notes, however, that the uptake of these indicators by countries has been limited to date.

It would be interesting to undertake an inventory of the indicators being used at national level, as reported in the 6th National Reports, to monitor progress towards each of the Aichi Targets, and to develop summary statistics on the frequency of use of each of the indicators across all the National Reports. Such analysis would, in essence, help to create a baseline of information on what indicators are currently being used at national level, and could help to inform the post-2020 biodiversity framework with respect to the indicators that are most frequently used.

Aiming to support the development of indicators via a more top-down approach, the Biodiversity Indicators Partnership (BIP) is a global initiative to promote the development and delivery of biodiversity indicators⁷. As of the end of 2018, the BIP has over 60 partner organisations and includes 64 indicators accepted for monitoring progress towards the Aichi targets⁸. The BIP uses an extended Pressure-State-Response (P-S-R) framework that includes a fourth category, Benefit, to classify indicators which track the benefits that biodiversity provides to people, such as ecosystem services. The P-S-R-B categories are designated by the creators/developers of the indicators.

3. NEW DEVELOPMENTS RELEVANT TO THE POST-2020 BIODIVERSITY FRAMEWORK

3.1 On the structure of the post-2020 biodiversity framework (and its measurability implications)

The current structure of the Aichi Targets and the indicator suite can be described as flat, where the 20 targets can be considered to be equally important. The 5 strategic goals represent “aspirations for achievement at a global level”⁹ which are unquantifiable. Beyond the targets and strategic goals, there is also a short vision statement and longer mission, from which the strategic goals are taken.

Following the recent submission of views on the post-2020 biodiversity framework, and as noted earlier, CBD/Post2020/PREP/1/1, Para 9, h includes the following language:

(h) The different elements of the post-2020 global biodiversity framework should be linked through a conceptual framework. Some have suggested that this should be based on the Strategic Plan for Biodiversity while others have suggested alternative approaches, including a pyramid approach with layers of objectives, actions and targets in support of an “apex goal” and combinations of outcome and output targets;

More specifically, a submission by a consortium of NGOs¹⁰ proposes a new logic structure for the biodiversity framework (Figure 2), which places an overarching “apex” goal at the top, supported by

⁷ The primary role of the BIP is to serve the global user community by responding to the indicator requests of the CBD and other biodiversity-related Conventions, for IPBES, for reporting on the Sustainable Development Goals, and for use by national and regional governments.

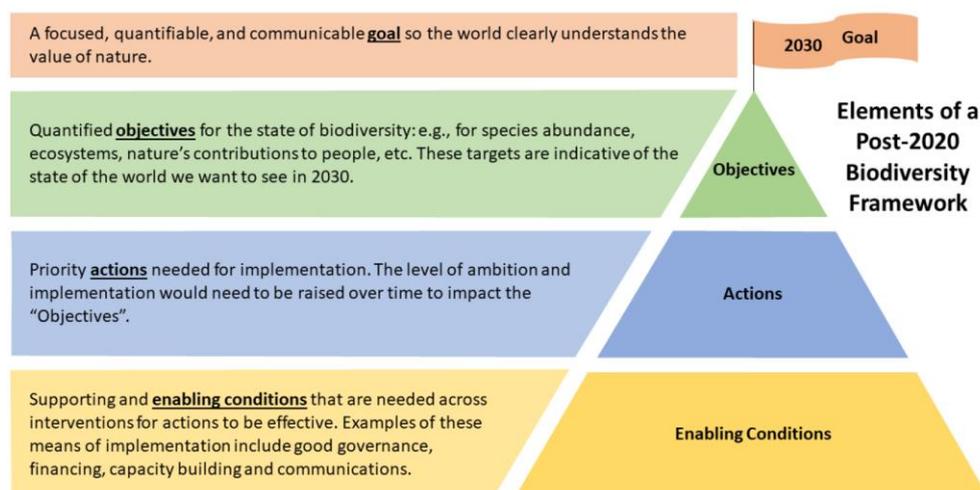
⁸ The BIP and its’ Steering Committee acts as a gatekeeper, assessing each indicator for certain data and coverage requirements before being accepted. Another round of review for additional proposed indicators for the BIP is currently underway.

