A THREE-DIMENSIONAL FRAMEWORK TO EVALUATE BIODIVERSITY POLICY INDICATORS APPLICABLE TO BOTH THE GLOBAL AND NATIONAL SCALES

by

Sang Hun Lee

A dissertation submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Energy and Environmental Policy

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Approved: _____

John Byrne, Ph.D.
Professor in charge of the dissertation on behalf of the Advisory Committee

Approved: _____

S. Ismat Shah, Ph.D.
Director of the Energy and Environmental Policy Program

Approved: _____

Maria P. Aristigueta, D.P.A.
Dean of the Joseph R. Biden, Jr. School of Public Policy and Administration

Approved: _____

Louis F. Rossi, Ph.D.
Vice Provost for Graduate & Professional Education and Dean of the Graduate College

I certify that I have read this dissertation and that in my opinion it meets the academic and professional standard required by the University as a dissertation for the degree of Doctor of Philosophy.

Signed: _____

John Byrne, Ph.D.
Professor in charge of dissertation

I certify that I have read this dissertation and that in my opinion it meets the academic and professional standard required by the University as a dissertation for the degree of Doctor of Philosophy.

Signed: _____

Saleem Ali, Ph.D.
Member of dissertation committee

I certify that I have read this dissertation and that in my opinion it meets the academic and professional standard required by the University as a dissertation for the degree of Doctor of Philosophy.

Signed: _____

Jaeho Lee, Ph.D.
Member of dissertation committee

I certify that I have read this dissertation and that in my opinion it meets the academic and professional standard required by the University as a dissertation for the degree of Doctor of Philosophy.

Signed: _____

Casey Stevens, Ph.D.
Member of dissertation committee

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More than twenty years ago, I was a little boy who loved to go fishing with his father. When wading in a river, I saw so many beautiful kinds of fish, and I felt the touch of the river and heard the sounds of other lives. Although I didn't yet know the meaning of the word, what I was experiencing was "biodiversity." This experience has led me to become a scholar who seeks ways for humans to live in harmony with nature.

The long journey to this dissertation would not have been possible without the help of many people. First of all, I would like to thank my family for their love and support. My parents always have been there for me. I want to tell them how much I appreciate their endless love and that I love them too.

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ABSTRACT

The Strategic Plan for Biodiversity 2011-2020 and Aichi Biodiversity Targets were adopted in 2010 to reduce the rapid decline of global biodiversity. However, the implementation of the global strategies at the national level has not been assessed and analyzed in a systematic way due to the lack of appropriate indicators. The necessity of compatible indicators that can be applied to both the global and national levels has been emphasized in multiple studies and international conventions including the Convention on Biological Diversity (CBD). The primary focus of the current global efforts, on the other hand, is mostly on the global level.

This study evaluates a set of global indicators identified by a detailed review of the research literature that can be applied to both the global and national scales and makes suggestions for improving indicators. It takes an integrated approach with three dimensions: indicators, criteria, and countries. Studies so far have not fully investigated national usability. Since the gap is larger in policy indicators than in scientific indicators, this study focuses on policy indicators. Thirteen global indicators, four criteria, and five countries are selected for the three-dimensional framework to evaluate biodiversity policy indicators. All 13 selected indicators are found to be usable at both the national and global scales. This study finds that data availability of indicators is high if there are data-collecting organizations, and indicators are used by more countries if they are simple or the use of them is encouraged by international organizations. Therefore, it is recommended to establish a data-collecting body and to encourage the use of indicators to enhance data availability and country-level usage. In

terms of data availability, it is found that there is a capacity gap between developed and developing countries since data availability is higher in countries with higher GDP. Most of the indicators analyzed in this study do not have sufficient academic evidence to show whether the actual change in biodiversity can be projected by the indicators. After the evaluation, the dissertation proposes two indices for use in the future: NBSAP Index and Biodiversity ODA Index. These indices can identify information that could not be captured by the existing indicators.

The three-dimensional framework in this study has three strengths: (a) the framework can be used as a basic tool to evaluate indicators, (b) internal and external factors that affect the institutional value of indicators can be analyzed, and (c) the framework can show patterns of data availability and current usage among countries to identify the capacity gap. It is expected that this three-dimensional framework would contribute to a better understanding of biodiversity policy indicators, leading to efficient and effective research in developing and improving indicators in the future.

Chapter 1

INTRODUCTION

1.1 Global Biodiversity Strategy and Indicators

Biodiversity, or the variability among living organisms, has become an issue of global concern in the past decades due to its rapid loss across the world. Recognizing the importance of biodiversity in sustaining life on earth including humanity, the Convention on Biological Diversity (CBD) was adopted at the United Nations Conference on Environment and Development in 1992. Parties to the CBD are making efforts to implement the convention, its protocols, and other policies adopted by the Conference of the Parties (COP). The COP is the main governing body of the CBD that sets norms and policies through the decisions adopted at its periodic meetings.

The Strategic Plan for Biodiversity 2011-2020 (hereinafter "the Strategic Plan 2011-2020") and Aichi Biodiversity Targets were adopted at the tenth meeting of the COP held October 18-29, 2010, in Nagoya, Japan. The Strategic Plan 2011-2020 provides an overarching international framework on biodiversity for the biodiversity-related conventions and other biodiversity management and policy development mechanisms (CBD, 2020). It has five strategic goals and 20 global targets to be achieved by 2020 (Table 1.1). The five goals follow the Drivers-Pressures-State-Impacts-Responses (DPSIR) model, aiming to address the global biodiversity issue in an integrated manner contrasting to the previous environmental targets that only focused on building capacities for conservation activity or reducing pressures on biodiversity (Mace et al., 2013).

Table 1.1 Strategic Plan for Biodiversity 2011-2020 and Aichi Biodiversity Targets

Mission: Take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services, thereby securing the planet's variety of life, and contributing to human well-being, and poverty eradication. To ensure this, pressures on biodiversity are reduced, ecosystems are restored, biological resources are sustainably used and benefits arising out of utilization of genetic resources are shared in a fair and equitable manner; adequate financial resources are provided, capacities are enhanced, biodiversity issues and values mainstreamed, appropriate policies are effectively implemented, and decision-making is based on sound science and the precautionary approach.	
Strategic goal A. Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society	
Target 1	By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.
Target 2	By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.
Target 3	By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio-economic conditions.
Target 4	By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.
Strategic goal B. Reduce the direct pressures on biodiversity and promote sustainable use	
Target 5	By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.
Target 6	By 2020, all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.

Table 1.1 Continued.

Target 7	By 2020, areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.
Target 8	By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.
Target 9	By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.
Target 10	By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.
Strategic goal C. Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity	
Target 11	By 2020, at least 17 per cent of terrestrial and inland water areas, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.
Target 12	By 2020, the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.
Target 13	By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.
Strategic goal D. Enhance the benefits to all from biodiversity and ecosystem services	
Target 14	By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.
Target 15	By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

Table 1.1 Continued.

Target 16	By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.
Strategic goal E. Enhance implementation through participatory planning, knowledge management and capacity-building	
Target 17	By 2015, each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.
Target 18	By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.
Target 19	By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.
Target 20	By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization, should increase substantially from the current levels. This target will be subject to changes contingent to resource needs assessments to be developed and reported by Parties.

Source: CBD COP Decision X/2

With the target timeline for the Strategic Plan and Aichi Biodiversity Targets getting closer, there is a need to analyze progress towards the goals for 2020. The development of indicators is essential to monitor and evaluate progress, and a lack of relevant indicators has been a hurdle for this (Balmford et al., 2005; Cicin-Sain et al., 2011). Moreover, many of the biodiversity indicators are underdeveloped and underinvested, so the development of indicators or the improvement of existing

indicators is required (Jones et al., 2011; Walpole et al., 2009). There are a relatively small number of relevant and evidenced indicators, especially for Aichi Biodiversity Targets 3, 13, 16, 18, 19, and 20, most of which are policy targets (Bubb et al., 2011). Mcowen et al. (2016) also pointed out that socio-economic indicators, including those for Aichi Biodiversity Targets 1, 16, 17, 18, 19, and 20, still need to be enhanced to inform decision-making.

Global society is trying to develop a set of indicators under the CBD. In 2016, the Ad Hoc Technical Expert Group (AHTEG) on Indicators for the Strategic Plan for Biodiversity 2011-2020 presented a list of indicators that is under updating (CBD COP Decision XIII/28). There have been several efforts to assess the progress towards the Aichi Biodiversity Targets by applying global biodiversity indicators. Leadley et al. (2014) used a wide range of indicators including those developed by the Biodiversity Indicators Partnership to review the progress, and Tittensor et al. (2014) conducted a mid-term analysis of the progress using 55 indicator data sets. The CBD also published and released the fourth edition of the Global Biodiversity Outlook (GBO-4) at the CBD COP 12 in 2014, based on relevant literature including the aforementioned analyses. GBO is a periodic report published by the CBD which provides summaries on the latest global status and trends of biodiversity (CBD, 2015).

While developing effective indicators is critical for countries to evaluate their actions to promote biodiversity, most of existing indicators are for the global level (Soberón & Peterson, 2009). Using the developed indicators not only at the global level but also at the national level has been continuously emphasized in the COP meetings (CBD COP Decisions XI/3, XII/2, XIII/28, & 14/1). However, less than half of the indicators provided by the AHTEG at COP 13 are potentially applicable at the

national level.[1] Moreover, some indicators are inconsistent between different levels (Hayashi, 2020).

There are some programs and studies to apply global indicators at the national level. The Biodiversity Indicators Partnership (BIP) provides a set of global indicators with some information on national usage. The number of nationally usable indicators available online from the BIP's website is 69 as of March, 2020, however, among which only 12 indicators are indicators for policy-related Aichi Targets.[2] The BIP mostly focuses on providing practical information such as backgrounds, methodologies, and examples of national use of indicators, but it does not conduct comprehensive evaluation of indicators. Bowles-Newark et al. (2015) further investigated on the indicators provided by the BIP to illustrate how to adapt global indicators at the national level. For example, Szabo et al. (2012) adapted the Red List Index to the national scale for the first time using the originally designed methods. Szabo et al. (2012) also pointed out that the indicators developed for global scale need to be implemented at multiple scales including the global and national scales for their effectiveness.

The development and identification of global indicators that are compatible with national indicators would bring several benefits. First of all, compatible indicators would contribute to closing the data gaps at multiple scales. Often,

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[1] A total of 147 indicators were presented in the CBD COP Decision XIII/28. Among them, only 50 indicators were marked to have a possibility to be disaggregated to create national indicator or aggregated from national data.

[2] Which are considered as policy-related targets among the twenty Aichi Targets is presented in Chapter 2.

biodiversity data are from national government or non-governmental organization (NGO) databases. These data are aggregated to form global indicators, but there is a huge gap in the data. Current biodiversity data often lack compatibility between data sets due to different collection methodologies and insufficient integration at different levels (national and global) (Mace et al., 2005). Therefore, data collection needs to be conducted in a coordinated and integrated manner to fill the data gaps (Jones et al., 2011; Maes et al., 2016; Pereira & Cooper, 2006). Indicators that can be commonly used for both global and national data can facilitate this coordination and integration, while also making it possible for the Secretariat of the Convention on Biological Diversity (SCBD) to easily aggregate or disaggregate the data.

Secondly, having a common set of indicators can increase synergy in international conventions and reduce reporting burdens of member states, especially of countries that do not have enough capacity and human resources to prepare for reports (CBD, 2019; United Nations Environment Programme [UNEP], 2015). The COP, at its thirteenth meeting, requested the Executive Secretary of the SCBD to consider developing common sets of indicators to enhance synergy on national reporting among relevant conventions (CBD COP Decision XIII/27).

Thirdly, using common indicators would increase objectivity, reduce arbitrary evaluation, and thus make it possible to compare. Currently, each Party evaluates its performance with its own indicators, which leads to a less convincing interpretation. South Korea, for example, concluded that its contribution rate of the 3rd National Biodiversity Strategy to the Aichi Biodiversity Target 20 is 100%, while the SCBD scored South Korea's achievement only 2 points out of 5 for the same target (CBD, 2016; Ministry of Environment, Republic of Korea, 2016). In the meantime, the use of

common indicators allows policy makers to compare even among different areas within a country as exemplified by Byrne et al. (2017).

Among the above benefits, it is worth taking note of the importance of reducing reporting burdens. There are several cases of global efforts to facilitate alignment of reporting requirements. The World Health Organization (WHO), for example, has been publishing global reference list of core health indicators to provide a guidance for selecting and using standard indicators. Indicators related to the Sustainable Development Goals (SDGs) are newly included in the 2018 edition (WHO, 2018).[3] The CBD also has a long history of harmonization of biodiversity-related reporting. A feasibility study for a harmonized information management infrastructure for biodiversity-related treaties was conducted in 1998, and a number of relevant decisions and recommendation have been adopted (CBD, 2019). Just as the WHO recently reflected health-related SDGs in its core health indicator list, it is necessary to further study the usability of biodiversity-related SDG indicators. Indicators that increase reporting burdens would not be used by countries even though they are scientifically well developed.[4] For the practical reasons, it is necessary to particularly consider linkage with other internationally agreed schemes including the SDGs.

Despite the benefits of compatible indicators, the focus of current global efforts is mostly on developing and testing global indicators. Moreover, there are only a small number of socio-economic indicators to assess the progress in policy targets

[3] SDGs are 17 global goals to achieve by 2030 adopted at the United Nations Sustainable Development Summit in September 2015.

[4] Personal communication with a staff member at the SCBD in May 2018.

(Bubb et al., 2011; Mcowen et al., 2016). It is already the year of 2020, which is the time for reviewing the progress towards the 2020 global targets and setting a new strategy and targets for the next time-period. The post-2020 global biodiversity framework, which includes a new statement of mission, goals, and action targets for 2030, is currently under preparation. This preparation includes a comprehensive and participatory process to encourage all relevant stakeholders including Parties, international organizations, civil society, business community, and scientific community. Indicators are not only a tool for monitoring but also a means for communication between different stakeholders. Therefore, there is an impending need to identify and evaluate policy indicators that can be used at multiple levels. This will help the global society to assess the progress so far and to develop policies after 2020.

1.2 Role of Indicators in Global Environmental Governance

Indicators play a critical role in monitoring, assessing, and reporting the state of environment (Lehtonen, 2015). Therefore, a variety of indicators have been developed and used under the system of global environmental governance. One example is the global indicator framework for SDGs which include more than two hundred relevant indicators to monitor progress towards SDGs to be achieved by 2030. Indicators are used at different levels of environmental governance by different actors including international organizations, national governments, and other stakeholders (Lehtonen, 2015).

Establishing international environmental laws, or multilateral environmental agreements (MEAs), has been one of the major trends in global environmental governance to tackle environmental degradation (Delreux, 2018; Speth & Haas, 2006). International environmental laws can be classified into either hard law or soft law,

although the definitions vary among scholars (Shaffer & Pollack, 2010). Hard law can be defined as legally binding obligations, while soft law is legal arrangements with non-binding or weakened elements (Abbott & Snidal, 2000; Speth & Haas, 2006). Hard law is believed to have higher enforcement power technically, but both hard and soft law have advantages and weaknesses in reality (Shaffer & Pollack, 2010; Speth & Haas, 2006).

Unfortunately, most of the MEAs, regardless of whether they are hard law or soft law, have not been successful in achieving their goals (Clapp & Dauvergne, 2005). There are several measures to improve compliance of MEAs by contracting parties. Some MEAs have their own compliance mechanisms, while some others incorporate other treaties' measures that have stronger enforcement power, such as trade measures under the World Trade Organization (WTO) (Brack & Gray, 2003; Goeteyn & Maes, 2011).

Reporting and reviewing the implementation of environmental treaties is also essential in compliance mechanisms (Goeteyn & Maes, 2011). MEAs can take advantage of indicators for enhanced transparency, accountability, and precision, which are important factors that make Parties participate in and implement treaties (Abbott & Snidal, 2000; Bodansky, 2015). Thus, indicators are a useful tool not only to monitor the state of the environment but also to promote the implementation of international treaties. Institutionalization of indicators, or giving them legal status, might also help increase the link between indicators and relevant actions (Rapport & Hildén, 2013).

There are diverse actors in global environmental governance that possibly use indicators to review the state of implementation of MEAs. These actors can be

categorized into nation states, international organizations, NGOs, business actors, and science networks (Biermann & Pattberg, 2012; Porter & Brown, 1991). Although the role of each actor has changed over time, nation states have been in the center of global environmental governance (Compagnon et al., 2012). Development and use of indicators usually have been driven by national governments and international organizations as shown in CBD COP Decision XIII/27.

However, the role of other actors is no less important than that of nation states or international organizations. One of the strongest efforts to improve treaty performance comes from third-party actors including NGOs, business actors, and other relevant stakeholders. Nation states are often pressured by these actors (Speth & Haas, 2006). A well-known example is the influence of NGOs that can be found in the negotiations for the Paris Agreement, including its advocacy of a 1.5-2.0°C target (Allan & Hadden, 2017). After treaties are signed and amended, NGOs also play a significant role in pushing nation states to comply with their treaty obligations by naming and shaming (Falkner, 2016).

Recognizing the influential power of third parties, some MEAs have mechanisms for them to intervene, which include third-party monitoring. These mechanisms allow third parties to verify the accuracy of the information provided by nation states and inform, when necessary, the treaty secretariat of non-compliance by a contracting party (Goeteyn & Maes, 2011). In this respect, the importance of indicators can be underscored because they enable independent third-party support roles in treaty enforcement and compliance.

More and more MEAs are adopting a periodic review, such as stock-take. This may bring in the third-party voice in negotiations more than before. The 5-year review

sessions of the Paris Agreement, for example, are expected to increase the role of civil society in monitoring and giving pressures to governments to comply and exceed their national commitments (Falkner, 2016). If more indicators are considered and incorporated in a stock-take process, they would facilitate stock-take as a mechanism of periodic performance review, as is the case with the United Nations Framework Convention on Climate Change (UNFCCC). Integrated Assessment Models (IAMs) for climate change are a broad range of approaches to integrate knowledge from different disciplines into a single assessment (Hare et al., 2018; van Vuuren et al., 2011). As applications of IAMs spread in evaluating climate change policies, they have promoted stock-taking including their use by NGOs to argue for greater national commitments.

Indicators that can be used only by a certain actor or at a certain level would have less transparency since it is not possible for other actors to verify and produce the same indicator. Indicators sometimes have been used selectively or misused deliberately, which undermines the credibility of indicator systems (Lehtonen, 2015). There have been discussions to enhance the level of transparency to address this issue (e.g. Hood, 2007; Jackson, 2011).

Therefore, it is of great importance to identify and evaluate indicators that can be used by diverse actors such as international organizations at the global level, national governments at the national level, and civil society at the level of societal interest. If indicators are evaluated in an integrated manner, it would bring benefits including the enhancement of transparency, the increase of third-party actors' role, and the promotion of stock-taking (this point is elaborated in Chapter 6).

1.3 Research Objectives

This research aims to evaluate existing global biodiversity indicators that can also be used at the national level. During the evaluation, the following questions will be answered: (a) which global indicators are good for use at both the global and national levels for a better compatibility; and (b) if those indicators are not used at the national level, what are ways to encourage use of them.

An integrated approach is essential to address the global biodiversity challenge, including the setting of biodiversity targets, the development of indicators, the collection of data, and linking science and policy (Mace et al., 2005; Mace et al., 2013; Pereira & Cooper, 2006). Therefore, this research intends to offer an integrated methodology with three dimensions to evaluate selected indicators. The three dimensions are: indicators, criteria, and countries. Biodiversity-related indicators can be collected from a wide range of research such as academic papers and grey literature. And then, a set of criteria need to be composed to evaluate the indicators. By investigating the actual data availability and usage of indicators by countries, the indicator evaluation can be completed practically as well as technically.

Until now, only partial evaluations at the maximum of two dimensions have been conducted, and national usability has not been practically investigated. For example, the BIP showed the national usage of some global indicators without applying evaluation criteria; the AHTEG assessed global indicators' possibility to be disaggregated to obtain national data while no further information on national-level cases is provided; Chenery et al. (2015) focused on identifying potential global indicators by certain criteria, but not on the national usage by countries; and Tittensor et al. (2014) used global indicators at the global level while lacking the evaluation of

indicators. Thus, there has been no comprehensive evaluation of policy indicators focusing on national usability, which this research is dealing with.

There are already relatively many indicators to evaluate the status of biodiversity from the perspective of natural science. In addition, the Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services (IPBES) is expected to develop tools for the scientific evaluation. Considering these facts, this research focuses on socio-economic indicators. The objective of using a three-dimensional framework including analysis by country is not to compare the performances and achievements of each country but to find implications for the development of indicators in the future.

After the evaluation of indicators, some suggestions can be made to address the challenges in developing indicators and facilitating their use. Comparison by indicator, criterion, and country will help to identify reasons why some indicators are not used and provide insights into improving indicators in the future.

Fortunately, some lessons can also be learned from other international conventions. The UNFCCC and the CBD have some common features. Both of them, along with the United Nations Convention to Combat Desertification (UNCCD), were adopted at the United Nations Conference on Environment and Development in 1992. They have mechanisms for national strategies including action plans to achieve global goals. Nationally Determined Contributions (NDCs) under the Paris Agreement provide national targets to reduce greenhouse gas emissions and spur relevant climate actions.[5] Similarly, Parties to the CBD are required to submit their National

[5] The Paris Agreement was adopted at the twenty-first COP to the UNFCCC in 2015. It aims to enhance the global efforts to combat climate change with a target of holding the global average temperature increase to "well below 2°C above pre-industrial

Biodiversity Strategies and Action Plans (NBSAPs). Ways of setting targets and utilizing indicators can be learned from UNFCCC experience, in particular from the Convention's design and implementation of an NDC process.

In sum, the objective of this study is to evaluate biodiversity policy indicators considering the possibility of using at both global and national scales. There has not been comprehensive research for the evaluation of indicators, despite the importance of an integrated approach in this field. Thus, a new three-dimensional framework is designed to find issues in using the existing indicators and to provide insights into improving indicator usability and coverage in the future.

1.4 Organization of Chapters

In this chapter, the background of the global biodiversity strategy and the necessity of compatible indicators that can be used at the national level as well as the global level were discussed. The objective of this research was also presented in the previous section.

Chapter 2 elaborates on the analytical framework this research is based on. In the first section, how the Aichi Biodiversity Targets follow the DPSIR framework and how the policy-related targets and policy indicators are defined in this study are explained. The second section presents the design of a three-dimensional framework suggested in this study.

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levels" and pursuing further efforts to limit the temperature increase to "1.5°C above pre-industrial levels." It entered into force on November 4, 2016, and there are 189 Parties to this Agreement as of March 11, 2020.

Chapter 3 provides a detailed methodology of the three-dimensional framework. It presents methodologies to select indicators, criteria, and countries for this study. This chapter also explains how a comparative analysis is conducted. Lastly, the structure of Chapter 4 is previewed.

Chapter 4 evaluates indicators that are selected for this study. Indicators are categorized by the topics they address. After the evaluation, a summary table is shown at the end of this chapter, reporting findings and demonstrating the usefulness of the three-dimensional framework for evaluation of CBD-relevant indicators.

Chapter 5 conducts a comparative analysis. The results of the evaluation in Chapter 4 are analyzed by criterion, country, and indicator. Lessons from the Paris Agreement and NDCs are presented, and accordingly, new indices for tracking trends of biodiversity policies are suggested.

Chapter 6 concludes this study. A summary of the analysis, the importance of the three-dimensional framework, the challenges in this study, and the recommendations for future research are presented.

Chapter 2

ANALYTICAL FRAMEWORK

2.1 Aichi Biodiversity Targets and DPSIR Framework

After 10 years of adopting the CBD, the Strategic Plan for the CBD, which is the first global biodiversity strategy, was developed in 2002. Its mission was to significantly reduce the rate of biodiversity loss at the global, regional, and national levels by 2010 (Table 2.1). The Strategic Plan 2002-2010 had four goals to achieve its mission.[6] However, it did not have specific goals and targets at the time of the development, which means that the goals and targets were not measurable for the review and evaluation.

Two years later, the COP decided to develop a framework for the evaluation of the progress towards the Strategic Plan 2002-2010 and to establish goals and sub-targets for the clarification of the goals under the Strategic Plan 2002-2010. Eleven goals and 21 sub-targets were set under seven focal areas (Table 2.2). These goals and sub-targets were clearer than the Strategic Plan 2002-2010, but they were still vague to determine whether they were achieved or not. Provisional indicators were also adopted at this time, but they were in early stage of development and yet needed improvements in their design (Mace & Baillie, 2007).

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[6] The original wording for this plan is "Strategic Plan for the Convention on Biological Diversity," but it will be written as the Strategic Plan 2002-2010 in this study to distinguish it from the Strategic Plan for Biodiversity 2011-2020.

Table 2.1 Strategic Plan for the CBD (2002-2010)

Mission: Parties commit themselves to a more effective and coherent implementation of the three objectives of the Convention, to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth.
Goal 1: The Convention is fulfilling its leadership role in international biodiversity issues. 1.1 The Convention is setting the global biodiversity agenda. 1.2 The Convention is promoting cooperation between all relevant international instruments and processes to enhance policy coherence. 1.3 Other international processes are actively supporting implementation of the Convention, in a manner consistent with their respective frameworks. 1.4 The Cartagena Protocol on Biosafety is widely implemented. 1.5 Biodiversity concerns are being integrated into relevant sectoral or cross-sectoral plans, programmes and policies at the regional and global levels. 1.6 Parties are collaborating at the regional and subregional levels to implement the Convention.
Goal 2: Parties have improved financial, human, scientific, technical, and technological capacity to implement the Convention. 2.1 All Parties have adequate capacity for implementation of priority actions in national biodiversity strategy and action plans. 2.2 Developing country Parties, in particular the least developed and the small island developing States amongst them, and other Parties with economies in transition, have sufficient resources available to implement the three objectives of the Convention. 2.3 Developing country Parties, in particular the least developed and the small island developing States amongst them, and other Parties with economies in transition, have increased resources and technology transfer available to implement the Cartagena Protocol on Biosafety. 2.4 All Parties have adequate capacity to implement the Cartagena Protocol on Biosafety. 2.5 Technical and scientific cooperation is making a significant contribution to building capacity.

Table 2.1 Continued.

Goal 3: National biodiversity strategies and action plans and the integration of biodiversity concerns into relevant sectors serve as an effective framework for the implementation of the objectives of the Convention. 3.1 Every Party has effective national strategies, plans and programmes in place to provide a national framework for implementing the three objectives of the Convention and to set clear national priorities. 3.2 Every Party to the Cartagena Protocol on Biosafety has a regulatory framework in place and functioning to implement the Protocol. 3.3 Biodiversity concerns are being integrated into relevant national sectoral and cross-sectoral plans, programmes and policies. 3.4 The priorities in national biodiversity strategies and action plans are being actively implemented, as a means to achieve national implementation of the Convention, and as a significant contribution towards the global biodiversity agenda.
Goal 4: There is a better understanding of the importance of biodiversity and of the Convention, and this has led to broader engagement across society in implementation. 4.1 All Parties are implementing a communication, education, and public awareness strategy and promoting public participation in support of the Convention. 4.2 Every Party to the Cartagena Protocol on Biosafety is promoting and facilitating public awareness, education and participation in support of the Protocol. 4.3 Indigenous and local communities are effectively involved in implementation and in the processes of the Convention, at national, regional and international levels. 4.4 Key actors and stakeholders, including the private sector, are engaged in partnership to implement the Convention and are integrating biodiversity concerns into their relevant sectoral and cross-sectoral plans, programmes and policies.