⁹ <https://www.cbd.int/sp/elements/>

¹⁰ Birdlife International, Conservation International, Global Youth Biodiversity Network, International Fund for Animal Welfare, Rare, Royal Society for the Protection of Birds, The Nature Conservancy, The Pew Charitable Trusts, Wildlife Conservation Society and WWF.

objectives, actions and finally, enabling conditions. Under their proposal, the “apex” goal would be focused, quantifiable and communicable, analogous to the 2 degree target of the Paris Agreement. Below the apex goal, there is an explicit division between the objectives, which are measures of the state of biodiversity, and the actions needed to achieve the objectives (response targets). Finally enabling conditions, include good governance, financing, capacity building and communications, form the foundations that underpin the actions to achieve the objectives. The framework also calls for the ‘objective’ targets to be spatially-based and quantifiable.

Figure 2. Foundations, building blocks and elements of a post-2020 framework



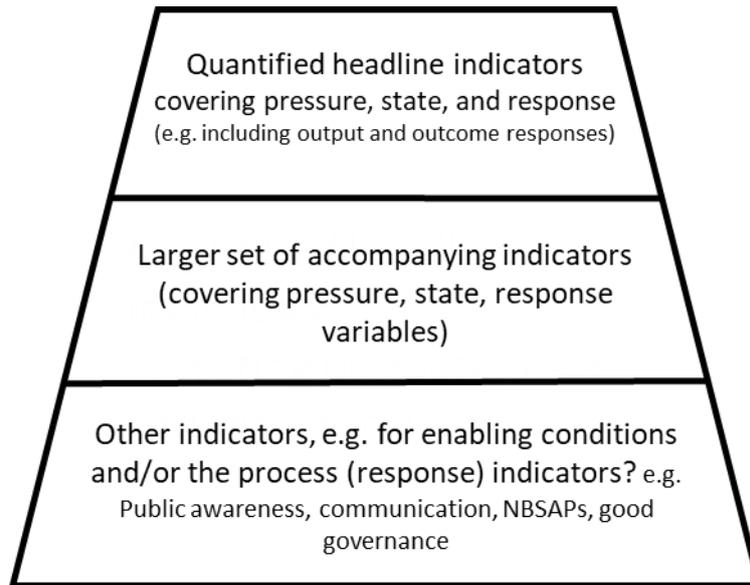
Source: Key Elements and Innovations for the CBD’s Post-2020 Biodiversity Framework: A Collaborative Discussion Piece. <https://www.conservation.org/publications/Documents/Post-2020-Discussion-Paper-October-2018.pdf>

How to interpret Figure 2 in terms of Table 1 in section 1 above, and the possible ways to describe responses in terms of inputs, process, output, outcome and impact? The “enabling conditions” in Figure 2 would seem to align most closely with inputs (e.g. finance, capacity building) and processes (e.g. good governance, capacity building), whereas the “actions” in Figure 3 seem to align more closely with “outputs” in Table 1.1.

With respect to indicators, an approach that has been adopted in the development the OECD Green Growth Indicators (OECD, 2017) work has been to identify a smaller set of *headline indicators* from the broader set of about 50 green growth indicators. One of the criteria that needs to be met in order for an indicator to be a headline indicator is that it is measurable and comparable across countries. Following this approach here, a new possible categorisation of indicators for the post-2020 biodiversity framework is depicted below in Figure 3, (i.e., as it relates to the measurability of the framework).

- Quantified headline indicators. These could be composed of a smaller set of e.g. 5 to 20/30 indicators, covering pressure, state, and response variables, which are measurable and comparable at both global and national level. The response indicators could include a combination of input, process, output, outcome and impact indicators
- Wider set of accompanying indicators (e.g. many more, not necessarily comparable at national level).
- If helpful, a separate category on enabling conditions (i.e. responses, with a focus on inputs and process).

Figure 3. Potential categories of indicators for the post-2020 biodiversity framework



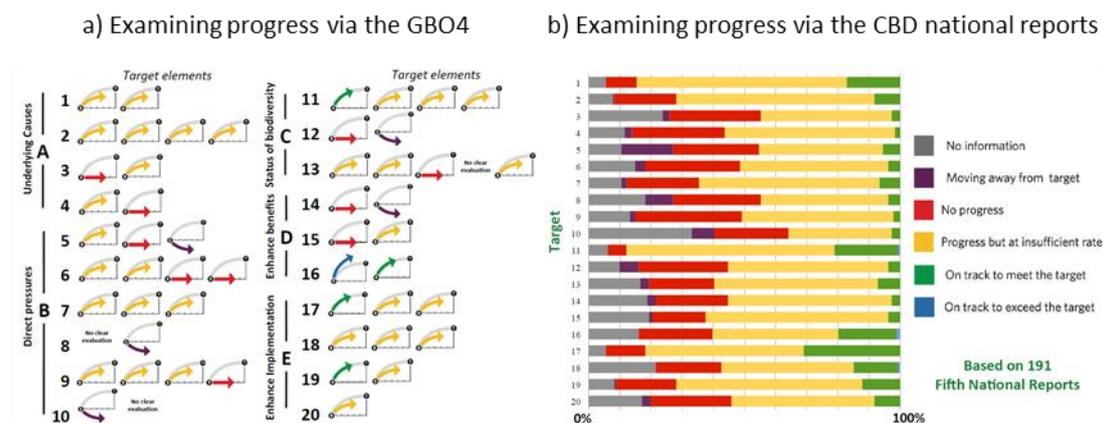
Source: OECD (2019), The Post-2020 Biodiversity framework: Targets, indicator and measurability implications at global and national level.

On enhancing the measurability of the post-2020 framework at global and national level

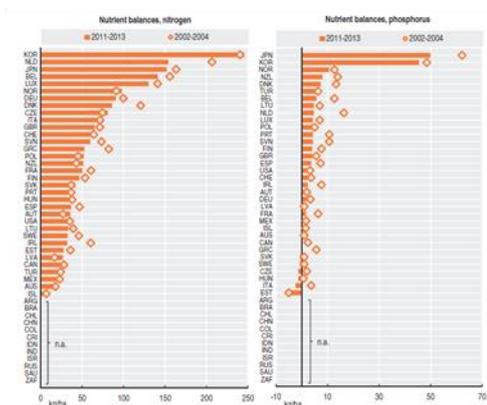
Various approaches have been taken to evaluate progress towards the Aichi Biodiversity Targets. Perhaps the most notable of these are the methods adopted by the GBO4, which may be considered to be a top-down approach, and the method via comparing progress based on the CBD National Reports, which can be considered a bottom-up approach (Figure 4 a and b). Both of these approaches are based, arguably to a large extent, on qualitative approaches.

In contrast, the approaches used under, for example, the UNFCCC and the OECD Green Growth Indicators framework, are in many ways, more quantitative (Figure 4 c). The question on enhancing the measurability of the post-2020 framework can thus be considered a question of how to evolve from approaches such as (a) and (b) in Figure 4, to (c).

Figure 4. Various ways to measure progress



c) Examining progress via the OECD green growth indicators



Source: CBD (Global Biodiversity Outlook 4 - Summary and Conclusions, 2014), Global Biodiversity Outlook 4; SCBD presentation at regional consultation workshop, Japan, 28 January, 2019; OECD (Green Growth Indicators 2017, 2017), Green Growth Indicators 2017.

In order to help inform the discussion on how one might enhance the measurability of the post-2020 biodiversity framework, it may be useful to consider the existing data sources for natural assets that are available at the multi-country level. The review below builds strongly on a study on *Measuring Green Growth at Country Level* undertaken by Narloch, Kozluk, and Lloyd (2016). Many of the categories in the report, notably those classified as biodiversity, land and soil resources, forests and timber, oceans and fish stock, are relevant to the CBD and the existing suite of Aichi Biodiversity Targets. Table 3 and Table 4 below present excerpts of the work as relevant for the CBD, and adapt and provide updates with additional data that has become available since then (e.g., CCI-Land Cover data). The tables also include efforts currently underway to collect additional data to increase country coverage (e.g. on government support to fisheries), and attempts to clarify which of these multi-country datasets reflect pressure, state, or response variables.