Source: CBD COP Decision VI/26

Table 2.2 Focal areas, goals, and sub-targets of the Strategic Plan 2002-2010

Focal Areas	Goals and sub-target
Protect the components of biodiversity	**Goal 1. Promote the conservation of the biological diversity of ecosystems, habitats and biomes** Target 1.1: At least 10% of each of the world's ecological regions effectively conserved. Target 1.2: Areas of particular importance to biodiversity protected **Goal 2. Promote the conservation of species diversity** Target 2.1: Restore, maintain, or reduce the decline of populations of species of selected taxonomic groups Target 2.2: Status of threatened species improved. **Goal 3. Promote the conservation of genetic diversity** Target 3.1: Genetic diversity of crops, livestock, and of harvested species of trees, fish and wildlife and other valuable species conserved, and associated indigenous and local knowledge maintained.
Promote sustainable use	**Goal 4. Promote sustainable use and consumption.** Target 4.1: Biodiversity-based products derived from sources that are sustainably managed, and Production areas managed consistent with the conservation of biodiversity. Target 4.2: Unsustainable consumption, of biological resources, or that impacts upon biodiversity, reduced Target 4.3: No species of wild flora or fauna endangered by international trade
Address threats to biodiversity	**Goal 5. Pressures from habitat loss, land use change and degradation, and unsustainable water use, reduced.** Target 5.1: Rate of loss and degradation of natural habitats decreased **Goal 6. Control threats from invasive alien species** Target 6.1: Pathways for major potential alien invasive species controlled. Target 6.2: Management plans in place for major alien species that threaten ecosystems, habitats or species. **Goal 7. Address challenges to biodiversity from climate change, and pollution** Target 7.1: Maintain and enhance resilience of the components of biodiversity to adapt to climate change Target 7.2: Reduce pollution and its impacts on biodiversity

Table 2.2 Continued.

Focal Areas	Goals and sub-target
Maintain goods and services from biodiversity to support human well-being	**Goal 8. Maintain capacity of ecosystems to deliver goods and services and support livelihoods** Target 8.1: Capacity of ecosystems to deliver goods and services maintained. Target 8.2: biological resources that support sustainable livelihoods, local food security and health care, especially of poor people maintained
Protect traditional knowledge, innovations and practices	**Goal 9 Maintain socio-cultural diversity of indigenous and local communities** Target 9.1: Protect traditional knowledge, innovations and practices Target 9.2: Protect the rights of indigenous and local communities over their traditional knowledge, innovations and practices, including their rights to benefit sharing
Ensure the fair and equitable sharing of benefits arising out of the use of genetic resources	**Goal 10. Ensure the fair and equitable sharing of benefits arising out of the use of genetic resources** Target 10.1: All transfers of genetic resources are in line with the Convention on Biological Diversity, the International Treaty on Plant Genetic Resources for Food and Agriculture and other applicable agreements. Target 10.2: Benefits arising from the commercial and other utilization of genetic resources shared with the countries providing such resources
Ensure provision of adequate resources	**Goal 11: Parties have improved financial, human, scientific, technical and technological capacity to implement the Convention** Target 11.1: New and additional financial resources are transferred to developing country Parties, to allow for the effective implementation of their commitments under the Convention, in accordance with Article 20. Target 11.2: Technology is transferred to developing country Parties, to allow for the effective implementation of their commitments under the Convention, in accordance with its Article 20, paragraph 4.

Source: CBD COP Decision VII/30

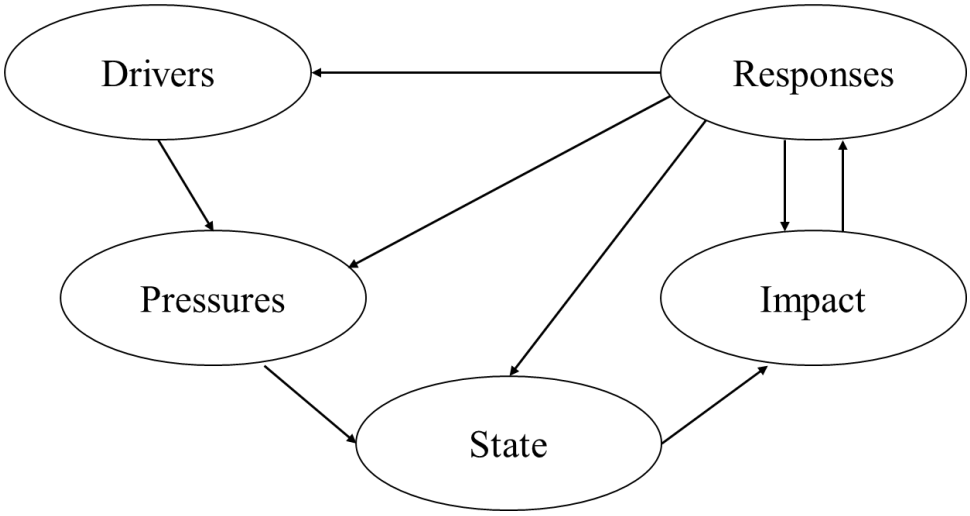
With a lack of clear targets and indicators, the SCBD concluded in 2010 that the first global strategy for biodiversity and its targets for 2010 had not been met (SCBD, 2010). Rather, biodiversity had declined continuously without significant reductions in rate (Butchart et al., 2010). Thus, there was an urgent need for revising the global strategy accordingly.

In 2010, the second global strategy, the Strategic Plan for Biodiversity 2011-2020, was adopted at the 10th meeting of the CBD COP. It includes a new mission, five strategic goals, and 20 Aichi Biodiversity Targets as shown in Chapter 1 (Table 1.1). The mission became more ambitious. The previous mission of the Strategic Plan 2002-2010 was to 'reduce' the rate of biodiversity loss, while the new mission of the Strategic Plan 2011-2020 is to 'halt' the loss of biodiversity (Table 1.1 & 2.1). The goals and targets of the Strategic Plan 2011-2020 were established more systematically following the DPSIR framework (Mace et al., 2013). Recognizing the urgency of conservation of biodiversity, the UN General Assembly, at its 65th session, declared 2011-2020 the United Nations Decade on Biodiversity to support global efforts to implement the Strategic Plan 2011-2020.

Five strategic goals and 20 Aichi Biodiversity Targets are underscored by the DPSIR framework. DPSIR is a causal framework for describing the interactions between society and the environment (European Environment Agency [EEA], 2007). It is an expanded version of the pressure-state-response (PSR) model that was originally proposed by Rapport and Friend (1979) and then further developed by the Organisation for Economic Co-operation and Development (OECD) (as cited in OECD, 2011, p.238). DPSIR helps policy makers understand complex environmental

problems easily as well as systematically. How each category under this framework interacts with others is shown in Figure 2.1.

According to the description by Smeets and Weterings (1999), drivers include the social and economic developments and the consumption and production patterns. These drivers can change the release of pollutants or the use of resources, which are pressures on the state of the environment. The change in the environmental state impacts human health and ecosystems. People respond to these impacts by taking measures to feed back on drivers, pressures, state, or impacts.



Source: Smeets & Weterings (1999).

Figure 2.1 DPSIR Framework

Five goals of the Strategic Plan 2011-2020 correspond with drivers, pressures, state, impacts, and responses respectively (Table 2.3). To briefly explain, addressing underlying causes (drivers) of biodiversity loss is expected to reduce the pressures on biodiversity, and then the status of biodiversity would be improved, leading to an enhanced benefits (impacts) from it. All these chains can be improved by supporting measures (responses) such as participatory planning, knowledge management, and capacity-building. This structure assumes that each goal would affect the next goal in the DPSIR cycle allowing policy makers to take an integrated approach to better conserve biodiversity.

Among the five categories of the DPSIR framework, pressures, state, and impacts most clearly address environmental aspects including physical, biological, and chemical conditions (Maxim et al., 2009; Smeets & Weterings, 1999). Indicators for measuring these conditions are mostly scientific in nature. On the other hand, drivers and responses are related to social, economic, and political aspects (Maxim et al., 2009; Smeets & Weterings, 1999). Therefore, driver and response indicators are likely to be socio-economic or policy indicators. DPSIR can be an efficient tool to distinguish policy indicators from scientific indicators. Based on this, it can be assumed that indicators for Strategic Goal A and E are mostly policy indicators.

However, separating policy indicators from scientific ones cannot be strictly done by simply applying the DPSIR framework. All the components of the DPSIR framework are closely interacting with one another, and the definition of them also differs in literature (Maxim et al., 2009). Thus, there can be some exceptions, and it would be necessary to look into the five goals in more detail.

Table 2.3 Strategic Plan 2011-2020 by DPSIR category

DPSIR Category	Strategic goal	Aichi Biodiversity Target	Policy or scientific indicator
Drivers	A. Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society	1. Awareness increased	Policy
		2. Biodiversity values integrated	Policy
		3. Incentives reformed	Policy
		4. Sustainable consumption and production	Scientific
Pressures	B. Reduce the direct pressures on biodiversity and promote sustainable use	5. Habitat loss halved or reduced	Scientific
		6. Sustainable management of marine living resources	Scientific
		7. Sustainable agriculture, aquaculture and forestry	Scientific
		8. Pollution reduced	Scientific
		9. Invasive alien species prevented and controlled	Scientific
		10. Pressures on vulnerable ecosystems reduced	Scientific
State	C. Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity	11. Protected areas increased and improved	Scientific
		12. Extinction prevented	Scientific
		13. Genetic diversity maintained	Scientific
Impacts	D. Enhance the benefits to all from biodiversity and ecosystem services	14. Ecosystems and essential services safeguarded	Scientific
		15. Ecosystems restored and resilience enhanced	Scientific
		16. Nagoya Protocol in force and operational	Policy
Responses	E. Enhance implementation through participatory planning, knowledge management and capacity-building	17. NBSAPs adopted as policy instrument	Policy
		18. Traditional knowledge respected	Policy
		19. Knowledge improved, shared and applied	Policy
		20. Financial resources from all sources increased	Policy

Each goal has three to six Aichi Biodiversity Targets that focus on specific topics, and some of them have numeric target numbers as well. These topics are shown in Table 2.3. There are four topics under Strategic Goal A, which is the driver category. Aichi Biodiversity Target 1, 2, and 3 are on raising awareness, integrating biodiversity values, and reforming incentives. Target 1 can be measured in a social context, and Target 2 and 3 explicitly aim at policies. Therefore, indicators for these three targets can be regarded as policy indicators. In the meantime, Aichi Biodiversity Target 4 can have both the political and scientific aspects at the same time. When looking into indicators presented by the AHTEG on Indicators for the Strategic Plan 2011-2020, however, most of indicators for this target are scientific ones such as Red List Index, ecological footprint, and human appropriation of net primary productivity. Indicators for Aichi Biodiversity Target 4 are regarded as scientific indicators in this study.

Strategic Goal B, C, and D, which correspond with pressures, state, and impacts respectively, have topics that can be addressed with scientific approach. For example, analyzing the status of habitat loss or investigating possible ways for ecosystem restoration requires scientific data. Well-known indicators for these Strategic Goals are Living Planet Index, Wild Bird Index, and Ocean Health Index. However, Aichi Biodiversity Target 16 on the Nagoya Protocol is an exception. This target aims to make the Protocol enter into force and operational at the national level, so currently available indicators for this target are all policy indicators.

All topics under Strategic Goal E are about implementing policy measures. Aichi Target 17 directly deals with national policies for biodiversity; Aichi Target 18 focuses on how to integrate and reflect the traditional knowledge in the

implementation of the CBD, Aichi Target 19 aims to improve knowledge-sharing; and Aichi Target 20 is to increase the amount of financial resources for the implementation of the Strategic Plan 2011-2020. Thus, all indicators for Strategic Goal E are policy indicators to assess the level of responses to drivers, pressures, state, and impacts.

To sum the above, this study will consider Aichi Targets 1-3, and 16-20 as policy targets. Indicators for which Aichi Targets are regarded to be policy indicators in this study is also presented in Table 2.3.

Policy indicators analyzed in this study measure what the society, economy, and policy are like for the conservation of biodiversity. Indicators for Aichi Target 1, 2, and 3 reflect the social and economic environment as drivers, while those for Aichi Target 16, 17, 18, 19, and 20 show how countries are responding to the state of biodiversity and their consequences. Of course, these indicators do not directly assess the actual impact on biodiversity. However, it would be possible to anticipate in which direction the state of biodiversity would change under the current social, economic, and political circumstances through the DPSIR framework. Thus, the DPSIR framework sets an essential background for the meaning of this study.

2.2 Three-Dimensional Framework: Indicators, Criteria, and Countries

This study proposes to apply an integrated approach to evaluate biodiversity indicators. Three dimensions that are considered in this study are indicators, criteria, and countries. All three dimensions are important in that (a) indicators are the main component and the object for evaluation, and investigating them will show the overall status of indicators such as the number of available policy indicators by topic; (b) criteria make it possible to evaluate indicators objectively and systematically, and indicators can be compared by applying the same criteria; and (c) the use of indicators

by countries can show how the indicators are utilized in reality, while also help identify patterns of using indicators by countries (e.g., developed versus developing countries).

As indicated in Chapter 1, however, there is little research that adopted more than two dimensions to analyze biodiversity indicators. The strength of integrative approach with the three dimensions is that this approach allows to evaluate indicators technically as well as practically. Indicators can be evaluated whether they are well designed or not with criteria that focus on technical aspects such as ability to convey information and usability at multiple scales. In the meantime, it would be possible to evaluate the actual usage of indicators by looking into real data of countries. Thus, the three-dimensional approach can integrate theories and the real world.

A three-dimensional framework for this study is designed as follows (Fig. 2.2).

First, indicators to be evaluated are collected from the literature. There are a number of biodiversity policy indicators at different development stages: some are already verified to have a high applicability in practice, while some others are just developed without being tested. It would be reasonable to select indicators that are not in too early stage, so that there are enough information and data for the evaluation.

Second, a set of criteria to evaluate indicators are composed. Criteria are drawn from previous studies that provided relevant ones. Different sets of criteria are applied when collecting indicators with enough data and when evaluating those indicators.

Third, certain countries are selected to investigate the actual usage of indicators. Selecting countries should consider balances in regional and economic groups so that the evaluation can avoid biases. The use of indicators at the national level can be evaluated just the same way as indicators are evaluated with criteria.

Therefore, the evaluation of indicators by country is integrated into and conducted as a part of the evaluation by criteria.

A detailed methodology for the three-dimensional framework is presented in the following chapter.

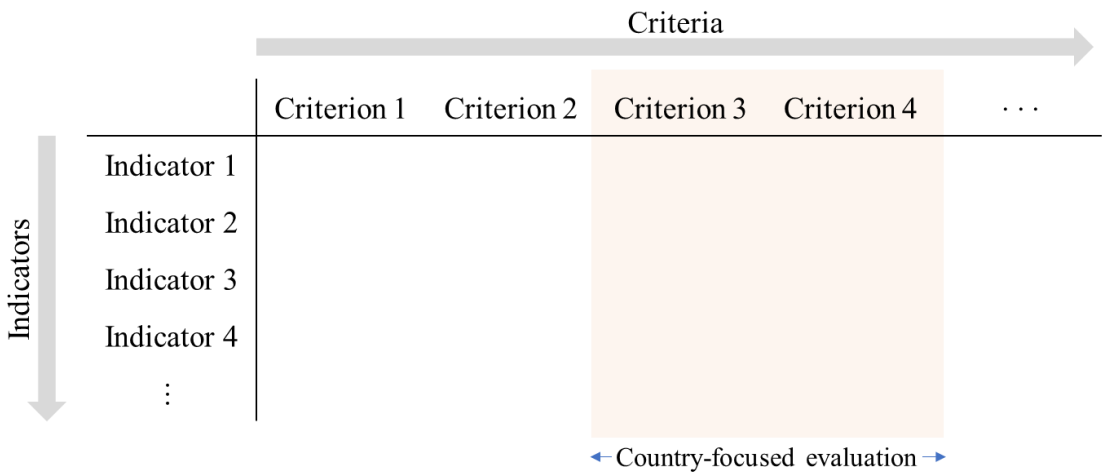


Figure 2.2 Structure of the three-dimensional framework in this study

Chapter 3

METHODOLOGY

3.1 Collection of Indicators from the Literature

Indicators are collected from four previous studies by the AHTEG (CBD COP Decision XIII/28), Chenery et al. (2015), Tittensor et al. (2014), and Leadley et al. (2014). All of these studies sorted indicators into one of the twenty Aichi Biodiversity Targets. Each research used different indicators, while many indicators are overlapping. In particular, indicators in Tittensor et al. (2014) and Leadley et al. (2014) are almost the same, and all the policy indicators in Leadley et al. (2014) are completely included in the research by Tittensor et al. (2014). The AHTEG provided the largest number of indicators among these studies. The number of policy indicators in each research is shown in Table 3.1.

A total of 38 indicators are collected when duplicated indicators are removed (Table 3.2). Since all the indicators in Leadley et al. (2014) are in Tittensor et al. (2014), those in Leadley et al. (2014) are not taken into account. The Aichi Biodiversity Target 3 has the largest number of indicators, while only two indicators are available for the Targets 16 and 17. Except for the Targets 16 and 17, there are at least four indicators available for each Target. It seems that only a small number of indicators are widely acknowledged in terms of the number of being used in the literature. Three out of 38 indicators were assessed in the all three studies and 16 indicators were assessed in two studies. The rest of the indicators were assessed in just one research.

Table 3.1 The number of policy indicators provided in the literature

Aichi Biodiversity Target	AHTEG (CBD COP Decision XIII/28)	Chenery et al. (2015)	Tittensor et al. (2014)	Leadley et al. (2014)
Target 1	3	3	3	3
Target 2	3	3	2	2
Target 3	6	7	2	1
Target 16	2	1	0	0
Target 17	2	1	0	0
Target 18	4	2	0	0
Target 19	4	3	3	3
Target 20	2	1	3	3
Total	26	21	13	12

Table 3.2 The number of indicators by the number of times referenced in the literature

Aichi Biodiversity Target	Assessed in the all 3 studies	Assessed in 2 studies	Assessed in 1 study	Subtotal
Target 1	1	2	2	5
Target 2	0	3	2	5
Target 3	0	6	3	9
Target 16	0	1	1	2
Target 17	0	1	1	2
Target 18	0	1	4	5
Target 19	1	2	3	6
Target 20	1	0	3	4
Total	3	16	19	38

3.2 Criteria for Selecting Indicators

Studies that conducted evaluation of biodiversity through indicators provided criteria for selecting indicators. This study draws criteria from Feld et al. (2010), Layke et al. (2012), and Tittensor et al. (2014). Among the criteria provided by them, some are overlapping, while a few others are not appropriate for the objective of this research. Therefore, a new set of criteria needs to be composed.

Feld et al. (2010) applied seven criteria to select indicators: (a) purpose of indication, (b) indicator type suited to address the purpose, (c) association of an indicator with specific biodiversity attributes or ecosystem service categories, (d) spatial scaling and scalability, (e) reference conditions, (f) standardized sampling protocols, and (g) applicability of remote sensing. The first three criteria are to determine whether indicators can convey information that are relevant and consistent with the purpose of indicators. The fourth one is related to applicability in diverse spatial extent and at multiple scales by aggregation or disaggregation. The fifth criterion to have reference conditions is to evaluate indicators whether there are available data for comparison to set targets or to measure the deviation from the reference. The sixth criterion deals with the ability to compare data across different temporal and spatial scales. The last criterion is related to data collection methods of remote sensing, so it is inappropriate for the evaluation of policy targets.

Layke et al. (2012) developed and used two criteria: (a) ability to convey information and (b) data availability. The first one is divided into three subcategories which tell whether indicators are intuitive, sensitive, and accepted. Intuitive and sensitive indicators can be informative since they provide information clearly and better detect changes. The second criterion, data availability, also has three subcategories, which are monitoring systems for gathering data, processing and

sharing of data, and normalized and disaggregated data. All these subcategories are basically related to data availability, but the subcategories of monitoring systems and normalized and disaggregated data are more concerned about whether data can be processed for different scales.

Tittensor et al. (2014) used five criteria to identify indicators that could be used for the GBO-4 extrapolation: (a) relevance to the Aichi Target, (b) scientific and institutional credibility, either through publication in the peer-reviewed literature or through having an institutional basis, (c) an end data point after 2010, although this was relaxed where an Aichi Target had few indicators or where an indicator was particularly relevant, (d) at least 5 data points, and (e) broad geographic coverage. The first criterion is to determine whether an indicator is informative enough to convey messages for achieving the Aichi Biodiversity Targets. The second one is related to whether indicators are reviewed or acknowledged by experts. The third and fourth criteria are about whether there are available data and an enough number of data points for indicators. The last one is for scientific data and indicators but can be also interpreted as spatial data availability across the world in the case of policy indicators.

Fourteen criteria that are briefly discussed above can be largely classified into four categories. Indicators are required to be (a) informative, (b) credible, (c) scalable, and to meet (d) data availability. Categorization of the criteria is shown in Table 3.3.

Table 3.3 Categorization of criteria drawn from the literature

Literature	**Criteria applied in the literature**	**Categories in this study**
Feld et al. (2010)	Purpose of indication	Informativeness
	Indicator type (suited to address the purpose)	Informativeness
	Association of an indicator with specific biodiversity attributes or ecosystem service categories	Informativeness
	Spatial scaling and scalability	Scalability
	Reference conditions	Informativeness, data availability
	Standardized sampling protocols	Scalability, data availability
	Applicability of remote sensing	*Not applicable*
Layke et al. (2012)	Ability to convey information – Intuitive	Informativeness
	Ability to convey information – Sensitive	Informativeness
	Ability to convey information – Accepted	Credibility
	Data availability - Monitoring systems gather data at sufficient temporal and special scales	Scalability
	Data availability - Processed and available	Data availability
	Data availability - Normalized and disaggregated	Scalability
Tittensor et al. (2014)	Relevance to the Aichi Target	Informativeness
	Scientific and institutional credibility, either through publication in the peer-reviewed literature or through having an institutional basis	Credibility
	An end data point after 2010, although this was relaxed where an Aichi Target had few indicators or where an indicator was particularly relevant	Data availability
	At least 5 data points	Data availability
	Broad geographic coverage	Data availability

Thirty-eight indicators that are collected in this study are scored 1 or 0 for each criterion based only on the features of indicators given in the literature. The AHTEG on Indicators for the Strategic Plan for Biodiversity 2011-2020 has provided the features of indicators including whether an indicator is available today, easy to communicate, used in GBO-3 or GBO-4, and whether global indicator can be disaggregated to create national indicator or aggregated from national data (Table 3.4). Some other features are provided by Chenery et al. (2015), which are alignment to Aichi Target element, temporal relevance, and spatial coverage (Table 3.4). In the meantime, Tittensor et al. (2014) selected indicators by applying five criteria above, so all the indicators in their research can be regarded to already qualify for those criteria. How the features of indicators provided in these three studies match the four criteria in this study is shown in Table 3.4.

When a score of features is different in different studies, a higher score is given. This is because the main purpose of selecting indicators out of 38 indicators is not to choose already well-established indicators but to exclude premature indicators that do not have enough information for the analysis. In case that no information is available for a certain criterion, no score is given, which is the same as a score of 0. Indicators that pass all the criteria, or with a total score of 4, are selected to compose a set of indicators that will be evaluated for this study.

Table 3.4 Features of indicators in three studies matching the four criteria in this study

	Informativeness	**Credibility**	**Scalability**	**Data availability**
AHTEG (CBD COP Decision XIII/28)	- Easy to communicate	- Available today	- Global indicator can be disaggregated to create national indicator - National data are aggregated for global indicator	- Used in GBO-3/ GBO-4
Chenery et al. (2015)	- Alignment to Aichi Target	- Indicators brought together under the BIP excluding inactive ones	None	- Temporal relevance to the Strategic Plan - Spatial coverage
Tittensor et al. (2014)	- Relevance to the Aichi Target	- Scientific and institutional credibility	None	- An end data point after 2010 - At least 5 data points - Broad geographic coverage

Considering the importance of harmonization with SDG indicators to reduce reporting burdens, indicators' link to the SDGs needs to be considered in addition to the four criteria. There are 232 SDG indicators excluding duplicated ones (United Nations Statistics Division, n.d.-b).[7] Not all are ready for use, while they cannot be evaluated by the four criteria due to the lack of relevant information. However, the Inter-Agency and Expert Group on SDG Indicators (IAEG-SDGs) have been

[7] The global indicator framework for Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development was adopted by the UN General Assembly on July 6, 2017 (A/RES/71/313).

evaluating these indicators classifying them into three tiers according to conceptual clarity, methodological development, and data availability (United Nations Statistics Division, n.d.-a). Tier I indicators are those with clear concept, internationally established methodology and standards, and available data in more than 50 percent of countries and population (United Nations Statistics Division, n.d.-a). Therefore, Tier I indicators are automatically selected regardless of meeting the other four criteria in the above. As of May 11, 2018, ninety-three indicators out of 232 are classified into Tier I (United Nations Statistics Division, n.d.-a).

Based on the literature and considerations discussed above, a total of 13 indicators are qualified for this research (Table 3.5). A detailed score table for 38 indicators is provided in Appendix A. Indicators are numbered with two digits: the first digit is the Aichi Biodiversity Target number, and the second digit follows the order of indicator under each Aichi Biodiversity Target (Table 3.5).

Table 3.5 Qualified indicators by Aichi Biodiversity Target

Aichi Biodiversity Target	**Indicator**	**Four criteria**	**SDG criterion**
1. Awareness increased	1.1 Biodiversity Barometer	√	
	1.2 Online interest in biodiversity (Google Trends)	√	
2. Biodiversity values integrated	2.1 Number of countries implementing natural resource accounts, excluding energy, within the System of Environmental-Economic Accounting (SEEA)	√	
	2.2 Number of countries that have integrated biodiversity in National Development Plans, poverty reduction strategies or other key development plans	√	

Table 3.5 Continued.

3. Incentives reformed	3.1 Trends in potentially harmful elements of government support to agriculture (produced support estimates)	√	
	3.2 Agricultural export subsidies (indicator for SDG target 2.b)		√
	3.3 Number of countries with national instruments on REDD plus schemes	√	
16. Nagoya Protocol in force and operational	16.1 Number of Parties to the CBD that have deposited the instrument of ratification, acceptance, approval or accession of the Nagoya Protocol	√	
	16.2 Number of countries that have adopted legislative, administrative and policy frameworks for the implementation of the Nagoya Protocol (SDG indicator 15.6)		√
17. NBSAPs adopted as policy instrument	17.1 Number of countries with developed or revised NBSAPs	√	
19. Knowledge improved, shared and applied	19.1 Growth in species occurrence records accessible through GBIF (Or number of records over time)	√	
20. Financial resources from all sources increased	20.1 Information provided through the financial reporting framework, adopted by decision XII/3	√	
	20.2 Official development assistance and public expenditure on conservation and sustainable use of biodiversity and ecosystems (indicator for SDG target 15.a and 15.b)	√	√
Total number	13	11	3

* One indicator for Aichi Target 20 satisfies both four criteria selected for this study and SDG Tier I criterion.

3.3 Criteria for Evaluating Indicators

Selected indicators need to be evaluated. Criteria that can be used in evaluation are not much different from those that were used in selecting indicators. However, credibility of indicators is not considered in this stage since it was to exclude premature indicators and is no longer appropriate for the evaluation stage.

Current usage will be added because the actual usage of indicators by countries are important for the practical purpose of this study. So, a new set of criteria for the evaluation stage are informativeness, scalability, data availability, and current usage. The first two criteria are to address features of indicators for technical evaluation, while the latter two aim to focus on the country-related information for practical evaluation (see Fig. 2.2).