Table 3. Multi-country data sources for natural assets, state and pressures (to be further developed)

| Measurement category | Measurement aspect (and type: pressure, state, response) | Potential indicators | Data source | Data coverage | Notes | Link |
|--------------------------|--|---|--|---|--|---|
| Biodiversity/ Species | Species abundance <i>State</i> | Benefits index for biodiversity | GEF | Global coverage; 2005 and 2008 only | Based on De Pandey et al., 2006 | http://data.worldbank.org/indicator/ER.BDV.TOTL.XQ |
| | Species abundance <i>State</i> | Local biodiversity intactness index | PREDICTS | Global, 2005 snapshot, predicted to 2095 | Shows the relative change in local biodiversity | https://www.nature.com/articles/nature14324 |
| | Trends in extinction risk <i>State</i> | Red List Index | IUCN Red List of threatened species (from IUCN Red List Partnership) | Global coverage; revised regularly | Can be used in many ways already reports on progress towards 10 of the Aichi Targets | http://dx.doi.org/10.1787/data-00605-en |
| | Species Occurrence <i>State</i> | Species range shifts | Global Biodiversity Information Facility | Global coverage over 1 billion records in >40,000 datasets | Largest collection of biodiversity data globally, began from OECD recommendation. Needs to be processed in order to be useful indicator. | https://www.gbif.org/ |
| | Species knowledge, distribution <i>State</i> | Species range shifts | Map of Life | Global coverage and time series | Built on data from GBIF and several other sources (to be completed) | https://mol.org |
| | Species knowledge, population trends, distribution <i>State</i> | Species status information index | Map of Life and GBIF | Global coverage updated twice a year | Shows the proportion of known species within a country about which information is available | https://mol.org/indicators/coverage |
| | Species abundance <i>State</i> | Living planet index | WWF/ZSL | Global, updated annually | Already an indicator under the BIP | http://livingplanetindex.org/home/index |
| | Habitat connectivity <i>State</i> | Protected Area connectivity | DOPA/ EC JRC | Global, and available at national level. ProtConn available for 2016 and 2018 (and soon for 2010, 2012, 2014, and for 2019) | Indicator of terrestrial protected area connectivity. ProtConn (Protected Connected) | https://www.sciencedirect.com/science/article/pii/S0006320717312284?via%3Dihub |
| | Human impacts <i>Pressure</i> | Human footprint index | UNBC/WCS/ETH Zurich/UQ/JCU/CUNY/CIESIN | Global at 1km resolution, only available for 1993 and 2009 | Made from a composite of 8 different human impact proxies | https://datadryad.org/resource/doi:10.5061/dryad.052q5 |
| | Restoration opportunities <i>State</i> | Atlas of Forest and Landscape Restoration Opportunities | WRI/IUCN/UM | Global 1km resolution periodically updated | Composite dataset based on potential habitat models, human pressure and land cover | http://www.wri.org/applications/maps/flr-atlas/# |
| | Agricultural land | Current agricultural area under different crops | FAO | Global; yearly updates | Official data, based on country self-reporting | http://faostat3.fao.org/home/E |