There are a variety of criteria used to select and evaluate biodiversity indicators (Heink & Kowarik, 2010). The four criteria presented above are representative types which are found in the study of biodiversity indicators. Informativeness is the most widely used criterion covering information provided by indicators such as relevance to the purpose and simplicity to measure and understand (Feld et al., 2010; Heink & Kowarik, 2010; Layke et al., 2012). It measures the ability of an indicator to convey a relationship between indicator and indicated phenomenon. Scalability is a critical criterion since this study focuses on applicability of global indicators at the national level. Indicators' applicability at different levels has been investigated by research papers (Hayashi, 2020; Szabo et al., 2012), and it is often used as one of the criteria to evaluate indicators (Feld et al., 2010; Layke et al., 2012). Data availability including existence of sufficient data points and reference values is also a commonly emphasized criterion to measure an indicator's feasibility for analysis and interpretation (Feld et al., 2010; Heink & Kowarik, 2010; Tittensor et al.,

2014). In particular for this study, data availability in countries across the world needs to be evaluated because, for example, indicators that are available only to developed countries, are not desirable as nationally usable indicators. Current usage by countries, or national governments, is emphasized in CBD Decisions and by the BIP as noted in Chapter 1. Indicators have not been systematically analyzed for multiple countries with this criterion, which is why the three-dimensional framework of this study differentiate itself from previous research in this field.

Indicators will be given a grade of "high", "medium", or "low" (2, 1, or 0 respectively) for each criterion except scalability (Table 3.6). Scalability will be evaluated by "yes" or "no" standard (1 or 0 respectively) since it does not make much sense for an indicator to have a "medium-level" scalability.

Informativeness can be evaluated by whether an indicator is relevant to its purpose and intuitively understandable. Indicators are given a score of "high" if the both conditions are met, "medium" if one condition is met, and "low" if no condition is met. The potential to aggregate and disaggregate data is assessed by the criterion of scalability. Indicators that can be used at the national level with or without slight modification are regarded scalable, while those that cannot are given a "zero" score. Data availability is determined according to the number of countries with relevant data

Table 3.6 Evaluation scales for four criteria

Score	0	1	2
Informativeness	Low	Medium	High
Scalability	No	Yes	-
Data availability	Low	Medium	High
Current usage	Low	Medium	High

in open-source databases. Indicators are given a score of "high" if data are available for more than 100 countries, "medium" if between 50 and 99, and "low" if less than 50. For the evaluation of current usage, five countries are selected due to the limited time and resources. When an indicator is used in National Reports (NRs) of four or five countries that are submitted to the CBD, it is graded as "high" in current usage. A grade of "medium" is given to indicators that are used in two to three countries, and "low" to that used in none to one country. A final score of each indicator is calculated by aggregating numerical scores of the four criteria.

NRs to the CBD are chosen for the evaluation of current usage because they are the reports mostly dedicated to providing information on the status of biodiversity and relevant measures taken by Parties. Therefore, it is highly likely that countries might use as many indicators as possible in their reports. NRs are periodically submitted to the CBD by Parties. A total of 192 Parties have submitted their 5th NRs as of April, 2020 (CBD, n.d.-e). At the COP 13, Parties were encouraged to submit their 6th NRs by December 31, 2018, in accordance with the CBD COP Decision XIII/27. However, less than a half of the Parties have submitted their 6th NRs online as of April, 2020 (CBD, n.d.-e). Therefore, data will be collected mostly from 5th NRs.[8]

[8] As of September 5, 2020, a total of 165 countries have submitted their 6th NRs (92 countries online and 73 countries offline). However, only a few of 6th NRs were available when this study started in 2018, not allowing the author to use the most recent data. Two out of 5 selected countries for this study still had not submitted their 6th NRs by the time the analysis was completed in February, 2020. Therefore, data from 5th NRs were used in this study.

3.4 Selection of Countries for Evaluating Indicators

Five countries are selected to evaluate a set of indicators. Two factors are considered in the selection: (a) data availability and (b) balances in regional and economic groupings. Since most of data will be collected from 5th NRs, countries that have not submitted their 5th NRs are excluded from the selection. Countries whose 5th NRs are written in languages other than English are also excluded due to the issues in translation. For the balances in regional and economic groupings, categories of United Nations (UN) regional groups and economic grouping by the International Monetary Fund (IMF) are used. Member states of the UN are categorized into five geopolitical groups, which are African group, Asia-Pacific group, Eastern European group, Latin America and Caribbean group, and Western European and others group (UN, n.d.). The strength of using the UN regional groups is that it considers not only geographical locations but also political circumstances which affect attitudes towards and policies for biodiversity. One country is selected from each group. For the balance in economic grouping, the grouping by IMF (2017) is used to determine which country is advanced economy, emerging market economy, or low-income developing country. Three countries are selected from emerging market economies, while one country is selected from advanced economies and low-income developing countries.

In addition, there are two more groupings that need to be taken into account: the Group of Like Minded Megadiverse Countries (LMMC) and the Alliance of Small Island States (AOSIS). Megadiverse countries are 17 countries in the world that are rich in biodiversity especially in endemic biodiversity (United Nations Environment Programme World Conservation Monitoring Centre [UNEP-WCMC], 2014). Considering the global importance of assessing and monitoring biodiversity in these countries, two countries are selected from LMMC to test indicators. AOSIS is also

important in global biodiversity since relative biodiversity and endemism of small island states are generally higher than those of other regions, while these countries are more vulnerable to external shocks such as climate change lacking appropriate strategies and capacity (Byrne & Inniss, 2002; Nurse et al., 2001). Therefore, one country is selected from this group.

Five countries that are selected from the above criteria are Brazil, Bulgaria, Germany, Solomon Islands, and South Africa. The final selection of the countries is shown in Table 3.7.

Table 3.7 Selection of countries for evaluating indicators

Country	**United Nations Regional Group**	**Economic Group by IMF (2017)**	**The Group of Like Minded Megadiverse Countries**	**Alliance of Small Island States**
Brazil	Latin American and Caribbean Group	Emerging Market Economies	Yes	No
Bulgaria	Eastern European Group	Emerging Market Economies	No	No
Germany	Western European and Others Group	Advanced Economies	No	No
Solomon Islands	Asia-Pacific Group	Low-Income Developing Countries	No	Yes
South Africa	African Group	Emerging Market Economies	Yes	No

3.5 Comparative Analysis

After evaluating the 13 indicators, a comparative analysis by each of the three dimensions is conducted to find if there are any patterns.

First, scores of indicators are compared by criterion. Since there can be interdependence between criteria (e.g., Feld et al., 2010), relationships between scores for criteria are investigated. The scores for each criterion are ordinal with scales from zero to two, so there should be tied scores among the 13 indicators. Kendall's tau (τ) is a robust correlation measure for ordinal variables and it performs well when there are ties in values (Agresti, 2010; Croux & Dehon, 2010). If there is no interconnectedness between criteria, it is tested if any grouping of 13 indicators shows statistical difference. For example, if a group of indicators are managed by an international organization, it is tested to figure out whether indicators in this group get higher scores for any of criteria than others. This can be done by a t-test. Even though scores are ordinal data with a small sample size, parametric statistics can be used and are robust according to Norman (2010). JMP Pro 14 software is used to calculate Kendall's tau values and to conduct t-tests.

Second, a comparison among countries becomes available when it comes to country-related criteria, which are data availability and current usage. Some patterns might be found in this analysis. For example, developed countries may have higher data availability, while least developing countries have lower data availability. Countries with higher data availability might use more indicators in their NRs. This kind of patterns can be identified when data availability and current usage are compared among countries.

Third, a comparative analysis among indicators can be done after the evaluation of indicators. Analyzing indicators with the same four criteria would

provide an opportunity to find strengths and weaknesses of each indicator compared to others. This might give insights into further improving existing indicators and developing new indicators in the future.

Lastly, other than the three dimensions, lessons can be learned from the Paris Agreement and NDCs under the UNFCCC scheme as mentioned in Chapter 1. Lessons are drawn from previous studies, and some suggestions are then made for the improvement of indicators.

3.6 Structure of Chapter 4

Chapter 4 evaluates 13 indicators that are categorized into 7 topics according to Aichi Biodiversity Targets. Sections are formed by topic, and each section starts with a brief background on the importance of the topic in conservation of biodiversity. And then, indicators under each topic are evaluated with four criteria.

Subsections for evaluation consist of several parts. The first part is to provide a background and a definition of each indicator. This part is followed by paragraphs of evaluation by four criteria in an order of informativeness, scalability, data availability, and current usage. A summarizing paragraph and a score table comprise the last part of subsections.

The structure of Chapter 4 is presented in Figure 3.1.

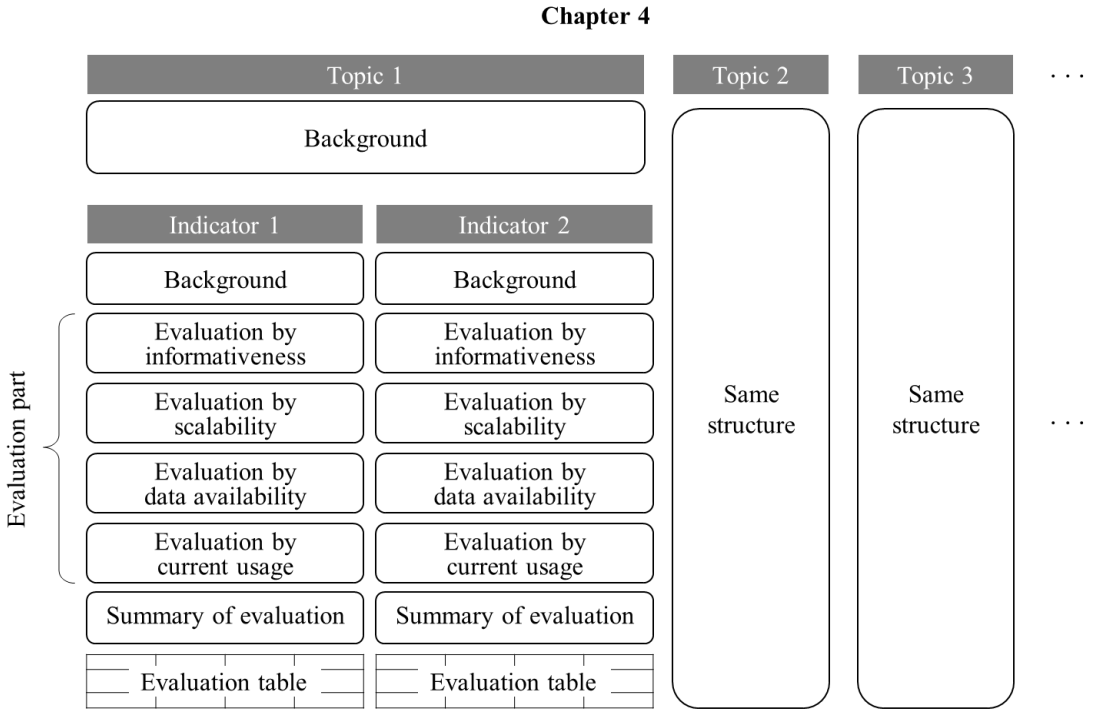


Figure 3.1 Structure of Chapter 4

Chapter 4

EVALUATION OF INDICATORS

4.1 Raising Awareness

The relationship between awareness of the environment and environmentally friendly behavior has long been discussed. Kollmuss and Agyeman (2002) reviewed some of the most influential theoretical frameworks for explaining the relationship between environmental knowledge and awareness, and environmentally friendly behavior. Most of the previous studies and models show that behavior is not simply determined by one factor but by a complex set of demographic, external, and internal factors, including knowledge and awareness (Kollmuss & Agyeman, 2002).

There are a number of studies indicating that the awareness of environment and biodiversity is one of the critical factors for people to determine their environmentally friendly behavior (e.g., Anderson et al., 2007; Feng & Reisner, 2011). It is also shown that better knowledge on species and biodiversity can result in the public's better decisions in financial support and funding allocation (Martín-López et al., 2007; Wilson & Tisdell, 2005). Government officials and actors from NGOs with hands-on experience commented that awareness of the full value of biodiversity, even though it does not necessarily lead to pro-conservation actions, plays an important role in transforming biodiversity politics (Adenle et al., 2015). Awareness of biodiversity and behavioral change can be stimulated by education, visiting zoos, or ecotourism (Macharia et al., 2010; Powell & Ham, 2008; Skibins & Powell, 2013).

The CBD recognizes the importance of raising awareness. Article 13 of the Convention seeks to promote understanding of biodiversity through public education. Considering that the text was written in 1992, education and awareness have long been perceived as a critical component for the conservation and sustainable use of biodiversity. Similar recognition can also be found in Aichi Biodiversity Targets. Raising awareness of the value of biodiversity and relevant actions for conservation of biodiversity is listed as the first target in the set of Aichi Targets. This fact shows that the CBD perceives awareness as a basis of biodiversity conservation.

For raising awareness, two indicators are selected and evaluated: Biodiversity Barometer and Google Trends.

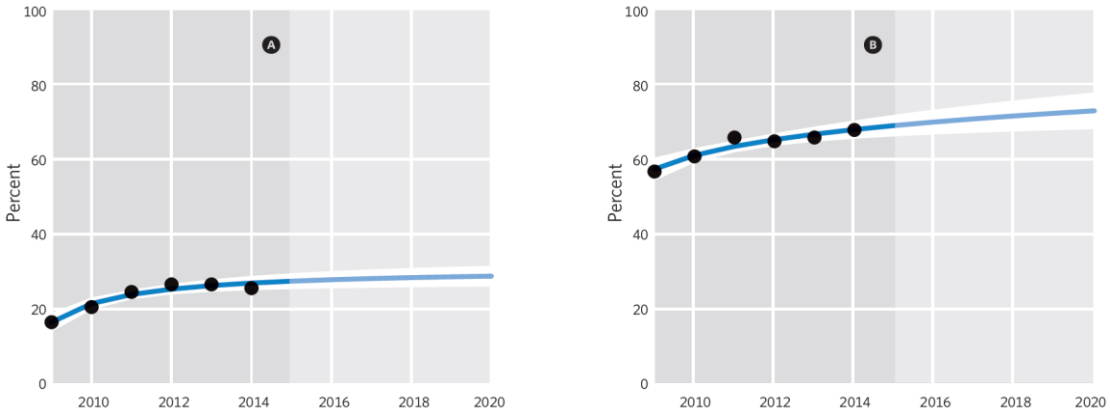
4.1.1 Biodiversity Barometer

The Biodiversity Barometer is a tool to assess public awareness of biodiversity (Tittensor et al., 2014). The Union for Ethical BioTrade (UEBT) has surveyed people's awareness of biodiversity in 16 countries since 2009 (UEBT, 2018). The Biodiversity Barometer surveys consist of a variety of questions, among which the most regularly asked questions are whether the survey respondents have heard of the term "biodiversity" and whether they can define biodiversity correctly. The percentage of the respondents is recorded and analyzed to produce the indicator at the national and global levels.

The Biodiversity Barometer is used in the fourth edition of the Global Biodiversity Outlook (GBO-4) to review the mid-term progress towards the Aichi Biodiversity Target 1. National data from France, Germany, the United Kingdom (UK), and the United States of America (USA) were aggregated to produce global data since surveys had been conducted consistently in these four countries (Tittensor

et al., 2014). Then, six data points from 2009 to 2014 were used to establish a trend model for projection towards 2020 (Fig. 4.1). The GBO-4 suggested from this analysis that public awareness of biodiversity has been continuously increasing while confidence level is not high due to the limited data (SCBD, 2014).

The ability of the Biodiversity Barometer to convey information is high. The biggest strength of this indicator is that it directly assesses public awareness. Since it produces percentage numbers, it can be compared to different years and countries. It is also intuitive and easy to interpret in that the higher percentage means the higher level of awareness. As discussed before, awareness of biodiversity is a basis for behavior for biodiversity conservation. However, since there are a variety of barriers that prevent awareness from resulting in relevant behavior, additional indicators that can measure the strength of those barriers are needed to complement the Biodiversity



Source: SCBD (2014)

Figure 4.1 Trend in the Biodiversity Barometer from 2009 to 2014 and projection from 2015 to 2020. Ⓐ shows the percentage of respondents who provided a correct definition of biodiversity, and Ⓑ shows the percentage of respondents who had heard of the term biodiversity.

Barometer. Financial incentives and regulations, as examples of external factors, can be monitored to assess enabling conditions. Once the Biodiversity Barometer is interpreted along with other indicators, a more robust interpretation would be possible. Indicators to assess the above enabling conditions will be addressed in following sections.

The Biodiversity Barometer can be applied at multiple scales. Basically, the UEBT has surveyed public awareness at the national level and has published reports annually. When necessary, national-level data can be transformed to produce global data as exemplified in the GBO-4. The same or similar surveys can be also conducted at the subnational level. While South Korea has a national-level survey result, its local governments such as Gangwon-do and Gyeongsangnam-do also conducted surveys independently, including the exact same survey questions on awareness of biodiversity as in the national-level survey (Gangwon Province, 2014; Gyeongsangnam Province, 2013). If a set of the same survey questions is established, it can help produce compatible data at multiple scales, and data can be easily aggregated or disaggregated for a specific purpose.

Despite a variety of strengths, the Biodiversity Barometer has yet to be widely used. Data availability is low considering that only 16 countries have been surveyed by the UEBT. Among them, 12 countries have at least two data points to assess changes in the numbers (Table 4.1). However, relatively high cost of the survey is an obstacle to spread this indicator to countries across the world (Cooper et al., 2019).

Brazil and Germany have relevant data and used in their NR among the five selected countries, which gives this indicator a grade of “medium” for the criterion of current usage. The UEBT has surveyed public awareness annually in Brazil since 2010

and in Germany since 2009 (Table 4.1). Brazil used the 2014 Biodiversity Barometer data, while Germany presented its own indicator including the result of the same or similar survey questions as the Biodiversity Barometer.

The final score of the Biodiversity Barometer is 4 out of 7 points (Table 4.2). The score shows that this indicator has significant potential to be utilized at both the global and national levels. This indicator is highly informative and scalable, but its data availability needs to be enhanced by encouraging countries to use it. In addition, it can be easily applied at multiple scales as exemplified in the cases of local-level surveys in South Korea.

Table 4.1 Countries and years that public awareness was surveyed by the UEBT

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
France	X	X	X	X	X	X	X	X	X	X	
Germany	X	X	X	X	X	X	X	X	X	X	
UK	X	X	X	X	X	X	X	X	X	X	
USA	X	X	X	X	X	X	X	X	X	X	
Brazil		X	X	X	X	X	X	X	X	X	
Japan		X									X
South Korea		X	X								X
Switzerland				X							
Peru				X				X			
India				X			X				
China					X						X
Colombia						X					
Vietnam						X					X
Netherlands							X				
Mexico							X				
Ecuador							X	X			

* Survey information from UEBT reports are combined to produce this table (UEBT, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019).

Table 4.2 Evaluation table for the Biodiversity Barometer

Indicator	Informativeness	Scalability	Data Availability	Current Usage	Score
Biodiversity Barometer	High	Yes	Low	Medium	4

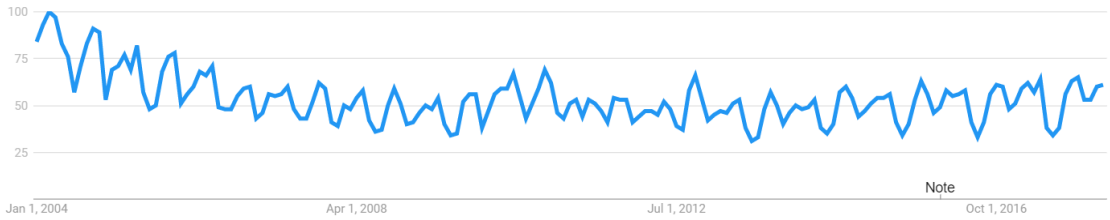
4.1.2 Online Interest in Biodiversity (Google Trends)

Google Trends is a web tool that provides information on the relative online search volume of a particular term. It is open to the public so that anyone can easily explore trends in searching specific terms simply by visiting the website and entering keywords. There have been an increasing number of studies that investigate public interest through Google Trends.

The public interest in biodiversity also has been investigated by using Google Trends data. McCallum and Bury (2013) and Tittensor et al. (2014) drew tendencies directly from the Google Trends data while Ficetola (2013), Funk and Rusowsky (2014), and Nghiem (2016) set benchmarking keywords to identify genuine trends out of normalized data. In the meantime, Troumbis (2017b) interpreted the pattern fitting the data by polynomial equation and explained with economic drivers.

Interpretation of trends varies according to methodologies applied to each study. Google Trends shows a decreased search volume worldwide for the term "biodiversity" when comparing the beginning and the end point of the time period from 2004 to the present (Fig. 4.2). McCallum and Bury (2013), Tittensor et al. (2014), and Troumbis (2017b) understood it as decreasing patterns of the public interest while Ficetola (2013) argued that there is no strong evidence of decreasing trends.

Google search volume is easy to intuitively interpret the searching trends. Google Trends provides normalized search volume data which is relative volume to the total searches scaled on a range of 0 to 100 (Google Trends, n.d.). For example, assume that there are five data points where the numbers of searches of a certain term divided by total searches are 10%, 12%, 16%, 18%, and 20% (Table 4.3). These percentages will then be divided by the maximum value, which is 20%, producing normalized data points of 50, 60, 80, 90, and 100. Thus, Google Trends shows numbers between 0 and 100 with always having the maximum of 100. This makes it easy to understand how much relative search volume is at a certain time period compared to its highest point.



Source: Google Trends (retrieved March 26, 2018)

Figure 4.2 Worldwide Google search volume for the term ‘biodiversity’

Table 4.3 Hypothetical example of Google Trends data points

Data point	#1	#2	#3	#4	#5
Number of searches	200	300	480	450	600
Total searches	2,000	2,500	3,000	2,500	3,000
Relative search volume	10%	12%	16%	18%	20%
Normalized volume	50	60	80	90	100

One of the main issues in Google Trends is that data cannot always be directly understood without being processed. Google Trends provides only normalized volume data, not the absolute number of searches or relative search volume as in the exemplified case in Table 4.3. Since data does not represent absolute volume, Ficetola (2013) argues to set some keywords as benchmarks to interpret. Correia (2018) also calls for a cautious approach when analyzing Google Trends data. However, some other researchers such as McCallum and Bury (2013) and Troumbis (2017a) do not see it necessary to refer to benchmark terms. In addition, Google Trends data for environment-related terms often show seasonal patterns that need to be dealt with. For example, peaks are shown in spring and fall while troughs in summer and winter, one explanation of which is the difference of student internet activity between school and non-school periods (McCallum and Bury, 2013). Funk and Rusowsky (2014) applied a Loess smoothing approach to deal with seasonal trends. Thus, data cannot be directly used or interpreted in some cases (Nghiem, 2016).

Other interpretation issues include whether biodiversity can be an appropriate topic to investigate by Google Trends. Mellon (2013) showed that economic issues can be easily tracked while environmental issues such as “global warming” do not show a strong enough relationship to be used as a proxy in academic studies. When interest in biodiversity has a relationship with economic circumstances, interpretation becomes more difficult (Troumbis, 2017b). Another factor to consider might be saturation effect. When people are satisfied with initial knowledge for specific terms, their interest might move to more specific terms and cases as pointed out by Funk and Rusowsky (2014). Funk and Rusowsky (2014) also showed that internet searching behavior based on English does not necessarily reflect the interest of people

worldwide due to the language differences. Some other issues to take note of include whether terms have ambivalent meanings and whether data processing methodology has been changed by Google (Funk & Rusowsky, 2014; Troumbis, 2017b).

The strength of Google Trends is that it produces data by country and sub-region in specified time periods. In other words, data can be retrieved at multiple scales. Troumbis (2017b) evaluated Google Trends to provide world coverage as well as to have high potential for disaggregation to regions. In the case of interests in biodiversity in the USA, for example, it is possible to compare 50 states and the District of Columbia, as well as the country as a whole in a given time period.

Basically, Google Trends data is available in more than 200 countries or regions. However, there is an issue of data bias since it only reflects interest of those who have access to internet (Nghiem, 2016; Troumbis, 2017b). In addition, Google Trends data might be less robust in countries where Google is not a dominant search engine such as China (Nghiem, 2016).

Google Trends data, unfortunately, is not widely accepted as an indicator for public interests in biodiversity. Among the five countries, no country provides information on Google data in their NBSAPs and NRs. Google Trends has been used in several academic papers at the national level, such as Brazil and Germany, to investigate trends of biodiversity-related issues (e.g., Proulx et al., 2014), but it does not seem to be yet recognized by national governments.

The final score of the Google Trends is 4 out of 7 points (Table 4.4). This indicator is moderately informative since it can be understood intuitively, while interpretation of it depends on circumstances of applying regions and methodologies. Google Trends can be utilized at multiple levels with high scalability, and has high

potential thanks to enormous data availability and coverage. Once an easy and consistent methodology is established, Google Trends is expected to be widely utilized in analyzing public interests.[9]

Table 4.4 Evaluation table for Google Trends

Indicator	Informativeness	Scalability	Data Availability	Current Usage	Score
Google Trends	Medium	Yes	High	Low	4

4.2 Integrating Biodiversity Values

Aichi Target 2 is to integrate biodiversity values into national and local development and poverty reduction plans and strategies, and to incorporate them into national accounting and reporting systems. Currently, many countries prioritize economic development over conservation and sustainable use of biodiversity. Economic development directly and instantly affects the livelihood of people, while the loss of biodiversity has negative impacts on people's lives slowly but steadily in a complex way.

Ecosystems, which are supported by biodiversity, are known to contribute to human welfare by providing ecosystem goods and services such as food, fuels, and cleansing (Costanza et al., 1997; Daily, 1997). The annual value of ecosystem services

[9] There are several efforts to advance the existing indicators for online interest in biodiversity. Cooper et al. (2019), for example, developed Biodiversity Engagement Indicator by combining online data sources including Google Trends.

globally is estimated to be more than $100 trillion (Costanza et al., 2014). These ecosystem services will be degraded with the loss of biodiversity. One of the most well-known cases that show biodiversity loss can lead to a decrease in welfare is the impact of insect pollinators on food production. The contribution of insect pollinators to crop production is calculated to be about 9.5% of total food production for humans, which decreases with the decline of pollinators (Gallai et al., 2009). Since biodiversity and ecosystem services contribute to a wide range of sectors, biodiversity values need to be reflected in policies across the sectors.

Articles 6(b) and 10(a) of the Convention provide that Parties shall integrate the value of biodiversity into national decision-making processes, including relevant sectoral or cross-sectoral plans, programs, and policies. There are several efforts for this integration such as environmental impact assessments (EIAs) and economic valuation of biodiversity. Article 14 deals with basic principles for impact assessment to be complied by Parties.

Indicators for implementing natural resource accounts and integrating biodiversity in national development plans are evaluated in the following subsections.

4.2.1 Number of Countries Implementing Natural Resource Accounts, Excluding Energy, Within the System of Environmental-Economic Accounting (SEEA)

The System of Environmental-Economic Accounting (SEEA) is a statistical system to provide information on the interactions between the environment and the economy, and on the trends in the use and stocks of environmental assets (United Nations [UN], European Union [EU], Food and Agriculture Organization [FAO], International Monetary Fund [IMF], et al., 2014). The 2012 SEEA Central Framework, built upon the previous versions, was adopted as an international standard

for environmental-economic accounts at the forty-third session of the United Nations Statistical Commission in 2012.[10] It includes the accounting systems for flows and stocks in various sectors such as energy, water, soil, and timber (UN, EU, FAO, IMF, et al., 2014).

The global indicator for environmental-economic accounting suggested by the AHTEG is to count the number of countries that are implementing natural resource accounts within SEEA, excluding the energy sector. It is included in the list of highlighted indicators selected by the IPBES for the use in regional and global assessments.

Interpretation of this indicator is straightforward since it counts the number of countries or accounts. The higher number at the global level means the more countries in the world that are implementing environmental-economic accounting systems. In the meantime, the higher number at the national level can be understood as the more accounts produced within a country.

However, using this indicator as it stands is not informative enough to measure the actual state of biodiversity and ecosystems. Accounts in a variety of sectors are being developed, while the indicator excludes only the energy sector. Some accounts such as extraction of metallic minerals are not directly related to biodiversity and ecosystem services. Accounting for timber resources is another example since it includes all trees available for wood supply under the same category, regardless of whether trees are living or dead (UN, EU, FAO, IMF, et al., 2014).

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[10] See *Economic and Social Council, Official Records 2012, Supplement No. 4* (E/2012/24).

An effort to develop a statistical framework dedicated to ecosystem accounting has been made, which needs to be tested and experimented (UN, EU, FAO, OECD, & World Bank [WB], 2014). This is called SEEA Experimental Ecosystem Accounting, and it aims to provide an accounting framework to measure the state of ecosystem services. Experimental Ecosystem Accounting is not yet acknowledged as an international standard, but the UN Committee of Experts on Environmental-Economic Accounting (UNCEEA) is revising it with intent to finish by 2020.[11] A set of robust accounts that are more informative than the currently available accounts will become available when the revising process is done in 2020.

The indicator of counting the number of environmental-economic accounts is simple enough that it can be converted to different-scale data. However, the use of this indicator at the national level requires a slight adjustment to count the number of environmental-economic accounts in a certain country or use the accounts themselves as indicators, instead of counting the number of countries with such accounts. The indicators are produced by countries, and then the number of countries with at least one environmental-economic account will be counted to form the global indicator. Information in national data needs to be preserved when converted to the global indicator, which would record only either "zero" or "one" for each country, so that the global data can be disaggregated to create national or regional indicators.

The information on environmental-economic accounts in 70 countries is available from the library of publications on environmental-economic accounting by

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[11] See *SEEA Experimental Ecosystem Accounting Revision 2020: Research Agenda and Approach* (UNCEEA/12/Area B2/1).

the United Nations Statistics Division.[12] The numbers of publications by country show big differences. There are relatively abundant data for several developed countries including Australia, France, Germany, Sweden, and the UK, while only few publications have been submitted for many other developing countries (Table 4.6).

Natural resource accounts within the SEEA is not yet widely used in NRs. Only Brazil's NR includes the progress on developing the national water accounting system and methodologies. However, none of NRs of the five countries contains actual data of environmental-economic accounts.

The final score of the number of natural resource accounts is 3 out of 7 points (Table 4.5). The score shows that this indicator can be utilized at both the global and national levels. This indicator is moderately informative with the medium level of data availability and coverage. It is not yet used by many countries with the current form. When SEEA Experimental Ecosystem Accounting is completely revised and adopted, the use of this indicator is expected to be expanded.

Table 4.5 Evaluation table for number of natural resource accounts

Indicator	Informativeness	Scalability	Data Availability	Current Usage	Score
Number of natural resource accounts	Medium	Yes	Medium	Low	3

[12] The United Nations Statistics Division invites countries, organizations, and individual experts to submit publications on environmental-economic accounting by international agencies, national statistical offices, academia, and NGOs (United Nations Statistics Division, n.d.-c).

Table 4.6 Number of publications on environmental-economic accounting submitted to the library of the United Nations Statistics Division by country

Country	Number of publications	Country	Number of publications
Argentina	1	Luxembourg	2
Australia	34	Malaysia	1
Austria	12	Mexico	9
Belgium	11	Morocco	1
Bolivia	1	Namibia	11
Botswana	7	Netherlands	30
Brazil	2	New Zealand	23
Canada	10	Nicaragua	1
Chile	2	Norway	23
China (Peoples Republic of)	6	Panama	1
Colombia	1	Papua New Guinea	1
Costa Rica	2	Paraguay	1
Cuba	1	Peru	1
Czech Republic	4	Philippines	9
Denmark	23	Poland	1
Dominican Republic	1	Portugal	5
Ecuador	2	Qatar	3
El Salvador	1	Republic of Korea	4
Estonia	1	Republic of Moldova	2
Finland	13	Romania	2
France	46	Slovakia	1
Germany	42	Slovenia	1
Greece	4	South Africa	13
Guatemala	9	Spain	6
Guyana	1	Swaziland	1
Honduras	1	Sweden	40
Hungary	3	Switzerland	4
Iceland	4	Taiwan (Province of China)	1
India	9	Thailand	1
Indonesia	3	United Kingdom	39
Ireland	3	United Republic of Tanzania	1
Italy	13	United States	13
Japan	8	Uruguay	1
Latvia	1	Venezuela	1
Lithuania	1	Zimbabwe	3

* Data are collected from the library of the United Nations Statistics Division to produce this table on February 7, 2019 at https://unstats.un.org/unsd/envaccounting/ceea/archive/. Countries that do not have any publication are excluded from this table.

4.2.2 Number of Countries That Have Integrated Biodiversity in National Development Plans, Poverty Reduction Strategies or Other Key Development Plans

Integrating biodiversity in national development plans is a key to mainstreaming biodiversity in the governmental sector. The indicator to assess efforts in integrating biodiversity in national plans, including development plans and poverty reduction strategies, was suggested by the AHTEG. This indicator at the global level is to count the number of countries that have integrated biodiversity value in their national plans. It needs to be adapted for the use at the national level. Technical guidance for the sixth NR by UNDP suggests that the Parties consider the following potential indicators (UNDP, 2018):

- The number of national development plans that your country has developed or revised (including food, water, disaster, climate, development, poverty) that specifically incorporates the values of biodiversity.
- The number of sectoral plans that your country has developed or revised (including tourism, energy, extractive sectors, transportation) that explicitly includes biodiversity considerations.

The above two indicators can be merged into one indicator to count national plans that specify and accept the value of biodiversity.

This indicator mirrors how widely the biodiversity value is accepted in various sectors at the governmental level within a country. The indicator would rise when a country integrates biodiversity value into more national plans. However, comparing the numbers between countries does not make much sense. Some countries might have a variety of sectoral development plans while some other countries might rather have a limited number of national development plans that integrate a wide range of sectoral plans. Simple comparison could result in underestimation of a country's performance for the latter case.

Integration of the biodiversity value into national plans is one of the necessary conditions for successfully reflecting on biodiversity throughout the decision-making process. However, there are a number of plans and strategies that are not implemented practically as intended. Some of the challenges to the full integration include: a lack of relevant information on economic value of biodiversity, the fragmented structure of governments, the ineffective engagement of stakeholders, neglected monitoring and feedback mechanisms, and a lack of financing mechanisms (Swiderska, 2002). Therefore, this indicator needs to be complemented by some other relevant indicators, for example, that assess data availability of economic value of biodiversity or effectiveness of monitoring system.

Informativeness of this indicator can be enhanced if the level of integration is measured by more detailed criteria. Roe (2010) explored the level of integration of biodiversity in national poverty reduction strategy papers (PRSP) by using four criteria as follows:

- Is biodiversity mentioned?
- Is the understanding of biodiversity narrowly focussed – e.g. on wildlife, forests, protected areas – or is it more broadly understood to include genetic diversity and agricultural biodiversity, or even broader to encompass ecosystem services? PRSPs were scored from 0-3: (0 = not mentioned, 1 = narrow focus; 2 = focus extends beyond wildlife/forests; 3 = focus encompasses ecosystem services).
- Is the link between poverty and biodiversity loss recognised? PRSPs were scored from 0-3 depending on the detail provided on this (0 = not mentioned, 1 = mentioned; 2 = elaborated; 3 = good practice).
- Is the link between biodiversity and poverty reduction recognised? Again PRSPs were scored from 0-3 depending on the detail provided.

Similar methods can be applied to measure the level of integration in national development plans and strategies. The strength of this measure is that it would allow

users to compare the level of integration within a country at different times and between countries as shown by Roe (2010).

This indicator is scalable in that it can be aggregated or disaggregated to different levels with the modifications mentioned above. The global indicator is created by aggregating national data. The number of countries will be counted if they have one or more development plans that have incorporated the value of biodiversity. The global indicator also can be disaggregated to create national indicators if all the information in national data is preserved when forming the global indicator.

Currently, there is no institution that compiles relevant information. It seems that there are only a few studies to investigate the current integration status of the biodiversity value in national plans and policies. Roe (2010), for example, reviewed 54 countries' national poverty reduction policies to evaluate how much the value of biodiversity and ecosystem services is recognized in them. Unfortunately, no more updates have been made since then (Chenery et al., 2015).

Fifth NRs by the Parties contain some information on their efforts and progresses on the integration. Bulgaria presented several national strategies and programs that have incorporated the conservation of biodiversity, including the National Development Programme, the National Strategy for Regional Development 2012–2022, and the National Strategic Plan and Program for Agricultural and Rural Development 2007–2013. The four other countries also demonstrated their ongoing efforts for the integration in a certain extent. However, relevant information was not provided in a systematic way. Most of the NRs enumerated their initiatives, programs, and policies, briefly mentioning how the biodiversity value is incorporated in them.

Therefore, detailed guidelines need to be provided so that the Parties can prepare their reports with data in a coordinated manner.

Tracking the progress in each country would provide decent data for the future use of this indicator. Updated information for this indicator will be provided by the Parties in their 6th NRs since templates for the 6th NR request the Parties to provide information on the achievement of national targets and the contribution to Aichi Biodiversity Targets (CBD COP Decision XIII/27). The up-to-date global assessment would also become possible if the Parties submit their 6th NRs with relevant information.

The final score of the number of national plans that integrate biodiversity is 5 out of 7 points (Table 4.7). The score shows that this indicator is highly informative and scalable to both the global and national levels. Currently, there is no compiled database for this indicator even though most of the 5th NRs contains relevant information. Further guidance seems to be necessary for the Parties to produce coordinated data for this indicator.

Table 4.7 Evaluation table for number of national plans that integrate biodiversity

Indicator	Informativeness	Scalability	Data Availability	Current Usage	Score
Number of national plans that integrate biodiversity	High	Yes	Low	High	5

4.3 Reforming Incentives

Aichi Target 3 is aiming to reform incentives that have either positive or negative impacts on biodiversity. Incentives that are harmful to biodiversity need to be eliminated or reformed while those that contribute to biodiversity conservation should be developed and encouraged. Article 11 of the CBD also mentions that each Party shall take incentive measures to conserve biodiversity in an economically and socially sound manner.

When Aichi Targets were adopted, clear definition and scope of "incentive" were not provided. However, the CBD Technical Series No. 56, published by the SCBD, defines that incentives harmful to biodiversity are policies that induce unsustainable behavior negatively impacting biodiversity, and that positive incentives are policy measures designed to encourage activities that promote conservation and sustainable use of biodiversity (SCBD, 2011). Some of the incentives take market-based approaches while some others take non-market approaches. Market-based instruments include taxes, fees and charges, subsidies, and tradable permits (Bräuer et al., 2006). Measures of non-market approaches include community-based management program and environmental awards (SCBD, 2011).[13] There are a number of cases showing that biodiversity-related incentives improve the state of biodiversity and ecosystem (e.g., Ingram et al., 2014). Incentive measures need to be carefully designed for their best effectiveness and efficiency in protecting biodiversity (Matzdorf & Lorenz, 2010; Sovacool, 2011).

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[13] Some instruments, such as eco-labelling, is regarded as either of them depending on the views by researchers. For example, Bräuer et al. (2006) put eco-labelling into market-based instrument category, while SCBD (2011) regarded it to have non-market means.

Three indicators to measure the state of reforming incentives, which are producer support estimates, agricultural export subsidies, and national instruments on REDD+ schemes, will be analyzed in the following subsections.

4.3.1 Trends in Potentially Harmful Elements of Government Support to Agriculture (Producer Support Estimates)

Producer support estimate (PSE) is an indicator that calculates "the annual monetary value of gross transfers from consumers and taxpayers to agricultural producers" (OECD, 2018). It aggregates all the values regardless of the objectives of policy measures or the impacts on farm production or income. Other relevant estimates include consumer support estimate (CSE) and general services support estimate (GSSE). CSE is the monetary value of transfers to consumers, while GSSE measures transfers related to creating enabling conditions for the primary agricultural sector (OECD, 2018). Total support estimate (TSE) is the sum of PSE, CSE, and GSSE.

The use of PSE as a policy indicator is recommended by AHTEG, expecting to provide information on potentially harmful support by government to producers in the agricultural sector. PSE was also considered as an SDG indicator in the beginning of discussions on SDG indicators in 2016 (Lisowska, 2016). However, national statistical offices found this indicator too complex and they could not come to an agreement on refinement of it (Adams & Judd, 2016). It was finally excluded from the list.

PSE is still an important indicator in assessing biodiversity-related incentives. With 78% of total support, it has the largest share in TSE (OECD, 2018). In addition, PSE is considered to have larger impact on biodiversity than other estimates since it influences farming behavior most (van Winkle et al., 2015).

PSE can be intuitively interpreted since it aggregates all the monetary value of transfers. The higher this indicator is, the more transfers to agricultural producers there are. However, not all subsidies are harmful to the environment so that impacts of policy measures on biodiversity cannot be directly inferred from the indicator itself (Lehmann et al., 2009; van Winkle et al., 2015). PSE, by its definition, can technically include subsidies both harmful to biodiversity and conducive to conservation of biodiversity. Therefore, it is necessary to further discuss how to make PSE a better proxy for the amount of subsidies harmful to biodiversity and ecosystem services.

One suggestion is to use PSE categories. Subsidies are classified into one of the categories provided by the OECD (Table 4.8). This classification reflects the factors on which payments are based, such as commodity output, input use, current area/animal numbers/receipts/income (A/An/R/I), and non-commodity criteria (OECD, 2018). Each category is closely connected to potential impact on biodiversity and its magnitude.

There have been efforts to identify potential environmental impact by category of subsidies (e.g., OECD, 2013; van Winkle et al., 2015). According to van Winkle et al. (2015), for example, category A1 subsidies, which are market price supports, have negative impact on biodiversity with high magnitude, whereas category F1 subsidies, which are based on long-term resource retirement, have positive impact with moderate to high magnitude. They suggested four possible variations of indicators to be used in monitoring progress towards Aichi Target 3: proportion and amount of PSE support tied to production, proportion and amount of PSE support to the potentially most harmful subsidies, proportion and amount of PSE with voluntary environmental input constraints, and payment based on non-commodity criteria. These possible indicators

Table 4.8 Definitions of the producer support estimate (PSE) categories

Category	Definition and sub-category
A1: Market price support	Transfers from consumers and taxpayers to agricultural producers from policy measures that create a gap between domestic market prices and border prices of a specific agricultural commodity, measured at the farm gate level.
A2: Payments based on output	Transfers from taxpayers to agricultural producers from policy measures based on current output of a specific agricultural commodity.
B: Payments based on input use	Transfers from taxpayers to agricultural producers arising from policy measures based on on-farm use of inputs: • Variable input use (B1) • Fixed capital formation (B2) • On-farm services (B3)
C: Payments based on current A/An/R/I, production required	Transfers from taxpayers to agricultural producers arising from policy measures based on current area, animal numbers, revenue, or income, and requiring production.
D: Payments based on non-current A/An/R/I, production required	Transfers from taxpayers to agricultural producers arising from policy measures based on non-current (i.e. historical or fixed) area, animal numbers, revenue, or income, with current production of any commodity required.
E: Payments based on non-current A/An/R/I, production not required	Transfers from taxpayers to agricultural producers arising from policy measures based on non-current (i.e. historical or fixed) area, animal numbers, revenue, or income, with current production of any commodity not required but optional.
F: Payments based on non-commodity criteria	Transfers from taxpayers to agricultural producers arising from policy measures based on: • Long-term resource retirement (F1) • A specific non-commodity output (F2) • Other non-commodity criteria (F3)
G: Miscellaneous payments	Transfers from taxpayers to farmers for which there is a lack of information to allocate them among the appropriate categories.

Note: A (area), An (animal numbers), R (receipts) or I (income).
Source: OECD (2018)

might be able to provide supplemental information in addition to PSE itself (van Winkle et al., 2015).

There are still some other issues to consider in interpreting PSE. The PSE dataset does not capture leakage and spillover effects of subsidy reform (van Winkle et al., 2015). In addition, PSE data and categories cannot be directly associated with biodiversity impact even though potential impact can be inferred from the categories (van Winkle et al., 2015). Thus, PSE does not contain complete information enough to assess progress in reforming subsidies harmful to biodiversity.

The scalability of PSE is high. The data is collected at the national level and then aggregated to form regional or global indicators (BIP, n.d.). Therefore, disaggregation of regional or global data into national data is also possible without any adjustment.

PSEs have been calculated since 1990 and updated annually by the OECD. PSE data are available in 25 countries and the EU from the OECD website as of April 2020.[14] As the data from 28 EU countries are aggregated to form the EU data since 2014, a total of 53 countries have data on PSE. Thus, data availability of PSE can be considered medium.

There was no country that included PSE data in their 5th NRs. Brazil and South Africa have PSE data as individual countries, while Bulgaria and Germany have data which have been combined under the EU category. However, the four countries did not utilize PSE data in assessing their biodiversity policies.

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[14] PSE data are available at the OECD Statistics website (https://stats.oecd.org/) under the category of Agriculture and Fisheries.

The final score of the PSE is 3 out of 7 points which is a moderate score (Table 4.9). The score shows that this indicator can be used at multiple levels, while it is not widely used with the medium level of data availability. This indicator is intuitive, but moderately informative since it does not directly show the trends of subsidies harmful to biodiversity conservation.

Table 4.9 Evaluation table for producer support estimates

Indicator	Informativeness	Scalability	Data Availability	Current Usage	Score
Producer support estimate	Medium	Yes	Medium	Low	3

4.3.2 Agricultural Export Subsidies

Agricultural export subsidies are policy instruments that are taken to provide incentives to domestic producers encouraging export of agricultural products. This indicator measures the total amount of subsidies given on this purpose.

Agricultural export subsidies have been recorded by WTO, while they also have been the interest of some other international organizations and instruments such as FAO, UNFCCC, and CBD. This is because agricultural behavior affects not only trade but many other aspects including human health, climate change, and biodiversity. Most of these organizations are trying to remove or, at least, reduce agricultural subsidies. Basically, export subsidies are prohibited by international

treaties such as the Agreement on Agriculture.[15] In 2015, at the 10th session of the Ministerial Conference of the WTO, members agreed to eliminate agricultural export subsidies.[16] SDGs also reaffirm that removing agricultural export subsidies is a common interest of the global society. Agricultural export subsidies is set as an indicator for the SDG Target 2.b to correct and prevent distortions in world agricultural markets.

Agricultural export subsidies can be intuitively understood. This indicator sums up the amount of agricultural export subsidies within a country. The larger the number is, the more subsidies there are. Once data are accumulated, trends can be easily tracked. The indicator also allows comparison by year and country.

However, like PSE, a larger amount of subsidies does not necessarily mean a higher negative impact on biodiversity. The impact of trade policies on biodiversity depends on a variety of circumstances such as initial patterns of production, consumption, and trade, while it has not been assessed rigorously compared to impacts on other sectors (Treweek et al., 2006). Furthermore, detailed classification of agricultural export subsidies is not available, which makes it difficult to distinguish subsidies with negative impact on biodiversity from those without it.

The indicator of agricultural export subsidies is scalable so that national data can be aggregated to produce regional and global data. However, information needs to be preserved when forming the regional- and global-level data. For example, the SDG Indicators Database collects data on agricultural export subsidies from WTO. While

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[15] See *Article 3, 8, and 10 of the Agreement on Agriculture*.

[16] See *Ministerial Decision* at the 10th session of the Ministerial Conference of the WTO (WT/MIN(15)/45).

the data for each country are available from the WTO Agriculture Information Management System, the SDG database shows only regional and global data which cannot be disaggregated into national data.[17] This means that the original national data are lost in the SDG database after composing regional and global data.

Data from 34 countries and the EU, which includes 28 member countries, are available at the WTO Agriculture Information Management System. Therefore, the data availability of this indicator can technically be regarded as medium since it covers 62 countries in the world. However, considering that some data points are missing for some countries, the actual data availability might be lower.

The current usage of this indicator in NRs is low. Brazil, Bulgaria, and South Africa, as individual countries, and Germany as a part of the EU, have data points for this indicator in the WTO database. However, no country among them is using agricultural export subsidies data in their 5th NRs.

The final score of the agricultural export subsidies is 3 out of 7 points (Table 4.10). This indicator is scalable with moderate informativeness. Even though data are available for more than 50 countries in the world, this indicator is not used in the reporting process.

[17] As of February, 2019, the national data can be retrieved from the WTO Agriculture Information Management System website (http://agims.wto.org/pages/default.aspx), while only regional and global data are available at the SDG Indicators Database (https://unstats.un.org/sdgs/indicators/database/).

Table 4.10 Evaluation table for agricultural export subsidies

Indicator	Informativeness	Scalability	Data Availability	Current Usage	Score
Agricultural export subsidies	Medium	Yes	Medium	Low	3

4.3.3 Number of Countries With National Instruments on REDD+ Schemes

Reducing emissions from deforestation and forest degradation in developing countries (REDD+) is an approach to encourage developing countries to take mitigation actions in the forest sector. It includes activities such as reducing emissions from deforestation, reducing emissions from forest degradation, conservation of forest carbon stocks, sustainable management of forests, and enhancement of forest carbon stocks (UNFCCC, n.d.).

There are a variety of national instruments on REDD+ scheme. Policy and planning instruments include national REDD+ strategies and action plans, nationally determined contributions (NDCs), nationally appropriate mitigation actions (NAMAs), and national adaptation plans (NAPs).[18] These instruments are regarded as the vehicles of implementing climate-change policies at the national level. In addition to policy and planning instruments, there are three financing instruments to fund REDD+, which are national and international funds, a direct market mechanism, and a hybrid (market-linked) mechanism (Caravani et al., 2010). However, it would not be

[18] Green Climate Fund (GCF) would support REDD+ investments which are aligned with national REDD+ strategies, NDCs, NAMAs, and NAPs to encourage country-driven approaches (GCF, 2017).

easy for countries to establish the latter two, since REDD+ is a voluntary approach that does not issue certificates to be traded in national or international markets. REDD+ is currently facing long-term financial risks and uncertainty with less approved international funds (Bird et al., 2017; Phelps et al., 2010).

There are no agreed criteria to determine what should be counted as national instruments on REDD+ schemes due to the broad range of instruments as shown above. Thus, the characteristics of instruments can vary by country. Therefore, it is difficult to compare instruments in different countries, and it is also impossible to say that a larger number in this indicator means more efforts a country is making. This indicator needs to be improved for future use by countries.

Another issue with this indicator is that REDD+ can have either a positive or negative impact on biodiversity. REDD+ can be an opportunity to conserve forest areas while it has risks of transforming native ecosystems to non-native reforested or afforested areas (SCBD, 2014). Recent research shows that REDD+ alone cannot guarantee the co-benefit for biodiversity. Further actions, such as integration of the value of biodiversity into REDD+ programs and additional funding for biodiversity, must be taken to maximize the opportunity for biodiversity conservation (Reside et al., 2017; Venter et al., 2013).

To achieve the biodiversity goals under REDD+, Gardner et al. (2012) argue that coordination between climate change goals and biodiversity goals is needed. In the meantime, Potts et al. (2013), emphasizing the fundamental differences between measures for climate change and biodiversity, assert that a decoupled approach will perform better.

Considering the ongoing debates on co-benefits and trade-offs between REDD+ and biodiversity conservation, the indicator of assessing national instruments on REDD+ does not seem to have a strong relationship to biodiversity. As discussed above, it is not possible to intuitively interpret the number of national instruments and to find the relationship between REDD+ programs and biodiversity-related benefits.

This indicator can be used at the national level with a modification, such as counting the number of national instruments or sub-national instruments. However, common criteria to determine whether an instrument can be regarded as a REDD+ instrument need to be established for the comparison at multiple levels.

There are several multilateral mechanisms that support REDD+ activities, such as Forest Carbon Partnership Facility, UN-REDD Programme, Forest Investment Program of the Climate Investment Funds, and Global Environment Facility Sustainable Forest Management and REDD+ Program (Asian Development Bank, 2010). However, there is currently no available database that produces relevant data for national instruments on REDD+. Therefore, data should be collected from various sources such as REDD+ Web Platform and the UN-REDD Programme website. As of April, 2020, only 12 countries have submitted relevant information to REDD+ Web Platform and 12 countries to the UN-REDD Programme website (Table 4.11).

Table 4.11 Countries that have submitted national REDD+ strategies to REDD+ Web Platform and the UN-REDD Programme website

Database containing national REDD+ strategies	**Countries that have submitted national REDD+ strategies**
REDD+ Web Platform	Argentina, Brazil, Cambodia, Chile, Colombia, Costa Rica, Ecuador, India, Indonesia, Malaysia, Mexico, and Paraguay
UN-REDD Programme website	Brazil, Costa Rica, Democratic Republic of the Congo, Ecuador, Fiji, Indonesia, Mexico, Peru, Philippines, Sri Lanka, Tanzania, and Viet Nam

* The number of countries that have submitted their national strategies on REDD+ is counted from REDD+ Web Platform (https://redd.unfccc.int/fact-sheets/national-strategy.html) and the UN-REDD Programme website under the category of "National REDD+ Strategies" (https://www.unredd.net/documents/un-redd-partner-countries-181/national-redd-strategies-1025.html).

Brazil, Germany, and Solomon Islands, among the five countries selected, have provided relevant information on national instruments on REDD+ in their NRs. However, it is impossible to draw specific numbers from the NRs. Brazil has 28 legal instruments on PES including REDD+, but the number of REDD+-specific instruments is not presented. Germany's NR indicates that it has a financial instrument, which is Energy and Climate Fund, that allocated €43 million to the measures for REDD+ and ecosystem-based adaptation. The NR of Solomon Islands contains the country's plan to develop legal framework for REDD+ by 2019.

The final score of the number of national instruments on REDD+ schemes is 2 out of 7 points (Table 4.12). This indicator is scalable, while it does not give much information on conservation of biodiversity through REDD+. Despite the lack of global mechanisms to collect data on this indicator, some of the countries are providing relevant information in their NRs.

Table 4.12 Evaluation table for countries with national instruments on REDD+ schemes

Indicator	Informativeness	Scalability	Data Availability	Current Usage	Score
Countries with national REDD+ instruments	Low	Yes	Low	Medium	2

4.4 Implementing Nagoya Protocol

The Nagoya Protocol is a supplementary agreement to the CBD, which entered into force on October 12, 2014. As of April, 2020, there are 123 Parties to this protocol including the EU. The objective of this protocol is to share the benefits arising from the utilization of genetic resources, which is one of the three objectives of the CBD. The protocol aims to achieve its objective by promoting appropriate access to genetic resources and technology transfer. The entry into force of the Nagoya Protocol is expected to contribute to access to genetic resources and the fair and equitable sharing of benefits arising from their utilization (ABS). ABS can possibly generate benefits to those who provide biological resources, and this can give incentives to providers to conserve biodiversity (Oberthür & Rosendal, 2014).

ABS also has legal grounds in the CBD. Article 15 of the CBD provides that Parties shall take measures to share the research and development results and the benefits from utilizing genetic resources with those who provide such resources. Article 16 is about access to and transfer of technologies that are relevant to the conservation and sustainable use of biodiversity.

Aichi Target 16 on implementing the Nagoya Protocol consists of two parts: the entry into force of the Nagoya Protocol and operationalization of it at the national level. The former was already accomplished in 2014, 90 days after the deposit of the 50th instrument of ratification. The latter, in the meantime, is in progress in many countries through establishing relevant laws, strategies, and policies.

Two indicators are evaluated for the topic of the Nagoya Protocol in the following subsections. The first one is the number of Parties that have ratified the Protocol, and the second one is the number of countries that have established relevant frameworks.