| Measurement category | Measurement aspect (and type: pressure, state, response) | Potential indicators | Data source | Data coverage | Notes | Link | |
|-------------------------|---|--|--|--|---|---|---|
| Land and soil resources | | Distribution of livestock | FAO/University of Oxford | 1km resolution or machine learning generated consensus polygons, 2010 only | Not currently updated annual, based on model predicted distributions from self reported FAO data | http://www.fao.org/livestock-systems/en/ | |
| | Value of agricultural land | Net Present Value of production potential of agricultural land | World Bank Wealth of Nations | Ca. 130 countries; for 1995, 2000, 2005, 2008, 2010, 2014 | Methodology currently updated | http://data.worldbank.org/data-catalog/wealth-of-nations | |
| | Land degradation NB: other land degradation indicators to be considered in the next version e.g. soil organic carbon and land productivity (SDG indicators) | Topsoil loss of agricultural land | FAO Global Assessment of Soil Degradation (GLASOD) | Ca. 145 countries; 1991,2008 | | | http://faostat3.fao.org/download/ES/E |
| | | Vegetation health index | NOAA/NESDIS STAR Global vegetation health produces | Global, 7km resolution 1986-present and 1km 2012-present | Range of products available but 1km resolution only available from 2012 | | https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/index.php |
| | | Erosion Risk map | Global Forest Watch | Global, 15 arc second resolution, 2015 with potential updates | Only available for 2015, update frequency is unclear | | http://water.globalforestwatch.org/map/ |
| Land and soil resources | Land cover change and conversions | Loss (and gains) of natural and semi-natural vegetated land | OECD based on CCI_CL, JRC Global Human Settlement Layer (JRC-GHSL), JRC Global Surface Water (JRC-GSW) | Global | Land cover data from earth observation can further be overlaid with geospatial data on protected areas to assess protected area's effectiveness | Forthcoming on oecd,stat | |
| | | Change in land area covered by buildings | UNCCD, FAO | | | | |
| | Agri-environmental indicators | Farmland Bird Index | Cf JWPAE documents | 12 countries in the EU up until 2014 | Can be used as is, but limited geographic and temporal coverage. | http://ec.europa.eu/eurostat/web/agri-environmental-indicators | |
| | | Nutrient Surpluses, etc | OECD, Eurostat, FAO | To be checked on FAO site | To be completed | To be completed | |
| | | Cropland nutrient balances | Earthstat, UMN IonE, LUGE lab at UBC | Global, 5 arc second, 2000 only (based on input data from 1994-2001) | Only available for 1 year, potential for update is unclear | http://science.sciencemag.org/content/345/6194/325.abstract | |
| Soil carbon stocks | Changes in soil carbon stocks over time | ISRIC-WIS | Global, regularly updated | Soil carbon is reported at 6 standard depths at 1km and 250m resolution. Derived using ensemble machine learning algorithms from | https://www.isric.org/explore/soilgrids | | |

| Measurement category | Measurement aspect (and type: pressure, state, response) | Potential indicators | Data source | Data coverage | Notes | Link |
|----------------------|--|---|---|--|---|---|
| | | | | | a variety of data sources. Based on the SoilGrids data | |
| | Cropland and Pasture Area | Change in cropland extent | USGS FAO Land Use | Global, regularly updated FAO (1961-present) | | https://www.croplands.org/ |
| | Cropland water use | Change in extent of irrigated and rain fed crops | GFSAD1000: Cropland Extent 1km Multi-Study Crop Mask, Global Food-Support Analysis Data | Global, 2000 only | Course resolution and limited to only 5 categories. Also based on 4 other maps with each have considerable associated uncertainty | https://explorer.earthengine.google.com/#detail/USGS%2FGFSAD1000_V1 |
| Forests and timber | Forest land | Land with different forest types and changes over time | FAO Forest Resource Assessment (from FAO Land Use) | Most countries; 1990-present annual updates | Official data based on country self-reporting | http://www.fao.org/forestry/ra/ |
| | | Land with tree cover gain (>25% canopy cover density for any vegetation above 5m) and changes over time | WRI Global Forest Watch based on University of Maryland analysis | Global map (30x30m); annual data from 2000, updates are planned | Results shown in Hansen et al. 2013 | http://www.globalforestwatch.org/ |
| | | Land with tree cover gain | WRI Global Forest Watch based on University of Maryland analysis | Global map (30x30m); annual data 2000-2012 | Results shown in Hansen et al. 2013 | http://www.globalforestwatch.org/ |
| | | Intact forest landscapes | WRI, UMD, Greenpeace, WWF Russia and Transparent World | Global map 30m, 2013 only | Shows landscapes with no signs of human activity | http://www.intactforests.org/ |
| | | Tree cover height | UMD | South America only, 1985-2016 | Limited geographic and temporal scope, | https://resourcewatch.org/data/explore/UMD-TreeCoverHeight |
| | | Forest tenure | Rights and Resources Initiative | 52 of the worlds most forested countries, 2002-2013 | Recognises 4 types of tenure, dataset created from a range of sources | http://rightsandresources.org/en/work-impact/tenure-data-tool/#.WSXopBPyywc |
| | Value of forest land | NPV of rents from sustainable roundwood production non-timber forest resources | World Bank Wealth of Nations | 130 countries; for 1995, 2000, 2005, 2008, 2010, regular updates | Methodology currently updated | http://data.worldbank.org/data-catalog/wealth-of-nations |
| | Timber stocks (and forest stocks) | Volume of industrial roundwood and woodfuel | FAO Forest Resource Assessment (and Forest Statistics) | Most countries; 1990, 2000, 2005 | Official data based on country self-reporting, widely used | http://www.fao.org/forestry/ra/fra2010/en/ |