4.4.1 Number of Parties to the CBD That Have Deposited the Instrument of Ratification, Acceptance, Approval or Accession of the Nagoya Protocol

Counting the number of countries that have ratified, accepted, approved, or acceded to the Nagoya Protocol is an indicator to evaluate how many countries have made a commitment to promoting the access to genetic resources and the sharing of benefits from their use. Ninety-two parties to the CBD signed the Protocol between February 2, 2011 and February 1, 2012 when the Protocol was open for signature. Signature indicates a signatory's willingness to take relevant steps but it does not give legal obligations. A country should ratify the Protocol to become a party to the Protocol and make it effective. Ratification is a procedure of approving a treaty at the domestic level with necessary domestic legislation (United Nations Treaty Collection, n.d.). Ratification, acceptance, approval, and accession all have legal obligation with a country's consent to be bound by the Protocol.[19]

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[19] Vienna Convention on the Law of Treaties, which was adopted in 1969 and entered into force in 1980, provides definitions and effects of ratification, acceptance,

The number of countries that have ratified the Protocol shows the progress on the first part of Aichi Target 16, which is the entry into force of the Nagoya Protocol. This indicator is simple and straightforward in that it directly counts how many countries have deposited the instrument of ratification, acceptance, approval, or accession of the Protocol. This indicator shows the level of consensus about the Protocol at the global level since ratification means a country's commitment to the Protocol. At the same time, it also provides information on whether a country has domestic legislations for the Protocol to be in force at the domestic level. Thus, this indicator mainly focus on how much the Protocol is legally in force at the global and national levels.

This indicator is scalable. When scaled down to the national level, this indicator needs to be modified to simply assessing whether a country has ratified the Protocol or not, which is a yes or no question. Once national data are collected, the global indicator can be produced. Data can also be re-grouped by regional and economic group, as exemplified in Table 4.13.

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approval, and accession. Each of them is regarded as the consent to be bound in accordance with the text of a treaty. Article 33 of the Nagoya Protocol provides that instrument of ratification, acceptance, approval or accession by States or regional economic integration organizations will have the same effect.

Table 4.13 Example of counting the number of Parties to the CBD that have ratified the Nagoya Protocol by UN regional group

Regional group	Number of countries that have ratified	Number of countries in each group	Percentage
African Group	45	54	83.3%
Asia-Pacific Group	36	54	66.7%
Eastern European Group	11	23	47.8%
Latin American and Caribbean Group	15	33	45.5%
Western European and Others Group	15	28	53.6%
Total	123	192	59.9%

* Countries that are not Parties to the CBD and not in any of the UN regional group are excluded, so the sum of the numbers in each group does not match with the total.
** Data are up-to-date as of April, 2020.

Data are available at the UN Treaty Collection (UNTC) website and the Access and Benefit-Sharing Clearing-house (ABSCH).[20] The UNTC website provides information on the status of the Protocol, including the date of entry into force, the number of Parties, the certified true copy of the Protocol text, and dates of signature, ratification, acceptance, approval, and accession by each participating country. In the meantime, the ABSCH shares data reported by each country such as ABS national focal points, relevant policy measures, and national websites. Whether a country has deposited the relevant instruments or not are available for all the countries at both websites.

[20] The address of the two websites are as follows:
UNTC (https://treaties.un.org/pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-8-b&chapter=27&clang=_en) and ABSCH (https://absch.cbd.int/).

All the five case study countries, in their NRs, provided relevant information on the progress towards ratifying the Nagoya Protocol. Even though they did not ratify the protocol at the time of publishing their 5th NRs, they specified whether they had ratified the protocol or not and what had been done to prepare for the ratification.

The final score of this indicator is 7 (Table 4.14). This indicator is straightforward to understand and scalable. There are databases that have records for all the countries in the world, and countries are providing relevant information in their reporting.

Table 4.14 Evaluation table for number of Parties to the CBD that have ratified the Nagoya Protocol

Indicator	Informativeness	Scalability	Data Availability	Current Usage	Score
Number of Parties that have ratified the Nagoya Protocol	High	Yes	High	High	7

4.4.2 Number of Countries That Have Adopted Legislative, Administrative and Policy Frameworks for the Implementation of the Nagoya Protocol

The Nagoya Protocol provides that each Party shall take legislative, administrative, or policy measures to implement the obligations of the Protocol. The obligations can be largely classified into three groups: access obligations, benefit-sharing obligations, and compliance obligations (CBD, n.d.-a). Parties shall report their measures to COP-MOP to the Protocol through the ABSCH. The categories of

such measures in ABSCH are: law, regulatory or administrative measures, guidelines, strategy/action plan, policy document, explanatory information, and other.[21]

Counting the number of countries with legislative, administrative, and policy frameworks including the above listed measures is useful mainly at the global level. It needs to be modified at the national level to count the number of measures within a country. Every country has various measures with different effects and results. So, direct comparison of numbers between countries does not make sense. Instead, tracking the trend within a country is meaningful.

This indicator can be intuitively understood in that it reports how many and what category of measures are being taken in a country. However, the number of measures itself does not provide enough information on the effectiveness of implementation of the Protocol at the national level, which is the second part of Aichi Target 16. Therefore, some other indicators are needed to make this indicator more informative. UNDP (2018) suggested following potential indicators:

- The extent to which the Nagoya Protocol is in force.
- The extent to which the Nagoya Protocol is operational, consistent with national legislation.
- The extent to which key laws, policies, subsidies and incentives that facilitate and/or inhibit sustainable use, conservation and equitable benefits sharing are assessed.

[21] These categories are provided in the step-by-step guides of the ABSCH (https://absch.cbd.int/en/help/about#submit-section).

- The extent to which key institutions, institutional structures and institutional capacities that facilitate and/or inhibit sustainable use, conservation and equitable benefits sharing have been identified and assessed.
- The effectiveness of NBSAP strategies and actions for ensuring fair and equitable sharing of benefits arising from the utilization of biodiversity, including genetic resources.

As mentioned above, this indicator needs to be modified to apply at different levels. When national data are aggregated to form global indicator, each country's data would be converted to either "zero" or "one," and then all the numbers will be summed.[22] Information can be lost to some extent at this stage. However, global indicator can be disaggregated to the national and regional levels if the original data are preserved.

ABSCH works as an instrument of gathering information on national legislative, administrative, and policy measures for implementing the Nagoya Protocol. As of April 6, 2020, a total of 333 measures have been reported through ABSCH from 73 countries and the EU. All the data are reported by national governments. There is no way to distinguish between countries that do not have relevant measures and those that have not reported yet.

Brazil and South Africa included information on relevant measures in their NRs. Currently, Bulgaria, Brazil, Germany, and South Africa have relevant data reported through ABSCH. However, when considering the NR submission dates, it is no wonder that only two country have mentioned in their NRs to have relevant measures. All the five countries have submitted their NRs before early 2015, while

[22] This indicator is listed as SDG indicator 15.6.1. The SDG Indicators Database provides data of "zero" and "one" for each country.

only South Africa ratified the Protocol at that time.[23] It is expected that more countries would utilize this indicator in the next version of NR.

The final score of this indicator is 4 out of 7 points (Table 4.15). This indicator is scalable, and has a medium level of informativeness, data availability, and current usage. It is not used widely at the present, but is expected to be used more in the future.

Table 4.15 Evaluation table for the number of countries with relevant frameworks for the Nagoya Protocol

Indicator	Informativeness	Scalability	Data Availability	Current Usage	Score
Number of countries with relevant frameworks for the Nagoya Protocol	Medium	Yes	Medium	Medium	4

[23] Bulgaria, Germany, Solomon Islands, and South Africa have submitted their NRs on June 13, April 1, March 31, and March 6, 2014, while Brazil on February 2, 2015.

4.5 Developing NBSAPs

NBSAP is an instrument for each Party to implement the CBD at the national level. Article 6(a) of the CBD provides that Parties shall develop national strategies, plans, or programs for the conservation and sustainable use of biodiversity. NBSAP needs to reflect the measures identified or recommended by the CBD. Some guidance on the process and contents of NBSAPs, such as target-setting and resource mobilization, have been provided by the COP decisions (CBD, n.d.-b). However, NBSAPs vary a lot between countries, since there are no strict formats or standards on developing NBSAPs.

Aichi Target 17 is to encourage Parties to develop, update, and adopt NBSAPs as a policy instrument. It also includes the component of implementing NBSAPs effectively. This target was intended to be achieved by 2015.

There have been several programs, such as the NBSAP Forum and Global Environment Facility (GEF) projects, that support contracting Parties to develop NBSAPs. The NBSAP Forum was established to support countries in revising and implementing their NBSAPs. It aims to share information, knowledge, and experience on NBSAP process by countries. In the meantime, the fifth replenishment of the GEF (GEF-5) supported enabling activities including revising NBSAPs in line with the Strategic Plan and preparing the 5th NRs. There were 145 countries eligible for these funds, and 130 countries have utilized them (CBD, n.d.-c).

One indicator is analyzed under the category of developing NBSAPs: the number of countries with developed or revised NBSAPs. This indicator measures how many countries have made progress on developing and updating NBSAPs, which is one of the aims of Aichi Target 17.

4.5.1 Number of Countries With Developed or Revised NBSAPs

Developing an NBSAP indicates a country's willingness to implement the Convention. Unlike NRs, which are required to be submitted to the COP by Parties, NBSAPs can be developed or revised anytime when countries decide to do so. As a result, some countries have revised their NBSAPs regularly, while some other countries have developed their NBSAPs only once.

Simply counting the number of countries with developed or revised NBSAPs does not clearly show the current status of NBSAPs in those countries. For this indicator to be more informative, it is important to look into submission dates and coverage of NBSAPs. Four categories and the number of countries in each category are provided by the SCBD as follows, as of April, 2020:[24]

- Parties whose post-2010 NBSAP takes the Strategic Plan for Biodiversity (2011-2020) into account: 157 countries
- Parties whose post-2010 NBSAP does not take the Strategic Plan for Biodiversity (2011-2020) into account: 13 countries
- Parties who have not yet submitted a post-2010 NBSAP: 21 countries
- Parties that have not yet submitted an NBSAP: 5 countries

Unfortunately, these categories do not fully provide information on how many countries have up-to-date NBSAPs. For example, Tuvalu has submitted its last NBSAP for the period of 2012-2016, so it is no longer effective. However, its NBSAP falls under the second category above with other active NBSAPs without any

[24] Information on submission of NBSAPs is available at the CBD website (https://www.cbd.int/nbsap/default.shtml).

distinction between them. Therefore, whether a country's NBSAP is active or not at the present also needs to be considered in assessing the current status of NBSAPs.

Countries can use the above categories at the national level. These categories can be regarded as steps to the up-to-date NBSAPs. Suppose a country has developed post-2010 NBSAP without reflecting the Strategic Plan. This country is in the second category above. It can use the indicator by setting a target to revise its NBSAP by taking the Strategic Plan into account. After the revision, this country will now be in the first category. Of course, these categories are specific to the current 2011-2020 global strategies, but the same categories can be still used by simply replacing the Strategic Plan 2011-2020 with the post-2020 strategic plans after 2020.

In the meantime, there is an example of adapting this indicator at the national level, which is to count the number of Subnational Biodiversity Strategies and Action Plans (SBSAPs) within a country. South Korea has an explicit target of encouraging local governments to develop their SBSAPs. A target in its third NBSAP aims to have at least eight SBSAPs by the end of 2018. As of November 2018, nine local governments including Seoul, Ulsan, Gangwon-do, Gyeongsangnam-do, and Chungcheongbuk-do have developed SBSAPs (Ministry of Environment, Republic of Korea, 2018).

This indicator can be used at multiple levels. As illustrated above, this indicator needs to be adjusted when using at the national level. The global data can be produced by compiling information provided by each country. Then, the number of NBSAPs will be counted and aggregated to form the global indicator. Once all the information is compiled, the global data can also be disaggregated for the use at the regional level.

The status of NBSAPs can be found at the CBD website. As of April 6, 2020, a total of 191 Parties have submitted NBSAPs, while 157 Parties reflected the Strategic Plan in their NBSAPs. Parties submit their new or revised NBSAPs to the SCBD so that the SCBD can provide up-to-date information online. The latest NBSAPs and submission dates are available at the SCBD website. However, the submission of SBSAPs has not been encouraged much compared to NBSAPs. Nineteen countries have submitted SBSAPs within their territories, while some other countries have not done so even though they have SBSAPs (CBD, n.d.-f).

Regardless of whether they have updated or not, all five case study countries have documented in their NRs how the NBSAPs have been updated. Bulgaria, in its 5th NR, elaborates on the second National Biodiversity Conservation Plan 2005-2010 and its plan to develop a new National Biodiversity Conservation Strategy of Bulgaria and the Third National Biodiversity Action Plan 2014-2020. Germany's NR documents how the Germany's pre-2010 NBSAP covers the Strategic Plan and Aichi Targets even though it was developed before 2010.

The reason why all five countries' NRs include the information on NBSAP status seems to be due to the guidelines for the 5th NR. The guideline provides the proposed structure and questions to be answered. This shows that the use of indicators at the national level can be encouraged by the COP decisions and influenced by the SCBD.

The final score of this indicator is 6 out of 7 points (Table 4.16). This indicator is moderately informative due to its limited capability in distinguishing up-to-date NBSAPs. In the meanwhile, it is scalable, and widely used in NRs. Data for all Parties are available at the CBD website.

Table 4.16 Evaluation table for number of countries with developed or revised NBSAPs

Indicator	Informativeness	Scalability	Data Availability	Current Usage	Score
Number of countries with developed or revised NBSAPs	Medium	Yes	High	High	6

4.6 Improving, Sharing, and Applying Knowledge

Information and knowledge play a big role in effective implementation of the CBD. Preamble of the CBD recognizes the need for improving scientific, technical, and institutional capacities to deal with the issue of lacking information and knowledge on biodiversity. Article 12, 16, 17, 18, and 19 also provide Parties' obligations on research and training, access and transfer of technology, exchange of information, technical and scientific cooperation, and handling of biotechnology and distribution of its benefits.

Aichi Target 19 is to promote the improvement, transfer, and application of knowledge and technology. Access to and sharing of information, such as through open access initiatives, would give great benefits to the users of those data in better conserving biodiversity (Gaikwad & Chavan, 2006). Technology transfer also contributes to conservation of biodiversity in developing countries as well as globally. It allows developing countries to utilize technologies in implementing their biodiversity conservation policies and projects, while transfer of high-level technologies would increase efficiency of those activities. However, technology

transfer has not yet been achieved sufficiently (SCBD, 2014). Developing countries have constantly been raising the issue of a lack of technology and information as a constraint for conservation of biodiversity (Ministry of Environment, Republic of Korea, 2014).

There have been several programs and initiatives to facilitate technology transfer. The Programme of Work on technology transfer and scientific and technological cooperation was adopted at the seventh meeting of the COP in 2004 to promote effective action for technology transfer. The LifeWeb and the Bio-Bridge Initiative have been established and financially supported by Germany and Republic of Korea respectively in cooperation with the SCBD. Achievements of these programs and initiatives needs to be further evaluated.

One indicator, growth in species occurrence records accessible through Global Biodiversity Information Facility (GBIF), is analyzed in the following subsection.

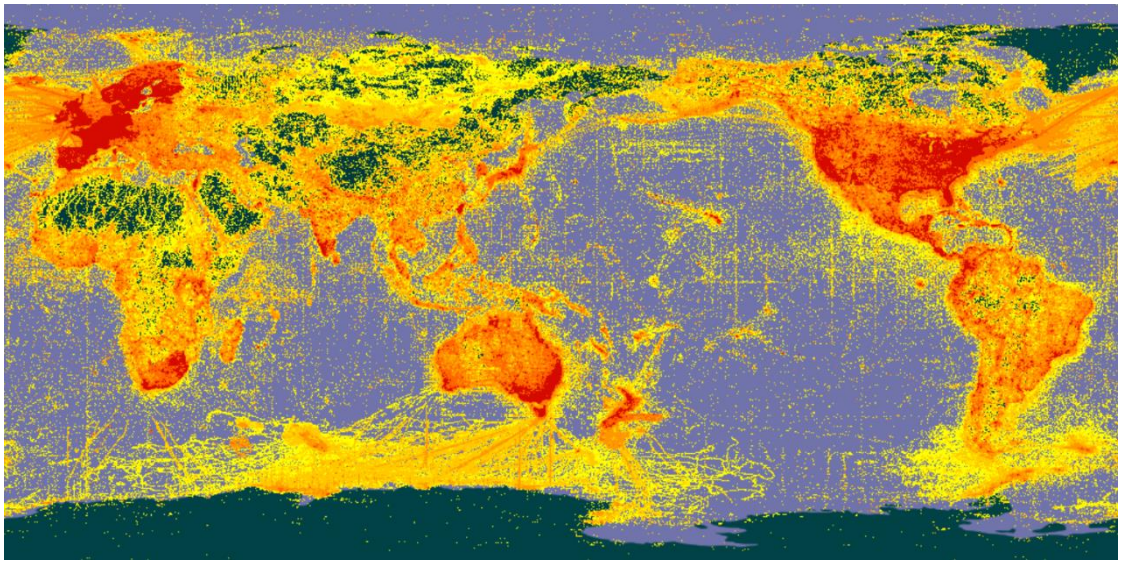
4.6.1 Growth in Species Occurrence Records Accessible Through GBIF

GBIF is an international research infrastructure funded by governments to provide open access to data about all types of life on earth (GBIF, n.d.). It was established in 2001 through Memorandum of Understanding between participating countries, international organizations, and other entities (GBIF, 2010). It aims to promote the dissemination and use of the biodiversity data across the world.

GBIF provides data of species occurrences throughout the world (Fig. 4.3). The total number of occurrence records is a cumulative number which increases as more data are submitted by various institutions. Calculating the growth in species occurrences records, or the number of records over time, indicates the volume of data available to the public.

This indicator can be used in two ways at the national level. One way is to count the number of records submitted by institutions from a country. The other way is to count the number of records available within a country's territory. The former represents a contribution of a country to the GBIF database, while the latter shows the volume of a country's data available to the public.

This indicator is intuitively understandable since it simply counts the number of records over time. The larger the value is, the more data points are shared with the public. However, the fact that more data are available to the public does not always lead to larger utilization of them, which is a component of Aichi Target 19. GBIF, unfortunately, does not produce information on actual utilization volume of data.



*Distribution of data points is shown from yellow to red in this world map. Darker (red) area means there are more data points in that location, even though the exact color legend is not provided by the GBIF website.

Figure 4.3 Distribution of georeferenced record locations published through the GBIF obtained from the GBIF website (as of April 6, 2020)

In addition, spatial bias due to uneven effort of data collection and management can be an issue in dealing with the data (Beck et al., 2014). As shown in Figure 4.3, spatial bias in records can be seen in industrialized areas with high densities. In the meantime, data quality itself can also be another issue in analyzing data retrieved from GBIF. Several suggestions have been made to fix this issue, such as providing additional information on precision, quality, and uncertainty of data, and allowing users to annotate errors or problems (Anderson et al., 2016).

This indicator can be used at multiple levels. Basically, data are collected from a variety of sources across the world. Even some data in non-participating countries are available because of the contribution by international or sub-national participants. For example, as of April, 2019, occurrences records in Oman are published by 133 publishers from 28 countries, even though Oman is neither a voting participant nor an associate country participant.[25] Since the data are recorded with coordinates, data can be retrieved by any country or polygon. Therefore, this indicator can be produced for all the countries at the national level. In the meantime, the number of data points published from a country can also be counted for the use at the national level. It would assess the contribution of a country to the global data.

Data availability itself is high thanks to the collection of data by international participants as described above. Every country can easily retrieve the data points within its territory including marine areas. The data quality and the number of records can be improved for the national use if a country join the GBIF as either a voting participant or an associate country participant with publishing occurrence data

[25] Information on publishers and publishing locations are available by country at the GBIF website (https://www.gbif.org/).

regularly. The use at the regional level is also possible, but the data quality cannot be fully controlled at this level due to the different data quality between participant countries and non-participant countries.

Only one among the five countries is using this indicator in its NR. South Africa mentions that it was the fourth largest data contributor to GBIF with 14 million records around the world. However, South Africa does not use the indicator for records in its territory, but only for records it has contributed. Some other countries specified their financial contribution or commitment as participants, but the indicator was not used.

The final score of this indicator is 4 out of 7 points (Table 4.17). This indicator has some limitations in describing an actual contribution to information sharing, and it is not used by many countries at this moment. However, it can be used at multiple levels, and data availability is also high.

Table 4.17 Evaluation table for growth in species occurrence records accessible through GBIF

Indicator	Informativeness	Scalability	Data Availability	Current Usage	Score
Growth in species occurrence records accessible through GBIF	Medium	Yes	High	Low	4

4.7 Increasing Financial Resources

Financial resources play a critical role in practically implementing biodiversity strategies. Article 20 of the CBD states that each Party needs to financially support its national plans and activities for biodiversity, and that developed countries shall provide financial resources to developing countries for the implementation of the CBD. Article 21 addresses the CBD's financial mechanism that operates financial resources under the policies, strategies, and criteria provided by the CBD.[26]

However, there is a massive funding gap between the amount required to reduce the rapidly decreasing trend of biodiversity and the actual funding amount (Arlaud et al., 2018; McCarthy et al., 2012). Furthermore, the world's finance for biodiversity is mostly generated and delivered in developed countries (Parker et al., 2012). Several suggestions have been made for expansion and efficient use of funding, such as the re-allocation of biodiversity-related funds and the establishment of biodiversity market mechanisms (Hein et al., 2013; Waldron et al., 2013).

The significance of financial resources is well reflected in Aichi Target 20. This target aims to substantially increase financial resources for implementing the Strategic Plan for Biodiversity 2011-2020. A specific number for this target was set in CBD COP Decision XII/3 in 2014, which is to double total biodiversity-related international financial resource flows to developing countries by 2015, and maintain this level until 2020. This Decision also encourages Parties to mobilize domestic financial resources to reduce the funding gap at the domestic level.

Two indicators are analyzed under this section: first one is information provided through the financial reporting framework adopted by Decision XII/3, and

[26] The GEF serves as the financial mechanism to the CBD.

the second one is official development assistance and public expenditure on conservation and sustainable use of biodiversity and ecosystems.

4.7.1 Information Provided Through the Financial Reporting Framework, Adopted by Decision XII/3

Recognizing the importance of increasing and monitoring financial resources for biodiversity conservation, the financial reporting framework was adopted at the COP12 in 2014 (CBD COP Decision XII/3). This framework aims to give guidance for gathering information on biodiversity finances to identify the current gap and encourage Parties to increase their funding resources accordingly. It requires the Parties to report relevant information, such as international financial resource flows, domestic biodiversity expenditures, funding needs and gaps, inclusion of biodiversity in priorities and plans, assessment and/or evaluation of values of biodiversity, national finance plans, and encouragement of participation by non-governmental sectors.

Information included in the financial reporting framework is broad as listed above. However, the indicator of assessing the information provided through the financial reporting framework does not specify which data among the above listed items need to be collected to form this indicator. There are nine items that comprise this indicator (Table 4.18). Those items can be classified into a form of either nominal, ordinal, or continuous variables, or more than two types at the same time. Since this indicator has items with different types, it is complex to evaluate this indicator.

Some items of this indicator are informative, while others are not. For example, items of international financial resource flows, domestic biodiversity expenditures, and national finance plans directly measure the current state of financial resources for biodiversity. These items can also be intuitively understood since a

larger number means more resources to conservation efforts. On the other hand, some items are not directly related to assessing the progress in increasing financial resources. Inclusion of biodiversity in priorities and plans does not explain much about financial resources, but rather, it is more related to Aichi Target 3 to integrate biodiversity value into national plans.

Table 4.18 Items in the financial reporting framework

Item	**Type**
International financial resource flows	Continuous
Inclusion of biodiversity in priorities and plans: (1) not yet started; (2) some inclusion achieved; (3) comprehensive inclusion	Ordinal
Assessment and/or evaluation of values: (1) not yet started; (2) some assessments/evaluations undertaken; (3) comprehensive assessments/evaluations undertaken	Ordinal
Current domestic biodiversity expenditures	Continuous
Assessment of the role of collective action: (1) no such assessment necessary; (2) not yet started; (3) some assessments undertaken; (4) comprehensive assessments undertaken	Nominal/ ordinal
Funding needs, gaps, and priorities	Nominal/ continuous
National finance plans	Continuous
Measures to encourage the private sector as well as non-governmental organizations, foundations and academia to provide domestic support: (1) no; (2) some measures taken; (3) comprehensive measures taken	Ordinal
Availability of financial resources for achieving targets: (1) to report domestic biodiversity expenditures? (yes/no); (2) to report funding needs, gaps and priorities? (yes/no); (3) to prepare national finance plans for biodiversity? (yes/no)	Nominal

In terms of scalability, this indicator can be used at different scales with a slight modification. Continuous items can be aggregated or disaggregated once national data are collected. In the meantime, nominal and ordinal items can be modified for the use at the global scale by counting the number of countries that are in a certain category. Both national and global data can be accessed at the CBD clearing-house mechanism (CHM).[27]

As of April 6, 2020, there are 82 countries that have reported their financial resource mobilization status through the financial reporting framework online. However, some countries have not provided all the required data due to different reasons. For example, Bulgaria has submitted its report, while it did not include funding needs, gaps, and priorities. This is because these data can be calculated based on NBSAPs, but Bulgaria could not include them since it is still developing its new NBSAP.

Only a limited number of data for this indicator are used in NRs. NRs of the five countries do not tend to contain financial status that requires detailed numbers, such as national financial plans and funding gaps. On the other hand, NRs usually include some information on countries' efforts related to nominal or ordinal items, such as whether the biodiversity value is included in priorities and plans or not.[28] Overall, it seems that this indicator is not widely used in NRs.

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[27] The global data that are aggregated from national data are available by using the function of Financial Reporting Framework Analyzer at the CBD CHM website (https://chm.cbd.int/search/financial-analyzer).

[28] Since this indicator covers a wide range of information, current usage of some items is already evaluated in other sub-sections. Sub-sections 4.2.2 and 4.7.2 evaluate current usage of inclusion of biodiversity in national plans and official development assistance, respectively.

The final score of this indicator is 3 out of 7 points (Table 4.19). This indicator is moderately informative, since it is composed of both items that give relevant information and that do not. Every item is scalable regardless of whether it is nominal, ordinal, or continuous values. There are available data for a certain number of countries, while this indicator is not currently used in many NRs.

Table 4.19 Evaluation table for information provided through the financial reporting framework

Indicator	Informativeness	Scalability	Data Availability	Current Usage	Score
Information provided through the financial reporting framework	Medium	Yes	Medium	Low	3

4.7.2 Official Development Assistance and Public Expenditure on Conservation and Sustainable Use of Biodiversity and Ecosystems

This indicator is suggested by AHTEG, and adopted and used by SDG-IAEG. It technically should cover the official development assistance (ODA) and other public expenditure. However, only ODA is currently recorded as an SDG indicator by the SDG-IAEG, and the BIP also provides ODA as the only indicator for Aichi Target 20.[29] Considering these facts, this research focuses on ODA for this indicator.

[29] The E-Handbook on SDG indicators (https://unstats.un.org/wiki/display/SDGeHandbook/Home) mentions that it "only covers the ODA part of the indicator."

ODA is defined as government aid to promote and target the economic development and welfare of developing countries (OECD, 2019). There are four Rio markers, which is a system of classifying the development finance flows by their objectives: biodiversity, desertification, climate change mitigation, and climate change adaptation (Petri, 2016). Biodiversity-related portions in ODA can be separated by the biodiversity marker.

Donors of ODA are not limited to a certain group of countries, however, most ODA is from OECD member countries. In addition, the term ODA is coined by the OECD Development Assistance Committee (DAC), and ODA flows are regularly recorded by the OECD.

This indicator is informative and intuitively understandable. It measures international financial flows to developing countries. The larger this indicator is, the more financial resources are disbursed for biodiversity. Since the amount can be converted to different currencies and different nominal value of a certain year, it is possible to compare financial resources by country and time.

Of course, there is an uncertainty issue in calculating resources or expenditures that are indirectly related to biodiversity. Some projects are directly related to biodiversity conservation, while others have biodiversity components with other main targets, such as climate change mitigation and combatting desertification. In this case, it is difficult to separate biodiversity-related parts from others. In the Rio marker system, three values are given with markers: 2 for a principal objective, 1 for a significant objective, and 0 for not targeted flows. How much portion of a flow is related to biodiversity can be determined by these values. For example, EU uses 100% coefficient factor for the value of 2, 40% for 1, and 0% for 0 (European Commission,

2016). Suppose a project aims to conserve biodiversity as a significant objective, this flow will be given a biodiversity marker with the value of 1, and the total flow will be multiplied by 40%, or 0.4, to calculate biodiversity-related portion. A country can determine its own coefficient factor, but the coefficient factor needs to be clearly stated when calculating.

Scalability of this indicator is high. Global indicator is produced by aggregating national data. Data can be also compiled or disaggregated for the use at the regional level. However, care should be taken when aggregating or disaggregating. Original data should be used at each calculation, since different countries can set different coefficient factors.

As of April 6, 2020, data on biodiversity-related ODA by 30 countries including EU institutions are available at the OECD Statistics website.[30] Data can also be re-sorted by more than 180 recipient countries and regions. Thus, the data availability of this indicator is high.

This indicator is not widely used among the five case study countries. Only Solomon Islands, as a recipient country, stated the portion of ODA in its total available funding sources. On the other hand, Germany, a member of the OECD, did not provide relevant information in its NR.

The final score of this indicator is 5 out of 7 points (Table 4.20). This indicator is highly informative and scalable. Data availability is also high in terms of both donor and recipient countries. Despite its high informativeness, scalability, and data availability, only a limited number of countries use this indicator. Therefore, there is a

[30] Data can be retrieved by biodiversity marker (https://stats.oecd.org/viewhtml.aspx?datasetcode=RIOMARKERS& lang=en).

need for encouraging Parties to use this indicator and provide relevant information through their NRs or the financial reporting framework. Since the financial reporting framework established in 2015 requires Parties to report on ODA, it is expected that this indicator will be more widely used, and will provide better information in the near future.

Table 4.20 Evaluation table for official development assistance and public expenditure on conservation and sustainable use of biodiversity and ecosystems

Indicator	Informativeness	Scalability	Data Availability	Current Usage	Score
Official development assistance and public expenditure	High	Yes	High	Low	5

4.8 Summary of Indicator Evaluation

A total of 13 indicators are evaluated by the criteria of informativeness, scalability, data availability, and current usage. The scoring table of indicators is in Table 4.21.

The average of total scores is 4.08, where the full score is 7. The range is from 2 to 7, and most of the indicators received scores between 3 and 5 (Fig. 4.4). Indicator 16.1 on ratification of the Nagoya Protocol received the highest score of 7, while indicator 3.3 on REDD+ scheme received the lowest score of 2.

Table 4.21 Scoring table of indicators

Indicator	Informa-tiveness	Scala-bility	Data availa-bility	Current usage	Total score
1.1. Biodiversity Barometer	2	1	0	1	4
1.2. Online interest in biodiversity (Google Trends)	1	1	2	0	4
2.1. Number of countries implementing natural resource accounts, excluding energy, within the System of Environmental-Economic Accounting (SEEA)	1	1	1	0	3
2.2. Number of countries that have integrated biodiversity in National Development Plans, poverty reduction strategies or other key development plans	2	1	0	2	5
3.1. Trends in potentially harmful elements of government support to agriculture (produced support estimates)	1	1	1	0	3
3.2. Agricultural export subsidies	1	1	1	0	3
3.3. Number of countries with national instruments on REDD plus schemes	0	1	0	1	2
16.1. Number of Parties to the CBD that have deposited the instrument of ratification, acceptance, approval or accession of the Nagoya Protocol	2	1	2	2	7
16.2. Number of countries that have adopted legislative, administrative and policy frameworks for the implementation of the Nagoya Protocol	1	1	1	1	4
17.1. Number of countries with developed or revised NBSAPs	1	1	2	2	6
19.1. Growth in species occurrence records accessible through GBIF	1	1	2	0	4
20.1. Information provided through the financial reporting framework, adopted by decision XII/3	1	1	1	0	3
20.2. Official development assistance and public expenditure on conservation and sustainable use of biodiversity and ecosystems	2	1	2	0	5
Average	1.23	1.00	1.15	0.69	4.08

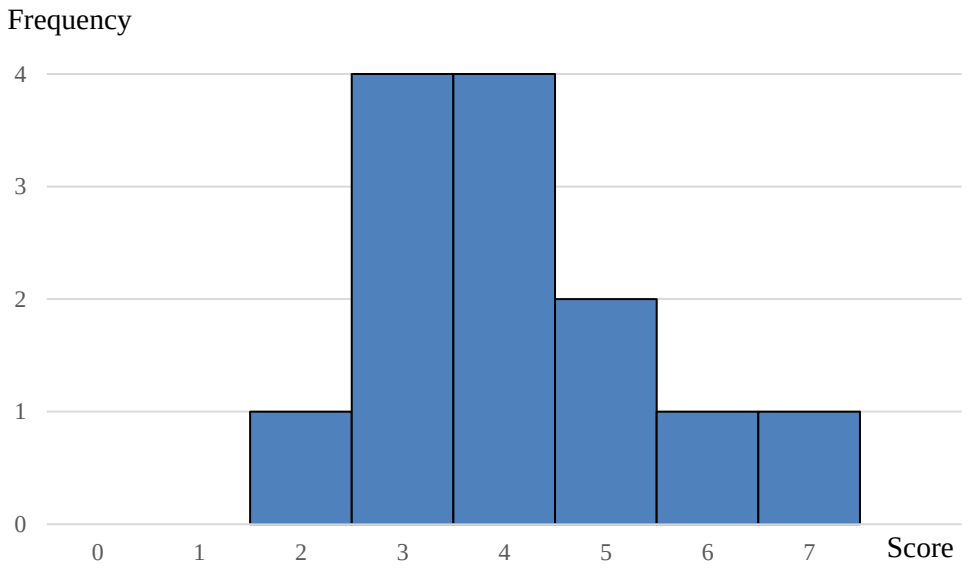

Figure 4.4 Frequency distribution of scores of the 13 indicators

The average score of the informativeness criterion is 1.23 out of 2, that of data availability is 1.15, and that of current usage is 0.69. All indicators received 1 for the scalability criterion. This means that the 13 indicators can be used at the national level with or without modifications.

Chapter 5

COMPARATIVE ANALYSIS

5.1 Analysis by Criterion

5.1.1 Relationship Between Criteria

The four criteria in this study can be interrelated. For example, indicators with high data availability might be preferred and used more by national governments, leading to a higher current usage rate. On the other hand, indicators that do not directly measure progress towards a certain goal might not be attractive, and as a result, they are not widely used. Therefore, relationships between the four criteria need to be investigated.[31]

Kendall's tau (τ) is calculated to measure relationships between criteria, and significance tests are also conducted to determine if the correlation is strong or within the bounds of variance among the variables. The highest correlation is found between informativeness and current usage. The tau value between them is 0.274, which reflects a weak to moderate correlation in strength (Fig. 5.1). It indicates that the more informative indicators tend to be used by more countries. However, this correlation is not statistically significant.

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[31] The "scalability" criterion is excluded from this analysis since all the indicators received the same score for this criterion.

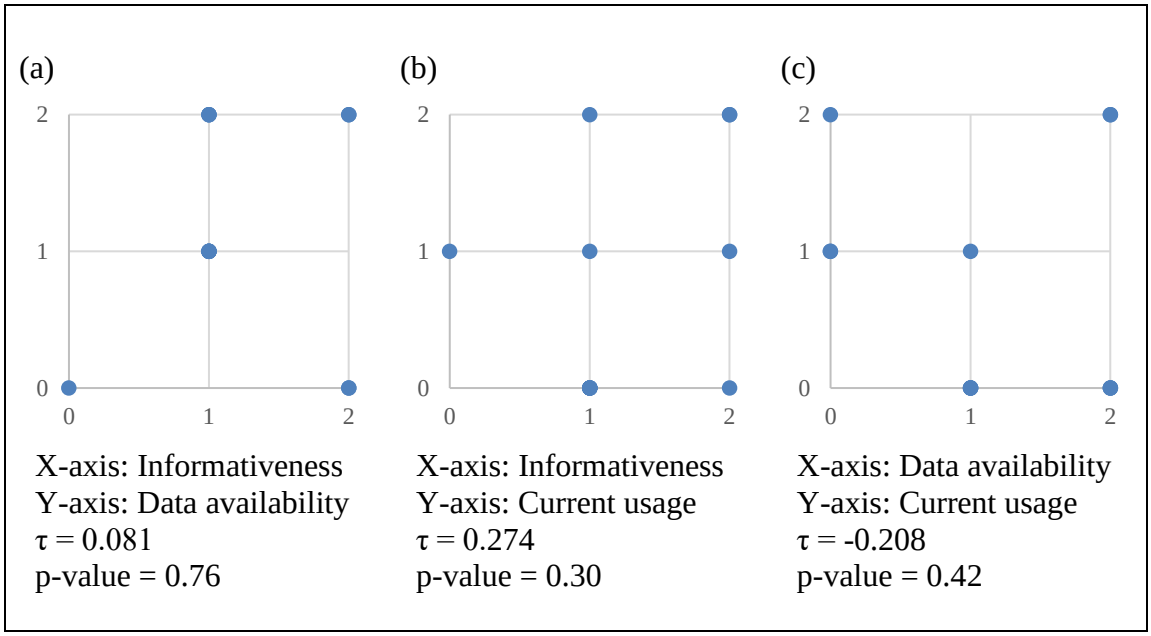

Figure 5.1 Scatterplots and Kendall's taus for correlation between criteria

Tau values between informativeness and data availability, and between data availability and current usage, are 0.081 and -0.208, respectively (Fig. 5.1). Correlations between these criteria are weak and not significant.

In sum, there is no notable and significant relationship between criteria. Therefore, the possibility of interconnectedness between criteria will not be considered further in this study.

5.1.2 Factors Affecting the Institutional Value of Indicators

Other than the features of indicators represented by the four criteria, there can be some other internal or external factors that affect the institutional value of indicators. For example, if the data of an indicator are managed by international organizations, this indicator might have higher data availability. If the use of a set of

indicators is encouraged by the CBD, those indicators might be used by more countries. Therefore, factors that are expected to affect the institutional value of indicators in a positive or negative way are analyzed to determine whether they result in significant differences. For this analysis, a t-test is conducted.[32]

The first factor is whether there is an international organization that collects or manages data or databases for the indicator. Those organizations can be either the CBD, international governmental organizations (IGOs), or non-governmental organizations (NGOs). Hypotheses to test for this factor are that (a) the institutional value of indicators for which data are collected or managed by the CBD is higher than others; (b) the value of indicators for which data are collected or managed by IGOs other than the CBD is higher than others; (c) the value of indicators for which data are collected or managed by NGOs is higher than others; and (d) the value of indicator for which data are not collected or managed by any organization is lower than others.

The second hypothesis reflects the value of the CBD's encouragement of an indicator's wide use. National policies tend to follow encouragement from the international level and reflect globally recognized principles (Balgos et al., 2015). Thus, indicators recommended in the CBD's guidelines or decisions are assumed to have relatively higher value. Hypotheses are that (a) the value of indicators that are provided in the National Report guideline is higher than others; (b) the value of indicators that are provided in CBD COP Decisions is higher than others; and (c) the value of indicators that are not provided in any of the CBD guidelines or Decisions is lower than others.

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[32] The "scalability" criterion is excluded from these tests since all the indicators received the same score for it.

The third factor is the international consensus by intergovernmental organizations or initiatives. The indicators included in the BIP or SDGs can be regarded as having greater value in promoting international consensus. Hypotheses for this factor are that (a) the value of indicators that are selected by the BIP is higher than others; (b) the value of indicators that are selected as SDG indicators is higher than others; and (c) the value of indicators that are not selected by either the BIP or SDG indicators is lower than others.

The last factor addressed by this study is the simplicity of indicators. The assumption is that simpler and more straightforward indicators can be more desirable institutionally, therefore, used more. Those that simply count the number of countries or policies are regarded to be simple indicators for this test. A hypothesis is that the value of indicators that are simple is higher than others.

The result of t-tests conducted on these hypotheses is shown in Table 5.1. Categorizations of each indicator under the four factors can be found in Appendix C.

The t-test analysis shows that data availability is higher if data are collected by the CBD. On the other hand, data availability of indicators for which data are collected by other IGOs or NGOs is not significantly different from that of other indicators. If data are not collected or managed by international organizations, indicators are found to have low data availability. This result shows the importance of establishing databases or data collecting bodies in improving data availability. It seems that the CBD plays the biggest role among international organizations. In terms of informativeness, current usage, and total score, there is no difference between data collecting bodies.

Table 5.1 Average score of indicators by influencing factor

Influencing factors			Average			
			Informative-ness	Data availability	Current usage	Total score
Average score of the 13 indicators for the reference			1.23	1.15	0.69	4.08
Data-collecting organization	CBD	Yes	1.40	1.60*	1.00	5.00
		(No)	(1.13)	(0.88)	(0.50)	(3.50)
	IGOs (except CBD)	Yes	1.29	1.43	0.43	4.14
		(No)	(1.17)	(0.83)	(1.00)	(4.00)
	NGOs	Yes	1.50	1.00	0.50	4.00
		(No)	(1.18)	(1.18)	(0.73)	(4.09)
	None	Yes	1.00	0.00*	1.50	3.50
		(No)	(1.27)	(1.36)	(0.55)	(4.18)
CBD's encouragement	National Report guideline	Yes	1.50	1.00	2.00*	5.50*
		(No)	(1.18)	(1.18)	(0.45)	(3.82)
	Reporting required by CBD decisions††	Yes	1.50	1.50	0.00†	4.00
		(No)	(1.18)	(1.09)	(0.82)	(4.09)
	None	Yes	1.11	1.11	0.56	3.78
		(No)	(1.50)	(1.25)	(1.00)	(4.75)
International consensus by organization or initiative	BIP	Yes	1.50	1.50	0.83	4.83*
		(No)	(1.00)	(0.86)	(0.57)	(3.43)
	SDG indicators††	Yes	1.33	1.33	0.33	4.00
		(No)	(1.20)	(1.10)	(0.80)	(4.10)
	None	Yes	1.00	0.80	0.60	3.40
		(No)	(1.38)	(1.38)	(0.75)	(4.50)
Feature of indicator	Simple counting (e.g., number of countries)	Yes	1.17	1.00	1.33*	4.50
		(No)	(1.29)	(1.29)	(0.14)	(3.71)

* p-value < 0.05

† An unexpectedly low score, which is statistically significant, in contrast to the hypotheses that indicators in this group would have higher scores.

†† CBD COP Decision XII/3 was adopted in 2014 and SDG indicators were first proposed in 2015, both of which are after the due date of 5th NR submission.

Indicators that are included in the 5th NR guideline received higher scores for current usage, and then total scores are also significantly higher. This means that these indicators are used more by countries. One result to take note is that indicators required to be used in financial reporting by the CBD COP Decision XII/3 are not currently used in the 5th NRs. This is not surprising since most of the 5th NRs were submitted by the end of 2014, while the CBD COP Decision XII/3 was adopted in October, 2014, leaving the Parties little time to include those indicators in their 5th NRs. Furthermore, there is no obligation for the Parties to include financial information in their NRs if that information is submitted through the online financial reporting framework. Other than these results, there is no significant difference under the CBD's encouragement factor.

Regarding the international consensus factor, indicators within the BIP are better than others in terms of total score. This implies that the BIP has selected indicators of high institutional value overall. On the other hand, SDG indicators do not show significant difference from those that are not selected as SDG indicators. Indicators that did not gain an international consensus by either the BIP or the SDGs received lower scores in each criterion and total score, but none of these are significant.

Simple indicators received higher scores in current usage, which means that they tend to be used more by countries. However, it seems that simplicity does not affect informativeness, data availability, or total score of indicators.

When looking into the overall influence of factors on the characteristics of indicators, it is found that informativeness is not affected by any of these factors. Informativeness seems to be determined at the stage of indicator development and by

its design, not at the time when indicators diffuse and are used. Data availability is affected only by the existence of data-collecting organizations. This implies that establishing database or data-collecting organizations should be set as the top priority if there is a need to improve data availability. Making other efforts, such as providing guidelines or reaching a consensus, would not directly contribute to data availability.

Current usage is affected by a variety of factors except the existence of data-collecting organizations. This suggests that the usage rate of certain indicators can be increased by the international organizations' encouragement or by an international consensus, not by the database management or presence of data-collecting organizations.

Indicators that are simple and required by the National Report guideline are used by more countries. On the other hand, indicators are less likely to be used if their use is not encouraged by, for example, CBD Decisions. This suggests the possibility that indicators in early stages, which are simple to understand and apply, can be diffused well if encouraged by the CBD. For example, indicator 20.1 calls for domestic financial status to be reported through the financial reporting framework, and South Africa did not use this indicator in its 5th NR, but included it in the 6th NR after the CBD COP Decision XII/3 on financial reporting was adopted.

Overall, it seems that the CBD secretariat can play an important role in the diffusion of certain indicators through the establishment of databases and the measures for encouragement and consensus.

5.2 Analysis by Country

One of the three dimensions of this research is countries, analysis for which can show some patterns among them. Two criteria—data availability and current

usage—can be analyzed by country. Data availability was previously evaluated by counting the number of countries in databases, while it can be re-assessed for the five countries to find out which indicators have data in each country. Current usage was previously assessed by looking into NRs of the five selected countries, and the same methodology can be used in the following analysis. These two criteria utilized different sources for their evaluation: data availability is assessed from international databases, while current usage is assessed from NRs.

When these two criteria are evaluated for the five countries, the same groupings which were used in selecting the five countries, such as IMF's economic groups and LMMC, can be utilized. This facilitates interpretation of results across country groupings to figure out if there is any pattern.

In terms of the number of indicators with available data for a country, Germany has the highest data availability for a total of 13 indicators, followed by Brazil for 12 indicators, South Africa for 11 indicators, and Bulgaria for 9 indicators (Table 5.2). Solomon Islands has the least data availability for 7 indicators. The order is in accordance with economic grouping from advanced economies to emerging market economies, and to low-income developing countries. This reaffirms the need for capacity building and resource mobilization for the development and application of indicators in developing countries, in particular least developed countries.

Within the same economic grouping, megadiverse countries tend to have higher data availability. Among the three emerging market economies, Brazil and South Africa have higher data availability than Bulgaria. This result corresponds with the findings of Lira-Noriega and Soberón (2015) that countries with rich biodiversity tend to have higher capacity in terms of scientific knowledge and data when taking

Table 5.2 Data availability and current usage in parenthesis by country

Indicator	Brazil	Bulgaria	Germany	Solomon Islands	South Africa
1.1. Biodiversity Barometer	Y (Y)		Y (Y)		
1.2. Online interest in biodiversity (Google Trends)	Y (N)	Y (N)	Y (N)	Y (N)	Y (N)
2.1. Number of countries implementing natural resource accounts within the SEEA	Y (Y)		Y (N)		Y (N)
2.2. Number of countries that have integrated biodiversity in National Development Plans	Y (Y)	Y (Y)	Y (Y)	Y (Y)	Y (Y)
3.1. Trends in potentially harmful elements of government support to agriculture (PES)	Y (N)	Y (N)	Y (N)		Y (N)
3.2. Agricultural export subsidies (indicator for SDG target 2.b)	Y (N)	Y (N)	Y (N)		Y (N)
3.3. Number of countries with national instruments on REDD plus schemes	Y (Y)		Y (Y)	Y (Y)	
16.1. Number of Parties to the CBD that have ratified the Nagoya Protocol	Y (Y)	Y (Y)	Y (Y)	Y (Y)	Y (Y)
16.2. Number of countries that have adopted policy frameworks for the Nagoya Protocol	Y (Y)	Y (N)	Y (N)		Y (Y)
17.1. Number of countries with developed or revised NBSAPs	Y (Y)	Y (Y)	Y (Y)	Y (Y)	Y (Y)
19.1. Growth in species occurrence records accessible through GBIF	Y (N)	Y (N)	Y (N)	Y (N)	Y (Y)
20.1. Information provided through the financial reporting framework (CBD CHM)		Y (N)	Y (N)		Y (N)
20.2. ODA and public expenditure on conservation and sustainable use of biodiversity	Y (N)		Y (N)	Y (Y)	Y (N)
Total number	12 (7)	9 (3)	13 (5)	7 (5)	11 (5)

global funding sources into account.

However, there still can be another interpretation. The order of data availability in five countries follows the order of gross domestic products (GDP) (Table 5.3). In 2019, Germany possessed the highest GDP among the five countries, followed by Brazil, South Africa, Bulgaria, and Solomon Islands (WB, n.d.). GDP might be the dominant factor that determines investment in or expenditure on data collection and management, which again leads to the data availability in each country. On the other hand, GDP per capita seems to have less relation to data availability. Bulgaria's GDP per capita in 2019 is larger than that of South Africa, but Bulgaria has less data availability (Table 5.3). It seems that the economic size of a country is a more important factor in determining data availability than the average standard of living of a country.

Table 5.3 GDP and GDP per capita of the five countries in 2019

	GDP in 2019 in US dollars at current prices (millions of dollars)	GDP per capita in 2019 in US dollars
Brazil	1,839,758	8,717
Bulgaria	67,927	9,738
Germany	3,845,630	46,259
Solomon Islands	1,425	2,128
South Africa	351,432	6,001

Source: WB (n.d.)

There are differences in the number of used indicators by country. Brazil used 7 indicators in its NR, and Germany, Solomon Islands, and South Africa used 5 indicators in theirs (Table 5.2). Only 3 indicators were used in Bulgaria's NR. This pattern cannot be explained by economic groupings or megadiverse countries. Neither GDP nor GDP per capita is related to this pattern as well.

There is one more thing to take note of. No country brought new data, which are not available from international database, into their NRs (Table 5.2). In this regard, it appears that each country tries to utilize available data as much as possible.

5.3 Comparison Among Indicators

One of the strengths of the research method adopted for this study is that evaluation with the same criteria makes it possible to identify ways of improving indicators. If an indicator generally has a strong or weak role, lessons can be learned across country type and options can be explored for national-international applicability. This section presents implications deducted from comparison among indicators.

The first implication to discuss is that most of the indicators do not directly measure changes that will lead to a change in the actual state of biodiversity. Indicators under the category of raising awareness are driver indicators, while all others are response indicators. The DPSIR framework provides the theoretical ground on how drivers, pressures, and responses can affect states of biodiversity. However, it is not clear whether the change in these indicators would be actually linked to the change in the state of biodiversity due to the complexity of ecosystem processes (McQuatters-Gollop et al., 2019). Only a limited number of studies investigate their actual impact on biodiversity or relevant activities.

Table 5.4 shows the list of studies that evaluate the causal relationship between indicators and the actual state of biodiversity or between Aichi Targets and the state of biodiversity. To the best of the author's knowledge, there is no study at the indicator level (Table 5.4). Only a few studies show the possibility that change in progress towards Aichi Targets might lead to a better conservation of biodiversity (Table 5.4). A lack of research makes it difficult to figure out the effectiveness of Aichi Targets and their indicators.

For example, there is no study that directly investigates the relationship between the amount of financial resources and impacts on the state of biodiversity throughout the world. Stepping and Meijer (2018) argue that this is due to three challenges: a lack of measures to quantify biodiversity at the national level, a difficulty in separating the exact funding amount of biodiversity components in projects, and a difficulty in measuring changes in the biodiversity state attributable to aid activities. Moreover, several studies show that a larger volume of resources does not necessarily lead to a better conservation due to inappropriate management, inefficient resource allocation, and conservation politics (Berghöfer et al., 2017; Horning, 2008; Joseph et al., 2009).

The reason why there is a dearth of studies seems to be the complexity of the process that affects the state of biodiversity. Policy indicators mostly measure responses which aim to change drivers or to mitigate pressures by policies. Only a few policies directly initiate targets to improve the state. Therefore, it is extremely difficult to prove that increase in the indicator's value leads to actual positive impact on biodiversity.

Table 5.4 Studies on the causal relationship between indicators and the state of biodiversity or between Aichi Targets and the state of biodiversity

Indicator	Studies suggesting the causal relationship between indicators and the state of biodiversity	Studies suggesting the causal relationship between Aichi Targets and the state of biodiversity
1.1. Biodiversity Barometer	-	Anderson et al. (2007), Feng & Reisner (2011), Martín-López et al. (2007), Wilson & Tisdell (2005)
1.2. Online interest in biodiversity (Google Trends)	-	
2.1. Number of countries implementing natural resource accounts within the SEEA	-	Primmer (2011)
2.2. Number of countries that have integrated biodiversity in National Development Plans	-	
3.1. Trends in potentially harmful elements of government support to agriculture (PES)	-	Aviron et al. (2009), Clements et al. (2013), Ingram et al. (2014), Matzdorf & Lorenz (2010), Vitalis (2007)
3.2. Agricultural export subsidies	-	
3.3. Number of countries with national instruments on REDD plus schemes	-	
16.1. Number of Parties to the CBD that have ratified the Nagoya Protocol	-	-
16.2. Number of countries that have adopted policy frameworks for the Nagoya Protocol	-	
17.1. Number of countries with developed or revised NBSAPs	-	Prip et al. (2010)
19.1. Growth in species occurrence records accessible through GBIF	-	-
20.1. Information provided through the financial reporting framework (CBD CHM)	-	-
20.2. ODA and public expenditure on conservation and sustainable use of biodiversity	-	

In addition, indicators that deal with strategies tend to have less studies contrasting to those for lower levels such as policies and projects. For example, there are some studies on incentives and subsidies, but there is few on national plans and legislations (Table 5.4). This might be because it is less complex to find the effectiveness of certain policies and projects than national strategies and plans. Another reason is that investigating the effectiveness of national plans requires massive data, while information on the implementation of those plans is limited due to a lack of capacity and resources (Prip et al., 2010).

A second implication is that there is a need for improving data-sharing and communication between relevant institutions. When there is a common interest among biodiversity-related institutions, they share data between them. For example, the SDG Indicators Database collects data from various sources including WTO, CBD, and OECD to provide the information on progress of the SDGs to the public. This promotes efficiency in data collection and management by enhancing communication between institutions, while also reducing reporting burdens of member countries of those institutions.

Currently, however, data are not shared efficiently. In the case of agricultural export subsidies data, the WTO Agriculture Information Management System provides data at the national level, while the SDG Indicators Database provides only regional and global data. The UNTC and the ABSCH provide the information on the Nagoya Protocol ratification, but they have slightly different data sets. These examples show that data users need to access both databases if they want to collect a complete set of data. Once these databases provide complete information with improved data-

sharing and communication between national and global institutions, then the information can be spread more widely with enhanced efficiency.

Of course, institutions have different interests, so they provide different data set they provide. They don't have any obligation to integrate their databases or to present all the data they have. However, simply providing data sources or links to the relevant databases would increase the efficiency in accessing to and sharing information across the world. Only a limited number of the databases investigated in this study provide direct links to the data sources or relevant databases.