| Measurement category | Measurement aspect (and type: pressure, state, response) | Potential indicators | Data source | Data coverage | Notes | Link |
|-------------------------|--|---|---|--|---|---|
| | | Above ground live woody biomass | Woods Hole Research Centre | Tropics, 2000 | Only for the tropics and only for one year. A longer time series might serve as a useful indicator | http://data.globalforestwatch.org/datasets/8f93a6f94a414f9588ce4657a39c59ff_1 |
| | | Above ground live mangrove biomass | UNEP-WCMC | Mangroves, 2014 | Limited to only mangroves, but time series would be useful | http://data.unepwcmc.org/datasets/39 |
| | Oil Palm concessions | Change in extent of concessions | WRI | 7 countries (Indonesia, Malaysia (Sarawak), Cameroon, Liberia, Congo, PNG and Soloman Islands) | Not time series and might not relate to the actual extent of oil palm | http://data.globalforestwatch.org |
| | Value of forest resource depletion | Value of excess roundwood harvest that is beyond natural growth (in US\$ or % of GNI) | World Bank World Development Indicators | Ca. 130 countries; 1970-2013, yearly updates | Methodology currently updated | http://data.worldbank.org/indicator/NY.ADJ.DFOR.GN.ZS |
| Oceans and fish stocks | Fishing effort | Marine Landings | OECD FAO FISHSTAT | 38 countries | Self-reported via questionnaire, data gaps exist | https://stats.oecd.org/ |
| | | Global footprint of fisheries | Global fishing watch | 0.5 degree resolution, daily updates | Results are in Kroodsma et al 2018, but daily dynamic maps produced by global fishing watch, the data are also freely available at very high resolution | https://globalfishingwatch.org/map-and-data/ |
| | Ocean health Pressure | Chlorophyll concentration | NASA | Global 9km resolution, 2002-present, monthly updates | Useful to monitoring ocean health, could easily construct time series | https://oceancolor.gsfc.nasa.gov/atbd/chlor_a/ |
| | | Status and exploitation of fish stocks | FAO | Multiple country datasets collated by the Fisheries and resource monitoring system, does not include North or South America or some parts of Asia and Africa | A coordinated database, with multiple datasets | http://firms.fao.org/firms/en |
| Air pollution emissions | Air pollution emissions accounts (under SEEA) | PM2.5, CO, NMVOC, SOx, NOx, and GHGs (CO2, CH4, N2O, HFC, PFC, SF6), | OECD Air Emissions Accounts | Selected countries, 2000-2013, ISIC Rev. 4 | Country coverage will be progressively expanded as countries adopt the SEEA standard. | http://stats.oecd.org/index.aspx?datasetcode=AEA |
| | | | Eurostat air emission accounts | | | |

| Measurement category | Measurement aspect (and type: pressure, state, response) | Potential indicators | Data source | Data coverage | Notes | Link | |
|--------------------------------|--|--|--|---|---|---|---|
| | Greenhouse gas emissions from croplands | total CO2e emissions, CO2e per Kcal of food produced | EarthStat/UMN IonE/LUGE Lab at UBC | Global year 2000 only | Only from the year 2000 but based on 172 crops | http://www.earthstat.org/greenhouse-gas-emissions-croplands/ | |
| Water resources | Available renewable freshwater resources, abstractions and | Total renewable water resources | FAO Aquastat | 200 countries; yearly updates | | http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en | |
| | Water stress | | OECD Environment statistics: water resources FAO Aquastat | | | | |
| | Areas/population exposed to water scarcity | Baseline water stress | | WRI Aqueduct FAO Aquastat | Global coverage; 2014 only | When overlaid with spatial population data, the population exposed to water stress can be calculated | http://www.wri.org/our-work/project/aqueduct/aqueduct-atlas |
| | | Agricultural exposure to water stress | | WRI Aqueduct FAO Aquastat | Global coverage; 2014 only | | http://www.wri.org/our-work/project/aqueduct/aqueduct-atlas |
| | | Overall water risk | | WRI Aqueduct | Global coverage; 2014 only | | http://www.wri.org/our-work/project/aqueduct/aqueduct-atlas |
| | | Flood Risk | | WRI Aqueduct | Global coverage; 2010-2030 (projected) | | http://floods.wri.org/#/ |
| | | Groundwater Vulnerability to Floods and Droughts | | BRG | Global, 2015 only | | https://www.whymap.org/whymap/EN/Maps_Data/maps_data_node_en.html |
| | Rainfall deficit | Global Aridity Index | CGIAR – Consortium for Spatial Information | Global coverage (1x1km), average for 1950-2000 only | Based on of precipitation, temperature and potential | http://www.cgiar-csi.org/data/global-aridity-and-pet-database | |
| Severity of drought conditions | Standardized Precipitation and Evaporation Index | Global SPEI database | Global (50x50km), 1901-2015 | Based on monthly precipitation and potential evapotranspiration from the Climatic Research Unit | http://sac.csic.es/spei/database.html | | |

| Measurement category | Measurement aspect (and type: pressure, state, response) | Potential indicators | Data source | Data coverage | Notes | Link |
|----------------------|--|--|---|---|--|---|
| | Water resources exposed to harmful pollution levels | Surface and groundwater quality | UNEP Global Environment Monitoring System (GEMS) Water Programme | Global (4,100 stations from all around the world) but country coverage and years vary | Measured parameters and frequency varies despite standardized methods | http://www.unep.org/gemswater/GlobalNetwork/tabid/78238/Default.aspx |
| | Freshwater resources and abstractions | Aquifer recharge, evapotranspiration, groundwater for abstraction, inflow, outflow, precipitation, total resource; gross abstraction for public supply, agriculture, manufacturing, electricity production | OECD Environment Statistics | OECD, 1980-2015 | Official data based on country self-reporting | http://stats.oecd.org/index.aspx?datasetcode=WATER_ABSTRACT |
| | Lake and river quality | Nitrates, phosphorus | OECD Environment Statistics | OECD, 1980-2013 | Official data based on country self-reporting | http://stats.oecd.org/index.aspx?datasetcode=WATER_QUALITY |
| | Soil moisture | Changes in average soil moisture over time | NASA-USDA | 2015-present, updated every 3 days, | Satellite monitoring | https://smap.jpl.nasa.gov/ |
| Other | Generic | Environmental performance index | Yale Center for Environmental Law and Policy (YCELP), Data-Driven Yale, and the Columbia University Earth Institute Center for International Earth Science Information Network (CEISIN) | 180 countries every two year | in 2018 the methodology changed so recent scores not comparable with past scores | https://epi.envirocenter.yale.edu |

Source: Adapted and updated from Narlof et al (2016).