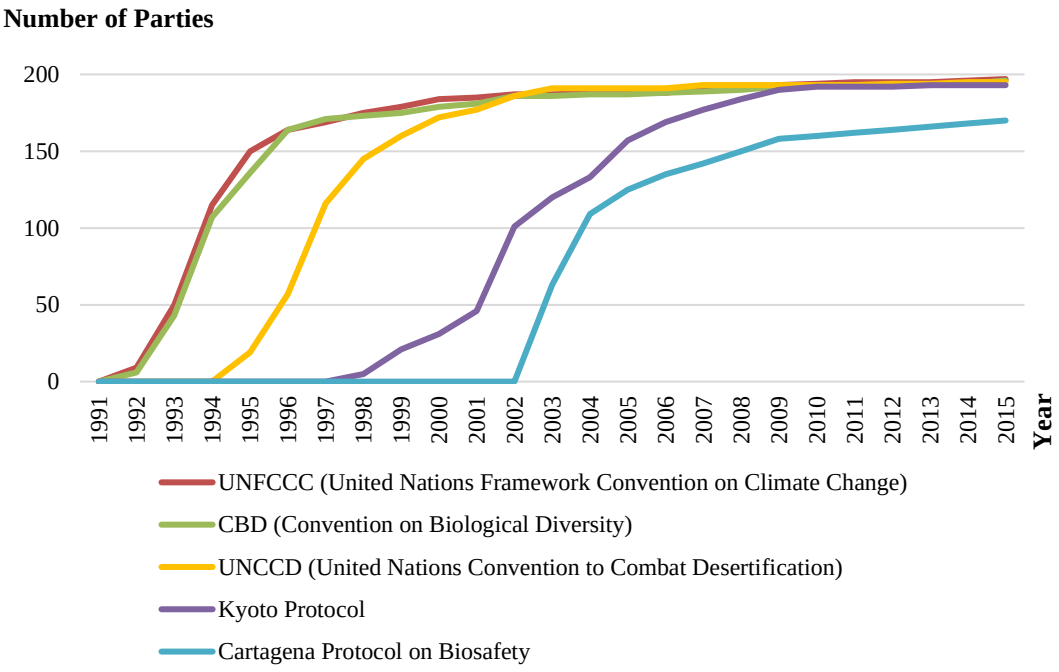
Thirdly, some indicators allow users to analyze the data in two or more dimensions. The GBIF species occurrence records can be collected either by the contribution of a country to the database or by the data volume available to a country as discussed in the previous chapter. The ODA data can also be analyzed in two ways: by donor country or by recipient country. This is possible because the data have other useful metadata embedded in them. Therefore, the more information contained in the database, the higher usability of the data for national as well as international institutions.

One potential way to include additional information in the database can be learned from Google Trends. The Google Trends system produces its data simply by recording the search volume of keywords and the location of those searches. If this system is introduced to the GBIF data, then additional analyses, such as species that gets the most interest by a country, might become possible.

Lastly, indicators specific to time-bound goals and targets obviously have limited applicability over time. For example, the number of countries that have ratified the Nagoya Protocol can be a critical indicator at an early stage. The number needs to

reach 50 for the Protocol to enter into force, and the implementation of the Protocol can be supported more as the number increases. However, like many other international conventions and protocols (Fig. 5.2), this increase will slow down eventually when most of the countries that are willing to join the Protocol have ratified it. This indicator will then become less meaningful to keep monitoring.

Another example is the number of countries with developed or revised NBSAPs. This indicator itself is not bound to a certain goal or target, but the CBD provides the data by relating it to the Strategic Plan for Biodiversity 2011-2020. In this case, the indicator needs to be changed after 2020 at the time of the Strategic Plan's



Source: United Nations Conference on Trade and Development. (n.d.)

Figure 5.2 Number of Parties to Environmental Conventions and Protocols (1991-2015)

expiration. In addition, the indicator would not be able to show stability or consistency if it needs to be linked to another goal or target whenever the previous Strategic Plan is replaced by a new one.

In conclusion, comparing different indicators provide useful insights which could not have been identified if just a single indicator had been investigated. The above four lessons can be incorporated in an indicator developing or improving procedure in the future.

5.4 Lessons from the Paris Agreement and NDCs

There are several lessons from the Paris Agreement and its use of NDCs that provide useful insights into improving biodiversity indicators.[33] First, there is the use of an explicit target and appropriate indicators in the Paris Agreement, which can be a model for CBD consideration. Mace et al. (2018) presented lessons from the Paris Agreement that establishing science-based targets, which are agreed globally, and identifying effective actions are key to achieving the global goal for the UNFCCC. They have suggested three indices to track the trends of biodiversity conservation (Mace et al., 2018). The three indices are the Red List Index, the Living Planet Index, and the Biodiversity Intactness Index, which respectively measure global losses of species, the abundance of wild species, and terrestrial biotic integrity.

A second lesson is that it is important to have a set of common indicators for the transparent review. As Pauw et al. (2018) have pointed out, NDCs vary in scope

[33] Nationally Determined Contributions (NDCs) are national plans for addressing climate change, including greenhouse gas emissions reduction targets and relevant climate actions.

and detail, which makes it difficult to capture diverse data in a systematic way for reviewing them. Moreover, few NDCs include components of assessment and review (Pauw et al., 2018). Indicators that can be commonly used would contribute to resolving this issue.

A third lesson is that indicators need to be reviewed periodically. Under the Paris Agreement, each party shall communicate their NDCs every five years, and a global stocktake will also be reviewed in a 5-year cycle to assess progress towards the goal set in the Paris Agreement. This will help create continuous momentum to achieve a long-term target (Falkner, 2016).

Fourth, capacity building and financial resources play critical role in meaningful participation by developing countries. But details on financial support are not provided in the Paris Agreement (Clémençon, 2016). Indicators that can inform policy makers of the current state of financial resources are necessary for planning and implementing financial strategies nationally and globally.

Concluding from the lessons above, it is important to utilize indicators to capture the overall trend of biodiversity conservation. However, using all the indicators that are currently available might be too complex to track policy trends in a timely way. Therefore, some indicators need to be selected to reach a global and national scale understanding of the trend. An indicator is generally perceived as a parameter or variable that represents what is being measured such as the state of phenomenon, environment, or area (Joumard & Gudmundsson, 2010; OECD, 2003). On the other hand, an index is a set of aggregated or weighted parameters or indicators, as exemplified in Environmental Performance Index (OECD, 2003; Wendling et al., 2020). Thus, an index allows users to track general trends of

biodiversity conservation in a more aggregated way than an indicator. There are several indices for scientific analysis as suggested by Mace et al. (2018), but few for policy measures. Developing indices for biodiversity policies would contribute to better tracking of trend in biodiversity policies around the world.

In this section, indicators that received scores above the average are selected to develop potential indices. Indicators must have high data availability to produce an index. There are four indicators that received scores higher than the average (Table 5.5). Among them, indicator 2.2 does not have enough data for the development of potential indices, while indicator 16.1 is not appropriate for continuous monitoring because it will become less meaningful as time goes on. The remaining two indicators to be examined for policy indices are: indicator 17.1 on NBSAP and indicator 20.2 on ODA (Table 5.5).

The two selected indicators offer complex information. Information on NBSAPs include how many countries have submitted them, when was the last time of submission, and whether an NBSAP refers to a global strategic plan. Information on ODA includes the amount of disbursements in biodiversity-related projects and the portions of investment by different biodiversity components. To capture all the information while making it more intuitively understandable, developing an index is necessary. The two indicators above are further investigated in the following subsections to suggest new indices for the global monitoring of biodiversity policies. A stocktake process learned from the Paris agreement is also taken into consideration for each index.

Table 5.5 Selection of indicators for developing indices

Indicator	Total Score	Data availability	Time-bound	Remarks
1.1. Biodiversity Barometer	4	0	No	
1.2. Online interest in biodiversity (Google Trends)	4	2	No	
2.1. Number of countries implementing natural resource accounts, excluding energy, within the System of Environmental-Economic Accounting (SEEA)	3	1	No	
2.2. Number of countries that have integrated biodiversity in National Development Plans, poverty reduction strategies or other key development plans	5	0	No	
3.1. Trends in potentially harmful elements of government support to agriculture (produced support estimates)	3	1	No	
3.2. Agricultural export subsidies	3	1	No	
3.3. Number of countries with national instruments on REDD plus schemes	2	0	No	
16.1. Number of Parties to the CBD that have deposited the instrument of ratification, acceptance, approval or accession of the Nagoya Protocol	7	2	Yes	
16.2. Number of countries that have adopted legislative, administrative and policy frameworks for the implementation of the Nagoya Protocol	4	1	No	
17.1. Number of countries with developed or revised NBSAPs	6	2	No	Selected
19.1. Growth in species occurrence records accessible through GBIF	4	2	No	
20.1. Information provided through the financial reporting framework, adopted by decision XII/3	3	1	No	
20.2. Official development assistance and public expenditure on conservation and sustainable use of biodiversity and ecosystems	5	2	No	Selected

5.4.1 NBSAP Index

Currently, the Secretariat of the Convention on Biological Diversity (SCBD) provides the number of Parties that have submitted their NBSAPs in four categories:

- Parties whose post-2010 NBSAP takes the Strategic Plan for Biodiversity 2011-2020 into account
- Parties whose post-2010 NBSAP does not take the Strategic Plan for Biodiversity 2011-2020 into account
- Parties who have not yet submitted a post-2010 NBSAP
- Parties that have not yet submitted an NBSAP

This classification focuses on the reflection on a specific strategic plan, which is not appropriate for the continuous monitoring after the expiration of the current Strategic Plan. However, the idea to evaluate the status of national planning in relation to an ongoing global plan can be helpful. Therefore, a newly suggested index would include two components, which are the number of up-to-date NBSAPs and the number of NBSAPs without updates. This can be used, in turn, in a stocktake process similar to the one in the Paris Agreement. Such an approach would link national planning and global targeting in synergistic process to enhance worldwide efforts to improve biodiversity conservation as a dynamic rather than a static process.

It would be reasonable to set a certain time span to determine whether an NBSAP is up-to-date or not. There is substantial variation in the time period designated for NBSAPs among countries. Some countries, such as Ireland, Micronesia, and Republic of Korea, have 5-year plans, while some others, such as France, Kuwait, and Uganda, have plans of 10 years. Several countries including Australia, Bolivia, Pakistan have NBSAPs of more than 10 years. Given these differences, it might be difficult to set an absolute time span for the criterion to

determine whether an NBSAP is up-to-date or not. However, considering that the global strategy under the CBD renews every 10 years, this study suggests 10 years as a criterion.

In the meantime, NBSAPs that are more than 10 years old are still meaningful. Some of them are plans designed for more than 10 years, and if that is the case, these NBSAPs are still effective even though they are not updated in line with the global strategy under the CBD. NBSAPs that have expired might also be meaningful because they can show the direction of a country's biodiversity policies and can be a reference for future updates. Therefore, NBSAPs that were submitted more than 10 years ago can be reflected in the new index by weighting them less than up-to-date NBSAPs. The weight for those is chosen by looking into the recently submitted NBSAPs that are of more than 10-year period. As of December, 2019, seven NBSAPs out of 18 that were submitted since 2018 have targets more than 10 years away from the beginning date of the NBSAPs (Table 5.6). This ratio of 0.4 can be used for weighting.

Of course, this categorization is not perfect. NBSAPs submitted in the recent 10 years are regarded to be up-to-date, while some of them could have expired if they were designed for less than a 10-year planning period. On the other hand, NBSAPs more than 10 years old might nonetheless be effective in some countries. However, since this study focuses on consistency between the global and national levels, whether an NBSAP reflects the global strategy will be more valued, and thus, more heavily weighted. Moreover, given that the current data are collected only by submission date, this categorization is simple, practical, and efficient.

Table 5.6 Target period of recently submitted NBSAPs

Country	Submission Date	Target Period	Whether for more than 10-year planning period
South Sudan	December 17, 2019	2018-2027	No
Republic of Korea	October 8, 2019	2019-2023	No
Singapore	May 21, 2019	Addendum for the target year of 2020	No
Turkey	April 16, 2019	2018-2028	Yes
Bolivia	March 28, 2019	2019-2030	Yes
Kuwait	January 9, 2019	2011-2020	No
Panama	December 19, 2018	2018-2050	Yes
North Macedonia	November 15, 2018	2018-2023	No
Federated States of Micronesia	October 29, 2018	2018-2023	No
Saint Vincent and the Grenadines	August 24, 2018	2015-2020	No
Turkmenistan	July 25, 2018	2018-2023	No
Vanuatu	25 June 2018	2018-2030	Yes
Trinidad and Tobago	25 May 2018	2017-2022	No
Portugal	7 May 2018	Revision for the target year of 2030	Yes
Pakistan	13 April 2018	2017-2030	Yes
Palau	14 March 2018	2015-2025	No
Chile	6 March 2018	2017-2030	Yes
San Marino	21 February 2018	Developed for the target year of 2025	No

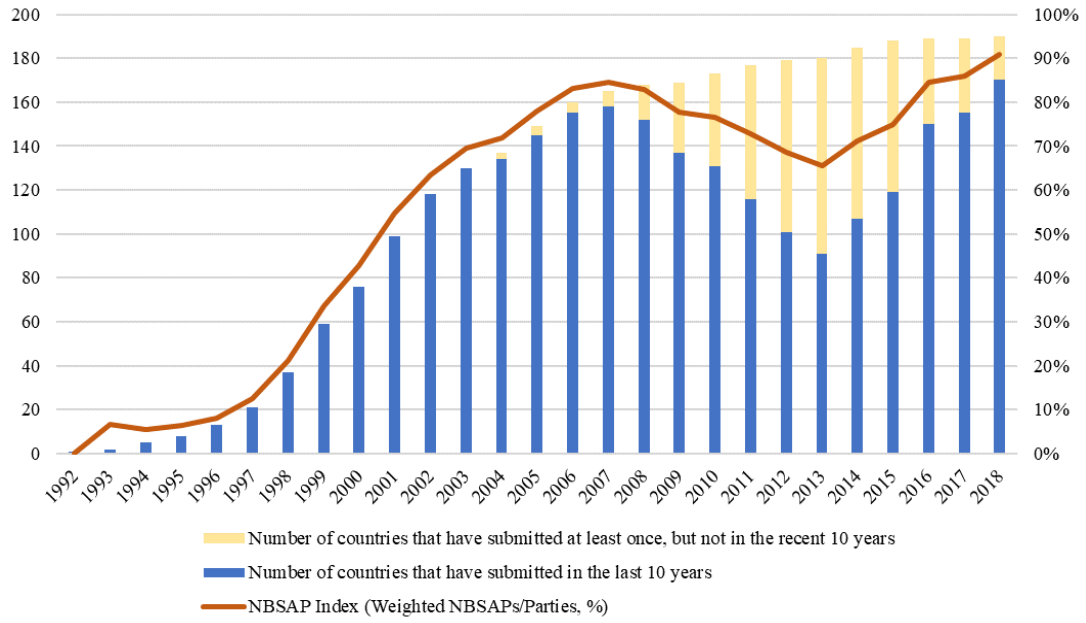
Source: CBD (n.d.-d)

The newly suggested NBSAP Index is calculated by adding the number of Parties that have submitted their NBSAPs within the recent 10 years (N_A) and the number of Parties that have submitted plans once but not in the recent 10 years (N_B) weighted by 0.4, and then dividing the sum of these two numbers by the number of Parties pledged to support the CBD at that time (N_P):

$$NBSAP\ Index = \frac{N_A + 0.4 \times N_B}{N_P}$$

This index can be produced annually so that it can show trends, which contrasts with the SCBD's data that show only current status. The NBSAP Index, the number of countries that have submitted their NBSAPs in the last 10 years, and the number of countries that have submitted once but not in the recent 10 years are shown in Figure 5.3.

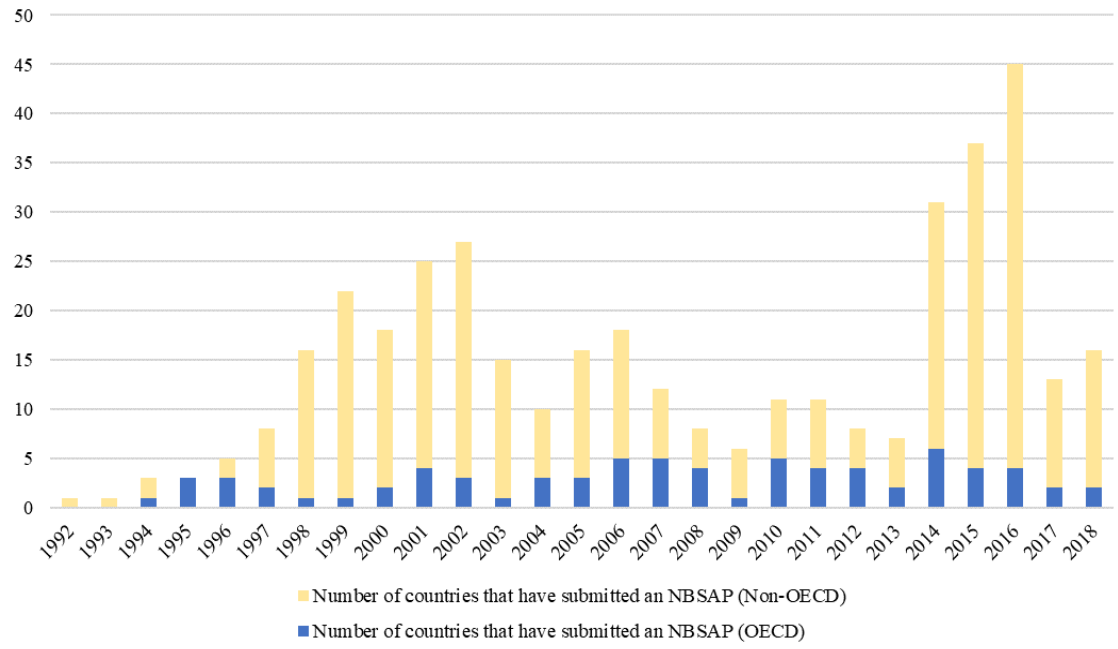
The number of countries that have submitted an NBSAP at least once, which is the sum of yellow and blue bars, have increased continuously (Fig. 5.3). But importantly, the NBSAP Index shows a decrease from 2007 to 2013.



Source: CBD (n.d.-d)

Figure 5.3 NBSAP Index and the number of countries with updated and not updated NBSAPs

The NBSAP Index shows two steep increases starting in 1998 and 2014. If looking into submission trends by year, there are two peaks: one in 1999-2002 and the other in 2014-2016 (Fig. 5.4). This trend is mostly driven by non-OECD, or developing, countries since the number of OECD, or developed, countries that submitted an NBSAP is relatively small and stable. The reason for this can be inferred from a review of GEF-project trends. The number of NBSAP-related projects is high in the GEF-1 and GEF-5 phases which are for 1994-1998 and 2010-2014 respectively (Table 5.7).



Source: CBD (n.d.-d)

Figure 5.4 Number of countries that have submitted an NBSAP by year

Table 5.7 Number of NBSAP-related projects by GEF phase

GEF Phase	GEF - 1	GEF - 2	GEF - 3	GEF - 4	GEF - 5	GEF - 6
Years	1994-1998	1998-2002	2002-2006	2006-2010	2010-2014	2014-2018
Number of NBSAP-related Projects	99	22	4	6	75	1

Source: GEF (n.d.)

In the GEF-1 phase, projects were not managed well so that there were a lot of delays in project completion. For example, NBSAP projects for Honduras and Jamaica were approved in 1998, while the completion of developing NBSAP was in 2001 for Honduras and 2003 for Jamaica. Thus, the submission year of developing countries are widely spread in the late 1990s and early 2000s. In the GEF-5 phase, there was a global project titled "Support to GEF Eligible Countries for Achieving Aichi Biodiversity Target 17 Through a Globally Guided NBSAPs Update Process (2014-2016)" to support projects for NBSAP development. Projects in this phase seem to be managed more reasonably compared to the GEF-1 phase, so the NBSAPs were submitted with much less delay resulting in intense submissions in 2014-2016.

It is noteworthy that these supporting projects seem to have started too late for the implementation of a global biodiversity strategy. The GEF-5 projects aimed to help developing countries revise their NBSAPs reflecting the Strategic Plan for Biodiversity 2011-2020. Projects for the GEF-5 phase were approved between 2012 and 2014. However, the latest project was finished in 2018, which is just two years before the end of the Strategic Plan. For the post-2020 framework, support needs to take place right immediately after the adoption of a new framework so that developing

countries can revise their NBSAPs in a timely manner to fully reflect the new global strategy.

At the same time, a regular stocktake process, for example every 10 years in accordance with current CBD planning or sooner—5 years as the Paris Agreement seeks to do—can encourage countries to update NBSAPs over time. This will be to the benefit of the proposed NBSAP Index.

5.4.2 Biodiversity ODA Index

Biodiversity-related ODA data are recorded by the OECD and available to the public on the OECD Creditor Reporting System (CRS) database. Biodiversity-related ODA can be simply separated by Rio markers. Rio markers for biodiversity divide ODA into three categories: principal, significant, and not targeted ODA. Rio marker data have been collected since 1998, but reporting based on Rio markers for biodiversity only became mandatory in 2006 (OECD, 2016).

ODA counted in the 'significant' category needs to be weighted less than those under the 'principal' category. Without this adjustment, the volume of biodiversity-related ODA would be overestimated. Currently, there is no agreed coefficient to weight ODA under the 'principal' and 'significant' categories (Ockenden, 2015; Drutschinin & Ockenden, 2015). A newly suggested ODA index uses the same coefficient factors as the EU, which are 100% and 40% coefficient factors to principal and significant categories respectively (European Commission, 2016).

The proposed Biodiversity ODA Index would calculate the ratio of weighted biodiversity-related ODA to total bilateral ODA, where BD_ODA_P is biodiversity-related ODA under the 'principal' category and BD_ODA_S is biodiversity-related ODA under the 'significant' category:

$$Biodiversity\ ODA\ Index = \frac{BD\_ODA_P + 0.4 \times BD\_ODA_S}{Bilateral\ ODA}$$

The absolute volume of biodiversity-related ODA is important, but it might encourage a misconception about the actual level of mainstreaming of biodiversity focused activity and funding in development aids. For example, assume that the absolute ODA volume for biodiversity has increased by 1%, while total ODA volume has increased by 10%. It seems there has been progress in the form of an increase in the absolute volume, but the relative share of biodiversity support would have decreased compared to other ODA categories. This hypothetical case shows that the share of biodiversity-related ODA matters more than the absolute value when it comes to the mainstreaming of biodiversity conservation activities. Therefore, the proposed Biodiversity ODA Index uses a ratio formula to reflect this consideration.

The reason why the index calculates the ratio to the bilateral ODA instead of the net ODA is that Rio markers are applicable only to bilateral contributions (Campillo, 2015). In addition, it is reasonable to calculate the index from 2006 since the Rio marker became mandatory in 2006, and the baseline for the Aichi Target 20 is from 2006 to 2010.

The Biodiversity ODA Index from 2006 to 2017 is shown in the Figure 5.5. The absolute biodiversity-related ODA has grown with some fluctuations since 2006. The volume in 2017 is USD 5,616 million, which is about 2.5 times larger than USD 2,181 million in 2006. The ratio of ODA for biodiversity conservation to total bilateral ODA, which is the Biodiversity ODA index, also has increased from 3.1% in 2006 to 4.6% in 2017. When comparing this index to one that does not apply a coefficient factor of 40% to "significant aid," which grew from 4.2% in 2006 to 7.2% in 2017, the increasing trend is less noticeable. These results imply that using

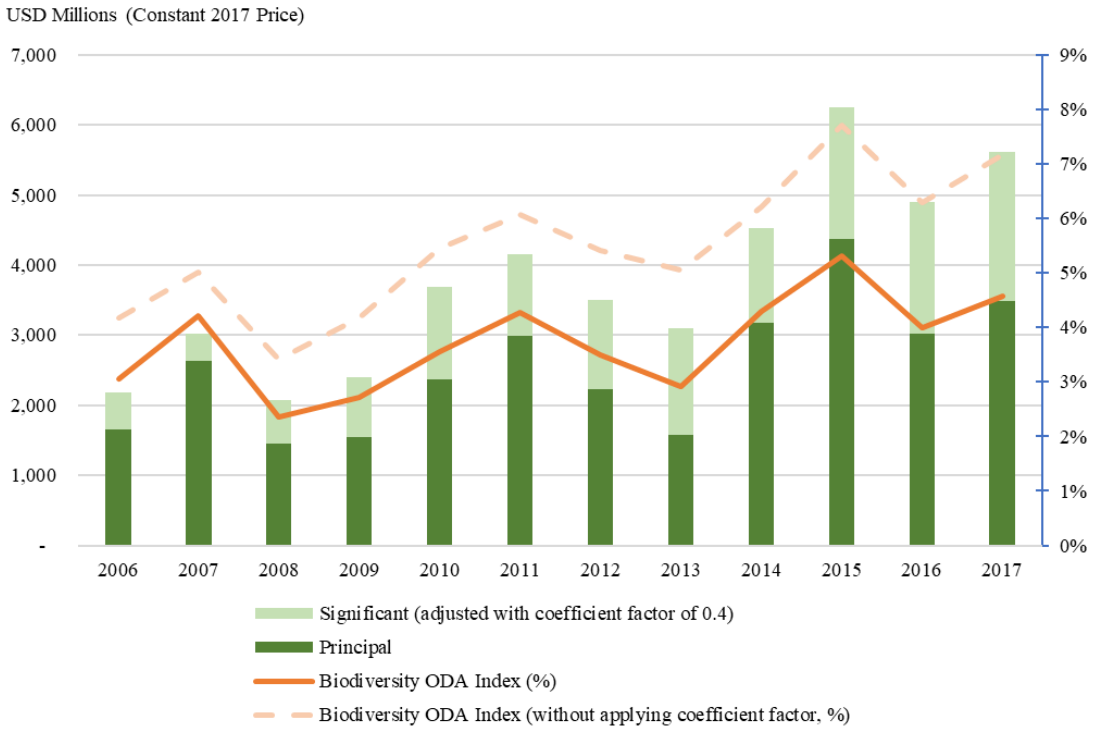


Figure 5.5 Biodiversity-related ODA and its ratio to total bilateral ODA

absolute ODA volume dedicated to biodiversity or the ratio without the 40% coefficient factor might overstate a trend of biodiversity-related ODA.

In addition, this increasing trend becomes weaker when the US is excluded from the calculation of the Biodiversity ODA Index. The US is the only OECD country that is not a Party to the CBD. Excluding the US from the index would show the efforts of the CBD Parties to increase financial resources for biodiversity conservation. Unfortunately, the efforts of the contracting Parties do not seem to have been enough to substantially increase biodiversity-related ODA.

When simply comparing 2006 and 2017, the Biodiversity ODA Index for all countries has increased from 3.1% to 4.6%, while the index excluding the US has

increased from 4.2% to 5.1% (Fig. 5.6). Considering there have been fluctuations, the general trend can be derived from a 3-year moving average. The moving average for all countries has increased steadily, however, the moving average excluding the US does not show as strong an increasing trend (Fig. 5.6).

This fact contrasts to the findings by multiple studies that biodiversity-related ODA is rising in general (e.g., OECD, 2016; SCBD, 2014). This contradictory result can be explained by the following three reasons.