Table 4. Multi-country data sources for responses (to be further developed)

| Measurement categories | Measurement aspect (and type: input, process, output, outcome, impact) | Potential indicators | Data source | Data coverage | Notes | Link |
|---|---|---|--|--|--|---|
| Environmental regulation and planning | Protected areas <i>Response: Outcome</i> | Terrestrial and marine protected areas | WDPA (UNEP-WCMC) OECD | All countries; 1990-2012 OECD: 47 countries; 1970, 80, 90, 95, 2000, 05, 10, 15, 17 | OECD: data without double-counting areas that overlap. | ProtectedPlanet.net http://dx.doi.org/10.1787/5fa661ce-en |
| | Environmental protection expenditure <i>Response: Input</i> | Environmental protection expenditure as % of GDP | OECD | OECD, 1990-2015 | Official data based on country self-reporting (OECD/Eurostat questionnaire) Questionnaire under revision to align with the SEEA. Plan to better cover biodiversity related expenditure. | http://stats.oecd.org/index.aspx?datasetcode=EPER |
| | Biodiversity expenditure <i>Response: Input</i> | | Eurostat (and OECD) BIOFIN CBD CHM | Varies | | |
| | Fossil fuel support ¹¹ <i>Outcome</i> | Price-gap based fossil fuel subsidies | IEA | 39 (primarily developing) countries; 2007-2011 | IEA has been constructing this dataset for over a decade uses price-gap approach | http://www.worldenergyoutlook.org/resources/energysubsidies/fossilfuelsubsidydatabase/ |
| | | Budgetary transfer and tax expenditure-based fossil fuel subsidies | OECD | OECD and G20 countries; 2005-2013 | OECD uses budgetary transfers and tax expenditures and broader range of measures than IEA | http://www.oecd.org/site/tadffss/ |
| | Fisheries support <i>Outcome</i> | Government support to fisheries | OECD | OECD and 4 non-OECD countries; 2008-2018 | Official data based on country self-reporting (OECD questionnaire) | http://stats.oecd.org/Index.aspx?datasetcode=FISH_FSE |
| | Agriculture support <i>Outcome</i> | Government support to agriculture | OECD | More than 45 countries | Also shown as trends in potentially environmentally harmful, neutral and other government support to agriculture | OECD PSE database |
| Environmental Policy Stringency | Index of stringency of Environmental Policies | OECD | 24 OECD countries; 1990-2012 | Composite indicators based on individual policies, new update including BRIICS countries in early 2016 | http://oe.cd/OQ | |
| | Policies and practices for IUU fishing | | OECD | 30 countries plus Chinese Taipei; 2005, 2016 (and soon 2018) | | |
| Biodiversity relevant policy incentives | Positive incentives for biodiversity conservation and sustainable use <i>Outcome</i> | Biodiversity-relevant taxes, charges and fees (including revenues); biodiversity-relevant tradable permits, subsidies. <i>Will soon add PES and biodiversity offsets</i> | OECD | More than 90 countries (OECD and several non-OECD countries); 1994-present | Official data based on country self-reporting (OECD questionnaire) | http://oe.cd/pine Tracking economic instruments and finance for biodiversity |

Source: Adapted and updated from Narlof, Kozluk and Loyd (2016).

¹¹ Difference between IEA and OECD explained: <http://www.oecd.org/site/tadffss/>. On-going methodological paper being prepared by OECD and others to address these given this is an SDG indicator.

Other sources of data to consider are those made available by the GBIF and those listed in (UNEP-WCMC, 2018). The GBIF is an international network and research infrastructure providing open access to biodiversity data. GBIF was created in response to recommendation from the OECD's Megascience Forum in 1999 and since its inception in 2001 it has grown to include over 1 billion species occurrence records and 41 000 datasets. The GBIF is relevant to the Aichi targets as growth in the number of records is an indicator under the BIP (targets 9,11,12,13 and 19). Overall, as noted by (Bingham, et al., 2017) and the BIP (2018), increasing the connections between the different information platforms and organisations at a global level will be important for improving the capacity for data collection and its utilisation in tracking progress towards the post-2020 framework, at international and national levels.

As noted earlier, another way that the response variables can be considered is in terms of inputs, process, outputs, outcomes and impacts (see Table 1 above). Earlier efforts by the OECD have explored how monitoring and evaluation of biodiversity mainstreaming could be undertaken and categorised various indicators as reflected in OECD (2018), *Mainstreaming Biodiversity for Sustainable Development*, Chapter 5 on 'Monitoring and Evaluating Biodiversity Mainstreaming' (Table 5.3, pp 169-170).