First, previous studies overestimate the actual contribution of 'significant'-category ODA to biodiversity improvement. The absolute volume of biodiversity-related ODA under both the 'principal' category and the 'significant' category has increased, while the latter has increased faster than the former. Because of this, the gap

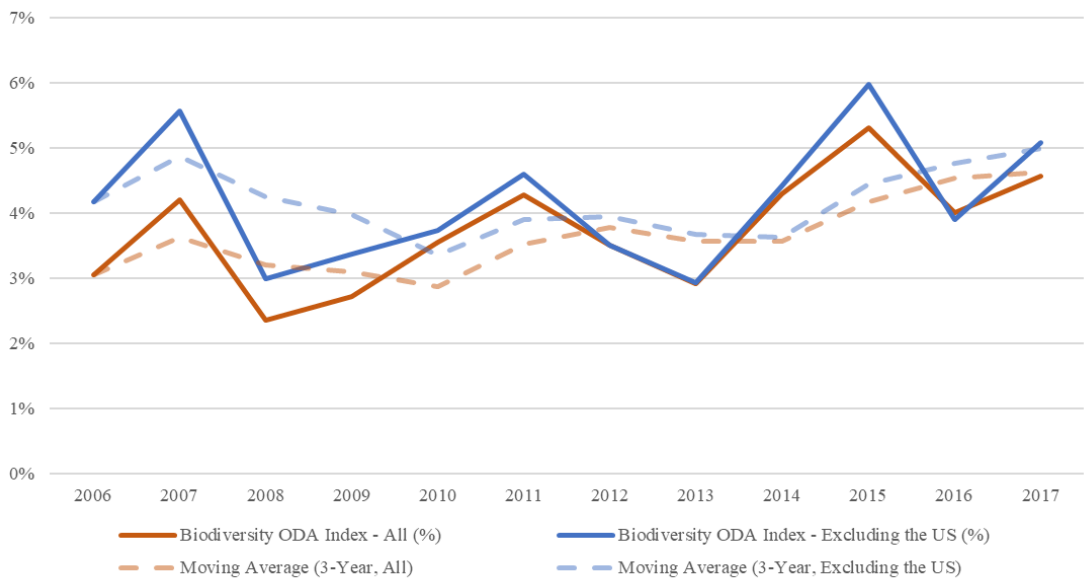


Figure 5.6 Biodiversity ODA Index for all countries and excluding the US

between the Biodiversity ODA Index with and without applying the coefficient factor of 0.4 to 'significant' category funding is getting larger in recent years (Fig. 5.5).

Second, the biodiversity-related ODA has increased, but this increase is not large compared to other sectors. Therefore, the Biodiversity ODA Index, which calculates the ratio to total bilateral ODA, has risen much slower than the absolute volume of biodiversity-related ODA (Fig. 5.5). This means that biodiversity conservation has not been fully mainstreamed or integrated into development aid.

Third, the overall increase in the Biodiversity ODA Index is attributable to the increase in US ODA, not to the efforts by the CBD Parties. Including the US dropped the ODA index by a large margin in 2000s, while it did not affect trends as much in the 2010s (Fig. 5.6). This implies that US support for biodiversity is relatively less than other OECD member countries in the 2000s, but the US increased its biodiversity portion in the 2010s. On the other hand, the CBD Parties have not made progress compared to 2006-2010 period in terms of their ratio of contribution and would need to make more efforts if they are to claim a consistently improving contribution.

These trends can be used to underscore the value of a 5-year stocktake process, which might reveal our challenge to be dynamic, not static or point-in-time.

This ODA-based index, like the one proposed for NBSAPs, can be used to support a more accurate understanding of policy needs in a manner that can be seen as parallel to what has been suggested for science-based indices (Mace et al., 2018).

5.4.3 Strengths of Suggested Indices

The two suggested indices can show policy trends in simple graphic form without losing relevant information. The NBSAP Index basically reflects the accumulated submission trend of NBSAPs, while it is adjusted according to whether

submitted NBSAPs are up-to-date. The Biodiversity ODA Index mostly tracks the volume of biodiversity-related ODA, but it also shows how much the biodiversity conservation component is mainstreamed in development aid by calculating its relative volume to total bilateral ODA. Thus, both indices are capable of summarizing complex information in a simple way.

The strength of the two indices is that both can identify some patterns that were not captured by existing indicators. For example, the indicator of counting the number of countries with developed or revised NBSAPs shows only whether there is an increasing trend but it is silent about up-to-date status, while the NBSAP Index captures the two steep increases that correspond to two GEF phases of supporting NBSAP development in developing countries.

The Biodiversity ODA Index indicates that biodiversity-related ODA has not risen much, which is a contrasting result to previous studies. And it can explain why. It shows that the share of biodiversity-related aid to other categories of aid has not kept pace. It also notes that the CBD signatories have not kept pace in their support.

It is important to develop a set of indices to track progress towards the global biodiversity goal as indicated by Mace et al. (2018). The two suggested indices can be used as policy indices to underpin a global monitoring process that, at the same time, can suggest types and levels of national involvement to meet the global goal. If these indices are used by the CBD, it can expect that they would contribute to identifying and analyzing the status and trends in biodiversity policies more efficiently and effectively. If a stocktake process is appended to these indicators as a part of CBD planning, these tools can support policy evaluation that is dynamic rather than static or point-in-time in nature.

Chapter 6

DISCUSSION

6.1 Summary

This research aimed to evaluate biodiversity policy indicators that can be used at the global as well as the national levels. To support this analytic purpose, a three-dimensional framework was applied, composed of indicators, criteria, and countries. Thirteen indicators were collected from a detailed survey of the literature and evaluated by a set of criteria. Four criteria drawn from a literature review are informativeness, scalability, data availability, and current usage. Current usage was evaluated from five countries: Brazil, Bulgaria, Germany, Solomon Islands, and South Africa. Country selection was guided by the need for the analysis to recognize the diversity of geographic locations, economic conditions, and natural resource endowments affecting national efforts to participate in the CBD process.

All 13 indicators were found to be useful at both the national level and the global level with or without modifications. Data availability and current usage of indicators by countries was found to vary significantly by indicator. Data availability tends to be high if there is a data-collecting organization for an indicator. Similarly, indicators which are simple or the use of which is encouraged by international organizations tend to be used more widely than others. Therefore, if there is a need to improve data availability or to enhance the use of a certain indicator, it is recommended to establish a data-collecting organization or support measures such as

the issuance of guidelines or CBD Decisions. The CBD secretariat and other IGOs can work to establish and facilitate these support measures.

When data availability and current usage of the five countries were analyzed by country, a pattern was found among them. Data availability is highest for Germany, which is an advanced economy, while it is lowest for Solomon Islands, which is a low-income developing country whose economy and population is small in scale. Among emerging market economies, Brazil and South Africa, which are megadiverse countries, have higher data availability scores. However, data availability also follows the order of GDPs of the five countries. Therefore, additional investigation is needed to figure out which factors have larger impact on data availability. No notable pattern was found in current usage of indicators by country.

While in evaluating the thirteen indicators, some implications could also be learned. Firstly, most of the policy indicators do not have enough research evidence to determine whether a change in an indicator measures the change in the actual state of biodiversity conservation. Secondly, data-sharing and communication between biodiversity-related institutions need to be enhanced. Thirdly, indicators can be better utilized when data are collected in more dimensions. Lastly, indicators for specific time-bound goals or targets can be less applicable as time passes. A stock-take process like that embedded in the Paris Agreement may prove to be helpful to address this circumstance.

After the analyses of indicators, two indices are suggested for the future use: NBSAP Index and Biodiversity ODA Index. These two were developed from existing indicators to deliver complex information in a simple and understandable way. Both are meaningful in that they can identify information which could not be captured by

existing indicators. These indices can be expected to contribute to efficient and effective tracking of the global policy progress under the CBD scheme.

6.2 Strengths of the Three-Dimensional Framework

The above findings of this study were shown through the application of a three-dimensional framework developed for the dissertation. The importance and strengths of this framework come from the fact that it enables researchers to combine and analyze indicators and criteria of international and national performance under the CBD system.

First, the framework can be used as a tool to evaluate performance of indicators under the CBD system. Since indicators are assessed with the same criteria, which are collected from the research literature, the framework can also foster robust comparisons. For example, Biodiversity Barometer and Google Trends received the same score of 4, but the two have quite different features. Biodiversity Barometer is directly related to people's awareness but data are not available across the world. Google Trends measures the awareness somewhat indirectly but data availability is high. Thus, the framework not only gives information on overall performance of indicators but also allows users to compare features of indicators focusing on a similar issue (awareness in this case) with using different data sources and collection methods.

A second strength of this framework is that internal and external factors that affect the features of indicators can be analyzed with the framework. Each criterion stands for one feature of indicators. If one group of indicators has a higher score for a certain criterion than another group, it can suggest that some factors might differently affect groups. Implications can be drawn from this analysis (e.g., indicators with

guidelines are used more by countries), and suggestions can be made to develop and improve indicators.

Thirdly, this framework can illustrate current usage and data availability by country, showing some patterns (e.g., capacity gaps among countries). This study covered only 5 countries. So, the pattern for data availability left two different potential interpretations that data availability follows economic groups with megadiverse countries or size of GDP alone. For the five countries analyzed here, no pattern could be identified. However, if the analysis can be done for a large number of countries, it is more likely that clearer patterns can be shown.

6.3 Challenges

Most of the challenges to carrying out this study came from the need to select from a broad range of data and information. There are many indicators, countries, and data sources, and a single researcher cannot analyze them. However, the framework's efficacy and applicability could be illustrated.

Thirty-eight indicators were collected, and 13 indicators that met four criteria were selected for detailed analysis. Generally speaking, a small number of samples usually leads to higher possibility not to reject a null hypothesis (Norman, 2010). In this study, a few features were identified to be significantly different across groups. If more indicators are analyzed, it is expected that more features might turn out to be statistically significant.

Another issue due to a small number of indicators is that all indicators received the same score for the scalability criterion. Of course, this result is still meaningful. This study is intended to show how to identify compatible indicators for the use at both the global and national levels, and all 13 indicators turned out to meet the criteria.

The fact that most indicators can be scaled to different levels means that the reason for countries not to use these indicators is not due to scalability. Factors that lead to countries' lesser use were discussed in the previous chapter.

If more than 13 indicators are analyzed with the framework used in this study, indicators might receive different scores for scalability. Among the 38 indicators collected in this study, there is an indicator that is to measure "progress towards national targets." It is designed specifically for the national level and cannot be used, in and of itself, at the global level, so scalability might be low. Another example is the Index of Linguistic Diversity (ILD). ILD is calculated by the change in the geometric mean of speakers' ratio of each language to total population (Harmon & Loh, 2010). Therefore, scaling up or down is not possible, and sometimes not meaningful. Still some other indicators, such as "global funds committed towards environmental policy, laws, regulations, and economic instruments," are only for the global level. Thus, the scalability criterion itself used in this study can identify indicators that can be used at both the global and the national levels. This study's failure to fully illustrate to potential users of this framework how to use it due to limited number of analyzed indicators can be cured by more users attempting to deploy it.

The number of countries to analyze is an important factor as well. This study selected countries from different regional and economic groups, but a total of only five countries were covered. As discussed in the previous chapter, it is not clear whether data availability is determined solely by GDP or by both GDP and biodiversity level of countries. Analysis of more countries will help figure out which is the more powerful explanation. This will also allow researchers to find detailed patterns within a group. For example, if more than 10 countries are analyzed within LDCs, there

might be a pattern that megadiverse countries have more data availability than other LDCs. In the meantime, this study could not identify any pattern in current usage. Some pattern might also be identified with increased numbers of countries analyzed.

Lastly, more precise and up-to-date assessments would be possible if data were retrieved from broader sources. Current usage was evaluated from 5th NRs only. NRs are the most relevant documents for studying performance in the CBD system because they include a broad range of biodiversity indicators, since they are published by national governments and submitted to the CBD regularly. However, there are many other documents and reports prepared for submission to other biodiversity-related organizations such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the International Union for Conservation of Natures (IUCN). A more comprehensive assessment will be possible if data sources other than NRs are analyzed. Moreover, 5th NRs are currently being replaced by 6th NRs, which Parties were required to submit by December 31, 2018.[34] Since only three out of five countries selected for this study have submitted their 6th NRs as of February 2020, current usage could not be evaluated in this study with 6th NRs. Once most countries submit their NRs, an up-to-date evaluation and the identification of more recent trends would be possible. For example, the influence of inclusion in the SDG indicator list and CBD decisions can be investigated with 6th NRs, which was not possible in this study as shown in Table 5.1.

[34] Despite deadline, several countries still have not submitted their reports.

6.4 Recommendations for Future Research

It is an opportune time for researchers to focus on biodiversity indicators since the global society is working on establishing a new framework for conserving biodiversity across the world. The post-2020 global biodiversity framework is under preparation and will be adopted at the fifteenth meeting of the CBD COP in 2021. This framework builds upon the previous strategy, the Strategic Plan for Biodiversity 2011-2020, and aims to promote transformation of economic, social, and financial models to recover society's relationship with biodiversity in the next 10 years. To do so, there is an urgent need for appropriate indicators that can guide these efforts. There have been several studies to develop and improve biodiversity indicators, but still more efforts are required to close the gap especially in the two areas of focus for this study, namely, indicators that more clearly inform policy and indicators that can be employed by nation states as well as international bodies.

This study suggests a new three-dimensional framework for evaluation of biodiversity policy indicators. The framework provides a useful tool by combining criteria, indicators, and countries in the analysis of global and national trends. As more countries are involved in performance review, regional trends can also be considered. It can not only evaluate indicators but also identify factors that affect features of indicators and patterns of indicator usage among countries. Considering the framework's strength and potential in indicator analysis, it is recommended to apply this framework to more indicators and many more countries in the future. It is expected to bring a much better understanding of considerations in developing indicators and encouraging the use of them.

Given the limitations in number of indicators and countries analyzed, it is still possible to partly utilize this framework. For example, the analysis of data availability

and current usage in Chapter 5 shows different capacities among countries. Thus, if a researcher plans to investigate and focus on the current state of capacity building, an analysis with just two criteria, namely, data availability and current usage, can be conducted with an expanded number of countries. This will provide insights and implications about capacity building across geographical areas of interest.

Another recommendation is to further improve and refine the two biodiversity policy indices suggested in this study. The two indices are new, so the components and formulas need to be continuously tested and verified. Both indices have a weighting component, and different weightings can be applied. For the Biodiversity ODA Index, coefficients that best reflect the actual portion of biodiversity aid components needs to be investigated to determine an over-coding issues, which causes overestimation of ODA, as Weikmans et al. (2017) indicated. The over-coding issue might be solved either by reducing mis-categorization itself or by applying conservative coefficients. Investigating these coefficients would contribute to estimating biodiversity financing more precisely, and perhaps, focusing additional financing more precisely on priorities. The NBSAP Index also needs to be continuously tested to find out whether it can keep its strength even after 2020 when a new global strategy for biodiversity is going to be released. The NBSAP Index can be further studied in another way. This study assumed NBSAPs submitted in the most recent 10 years are up-to-date due. However, up-to-date NBSAPs can be determined by whether they are actually effective or not through investigating all the available NBSAPs in the target period. The result can then be compared to the NBSAP Index suggested in this study, and a new pattern might be found.

The two indices can be used at different levels. The NBSAP Index can be calculated at the regional level to track progress in a region and compare it to other regions for reference purposes. The Biodiversity ODA Index can be produced at the national and regional levels. The regional-level index can provide an overall trend for each region, while the national-level index can show how much a donor country focuses on biodiversity assistance or how much a recipient country attracts funding for biodiversity initiatives. This strength of the Biodiversity ODA Index comes from the feature of ODA data that can be retrieved by country regardless of whether it is a donor or a recipient country.

The three-dimensional framework and the two indices can bring furnish benefits other than technical or administrative performance review. As noted earlier in Chapter 1, an integrated indicator framework would provide opportunities for numerous actors in global environmental governance including NGOs, business actors, and science networks to assess performance of the treaty and national strategies. If a stock-take process is embedded in the post-2020 global biodiversity framework, these opportunities would become greater than before. Therefore, it is recommended that diverse actors use and further develop the framework and indices proposed in this study.

Overall, the three-dimensional framework and the two suggested indices can be modified and utilized in a variety of ways. It is expected that they would contribute to tracking policy progress towards a global biodiversity conservation goal and finding new implications that could not have been identified by existing methodologies.

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Appendix A

EVALUATION TABLE FOR SELECTING INDICATORS

Aichi Target	Indicator	Infor-mative-ness	Credi-bility	Scalabi-lity	Data Avai-labili-ty	Total score	SDG indica-tor Tier
1	Biodiversity Barometer	1	1	1	1	4	
1	Online interest in biodiversity (Google Trends)	1	1	1	1	4	
1	WAZA global visitor survey	0	1	0	0	1	
1	Greendex - Consumer choice and the environment	1	0	*No info.*	1	2	
1	Investment in environmental education	1	1	*No info.*	1	3	
2	Number of countries implementing natural resource accounts, excluding energy, within the System of Environmental-Economic Accounting (SEEA)	1	1	1	1	4	
2	Progress towards national targets established in accordance with Aichi Biodiversity Target 2 of the Strategic Plan for Biodiversity 2011-2020 (indicator for SDG target 15.9)	0	0	0	0	0	Tier III
2	Number of countries that have integrated biodiversity in National Development Plans, poverty reduction strategies or other key development plans	1	1	1	1	4	
2	Investment in Environmental Impact Assessments (EIAs)	1	1	*No info.*	1	3	
2	Number of research studies involving economic valuation	1	1	*No info.*	1	3	

3	Trends in potentially harmful elements of government support to agriculture (produced support estimates)	1	1	1	1	4	
3	Trends in potentially harmful elements of government support to fisheries	0	0	0	1	1	
3	Agricultural export subsidies (indicator for SDG target 2.b)	0	0	0	0	0	Tier I
3	Number of countries with national instruments on biodiversity-relevant taxes, charges and fees	1	0	0	1	2	
3	Number of countries with national instruments on REDD plus schemes	1	1	1	1	4	
3	Number of countries with national instruments on biodiversity relevant tradable permit schemes	0	0	0	0	0	
3	Tax expenditures for fossil fuels	1	0	*No info.*	1	2	
3	Funding towards institutional capacity building in fisheries	1	1	*No info.*	1	3	
3	World Trade Organisation (WTO) 'green box' agricultural subsidies	1	1	*No info.*	1	3	
16	Number of Parties to the CBD that have deposited the instrument of ratification, acceptance, approval or accession of the Nagoya Protocol	1	1	1	1	4	
16	Number of countries that have adopted legislative, administrative and policy frameworks for the implementation of the Nagoya Protocol (SDG indicator 15.6)	0	0	0	0	0	Tier I
17	Number of countries with developed or revised NBSAPs	1	1	1	1	4	
17	Number of countries with NBSAPs adopted as policy instruments	0	0	0	0	0	
18	(a) Proportion of total	0	0	0	0	0	Tier II

	agricultural population with ownership or secure rights over agricultural land, by sex; and (b) share of women among owners or rights-bearers of agricultural land, by type of tenure (indicator for SDG target 5.a)						
18	Proportion of total adult population with secure tenure rights to land, with legally recognized documentation and who perceive their rights to land as secure, by sex and by type of tenure (indicator for SDG target 1.4)	0	0	0	0	0	Tier II
18	Number of local community-based monitoring on traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity	1	1	0	0	2	
18	Index of Linguistic Diversity	0	1	1	1	3	
18	VITEK	*No info.*	*No info.*	*No info.*	*No info.*	0	
19	Species represented in the barcode of life data system	0	1	0	1	2	
19	Growth in species occurrence records accessible through GBIF (Or number of records over time)	1	1	1	1	4	
19	Species Status Information Index	0	0	0	0	0	
19	Proportion of known species assessed through the IUCN Red List	0	1	1	0	2	
19	Funds committed to environmental education and research	1	1	*No info.*	1	3	
19	Knowledge transfer (number of biodiversity papers in Web of Science per year)	1	1	*No info.*	1	3	

20	Information provided through the financial reporting framework, adopted by decision XII/3 (https://chm.cbd.int/search/financial-reporting)	1	1	1	1	4	
20	Official development assistance and public expenditure on conservation and sustainable use of biodiversity and ecosystems (indicator for SDG target 15.a and 15.b)	1	1	1	1	4	Tier I/III
20	Funding provided by the Global Environment Facility	1	1	*No info.*	1	3	
20	Global funds committed towards environmental policy, laws, regulations and economic instruments	1	1	*No info.*	1	3	

* Qualified indicators are shaded.

Appendix B

FINANCIAL REPORTING FRAMEWORK

I. INTRODUCTION

This framework is intended for use by Parties for providing baseline information and reporting on their contribution to reach the global financial targets, under Aichi Biodiversity Target 20, as adopted by the Conference of the Parties to the Convention at its twelfth meeting, in accordance with Article 20.

In completing the reporting framework, Parties are encouraged to interact with their respective statistical offices or other relevant departments when gathering information. Some of the information needed for this process is likely already available and it should be used where possible in order to reduce the reporting burden and the duplication of efforts. Where precise information is not available, respondents are encouraged to use their best estimates.

II. REPORTING ON BASELINE AND PROGRESS TOWARDS 2015

This section provides the framework for providing necessary baseline information and reporting progress against the 2015 targets.[35]

Identification of respondent

Please complete the following table:

Country:	Name of respondent:
Please indicate on whose behalf this is being completed:	☐ National Focal Point ☐ Focal point for resource mobilization ☐ Other. Please specify:
Title and Department of respondent:	
Organization of respondent:	
Email address:	
Telephone contact:	
Date of completion and submission of completed framework:	

[35] Reporting on this section will take place by 31 December 2015, in accordance with paragraph 25 of decision XII/3.

1. International financial resource flows

1.1 Please indicate the amount of resources provided by your country in support of biodiversity in developing countries, in particular least developed countries and small island developing States, as well as countries with economies in transition.

Please indicate, as appropriate, the amount of financial resources provided by source as well as the total amount. Please also indicate your degree of confidence in the estimated amount or, alternatively, provide a range of estimates.

1.1.1 Baseline information

For the calculation of the baseline, please provide data for 2010 or the most recent year prior to that. If possible, provide data for the period 2006 to 2010. If specific annual data is not available, you may provide the best estimate of an average figure for 2006 to 2010.

Currency:

Year	ODA (1)	OOF (2)	Other flows (3)	Total
2006				
2007				
2008				
2009				
2010				
Average (baseline)				

Methodological information:

(4) ODA includes: ( ) bilateral; ( ) multilateral

(5) ODA/OOF: ( ) commitments; ( ) disbursements

(6) ODA/OOF includes: ( ) directly related; ( ) indirectly related

Other flows include: ( ) directly related; ( ) indirectly related

(7) As applicable, methodology used to identify official resource flows: ( ) OECD DAC 'Rio markers'; ( ) other (please specify): ( )

(8) As applicable, coefficient used for resource flows indirectly related to biodiversity, when calculating total numbers: ( )%

(9) (Average) confidence levels (please indicate high, medium, low):

ODA: ( )

OOF: ( )

Other flows: ( )

(10) Other methodological observations/comments, including sources of data: ( )

Additional explanations:

(1) Official Development Assistance (ODA) refers to flows of official financing administered with the purpose of promoting economic development and welfare of developing countries as the main objective, and which are concessional in character with a grant element of at least 25 per cent (using a fixed 10 per cent rate of discount).Where resources are provided or received for general budget support rather than for specific activities, an estimate of resources provided/received for biodiversity may be calculated from the proportion of the recipient country's budget devoted to such activities.

(2) Other official flows (OOF) refers to transactions by the official sector with countries on the List of Aid Recipients which do not meet the conditions for eligibility as Official Development Assistance or Official Aid, either because they are not primarily aimed at development, or because they have a grant element of less than 25 per cent non-ODA public funding, that is, transactions by the official sector with countries on the List of Aid Recipients which do not meet the conditions for eligibility as Official Development Assistance.

For the purpose of this reporting framework, information on resources provided by other, "non-donor" countries, i.e. through "South-South Cooperation", would also be included in this column, as appropriate.

(3) Other flows refer to resources mobilized by the private sector as well as non-governmental organizations, foundations, and academia. If you do not have reliable data, please leave this row empty. See also question 1.2.

(4) ODA can be bilateral or multilateral. Bilateral ODA refers to contributions of donor government agencies, at all levels, to developing countries. Multilateral ODA refers to funds provided through international financial institutions such as the Global Environment Facility, the World Bank and United Nations funds and programmes. Please include both categories as feasible. Please tick the appropriate box if ODA numbers provided include bilateral and/or multilateral ODA related to biodiversity. If the numbers include both categories, tick both boxes.

(5) You may report on either ODA/OOF commitments or actual disbursements, but please apply the same category for all years, including when reporting progress.

(6) Funding for biodiversity includes not only funding for direct actions to protect biodiversity but also funding related to actions across different sectors (e.g. agriculture, forestry, tourism) to promote biodiversity-friendly initiatives that have other primary purposes (e.g. ecosystem-based approaches to climate-change mitigation and adaptation). See section 5 below for a compilation of descriptions of activities that relate to biodiversity as provided in different methodological frameworks. Please tick the appropriate box if numbers provided include resources directly related or indirectly related to biodiversity.

(7) In past reporting under the preliminary reporting framework, many Parties that are members of the OECD DAC used the 'Rio markers methodology' under the OECD CRS database, to report on ODA directly related to biodiversity ('principal' marker) and indirectly

related to biodiversity ('significant' marker). Please indicate if you did apply this methodology and, if not, please provide a brief explanation on the methodology you applied.

(8) If you provided a total amount that includes resources indirectly related to biodiversity, indicate the coefficient used to aggregate amounts directly and indirectly related to biodiversity. Please use the same coefficient for all years, including when reporting progress.

(9) Please provide (average) confidence levels (high, medium, low).

(10) You may provide any other methodological observations or comments here.

1.1.2 Monitoring progress in mobilizing international financial flows

For the purposes of monitoring progress, please provide data for years after 2010:

Year	ODA	OOF	Other flows	Total
2011				
2012				
2013				
2014				
2015				

Methodological information:

(Average) confidence levels (please indicate high, medium, low):

ODA: ( )

OOF: ( )

Other flows: ( )

1.2 Has your country taken measures to encourage the private sector as well as non-governmental organizations, foundations and academia to provide international support for the implementation of the Strategic Plan for Biodiversity 2011-2020?

(1) no ( )

(2) some measures taken ( )

(3) comprehensive measures taken ( )

If you ticked (2) or (3) above, please provide additional information here.

You may wish to provide cross-references, as applicable, to your reply to question 8 of the fifth national report guidelines, or to your report on progress in achieving Aichi Biodiversity Targets 1, 2, 3, 4, 16, 18, and 19, under question 10 of the fifth national report guidelines:

( )

2. Inclusion of biodiversity in priorities and plans

Has your country included biodiversity in national priorities or development plans?

(1) Not yet started ( )

(2) Some inclusion achieved ( )

(3) Comprehensive inclusion ( )

If you ticked (1) or (2) above, please provide additional information here.

You may wish to provide cross-references, as applicable, to your reply to question 8 of the fifth national report guidelines:

( )

3. Assessment and/or evaluation of values

Has your country assessed and/or evaluated the intrinsic, ecological, genetic, socioeconomic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its components?

(1) not yet started ( )

(2) some assessments/evaluations undertaken ( )

(3) comprehensive assessments/evaluations undertaken ( )

If you ticked (2) or (3) above, please provide additional information here.

You may wish to provide cross-references, as applicable, to your reply to question 8 of the fifth national report guidelines, or on your report in achieving Aichi Biodiversity Target 2, under question 10 of the fifth national report guidelines:

( )

4. Reporting current domestic biodiversity expenditures

4.1 Please indicate the annual financial support provided to domestic biodiversity-related activities in your country.

Please indicate the total amount of financial resources spent currently or in the recent past, before additional resource mobilization activities were undertaken. Please provide also an assessment of your confidence in the estimated amount (high, medium low; alternatively provide a range of estimates). Please cover as many sources as possible but provide at least central government budget outlays directly related to biodiversity. Use table 4.2 below to indicate which sources and expenditure categories were covered.

If possible, provide data for several years. If specific annual data is not available, you may provide the best estimate of an average figure for several years.

If your financial year does not correspond to the calendar year, please use the calendar year in which the financial year begins.

As this question specifically relates to domestic expenditures, please do not include any funding provided to other countries but please include expenditures that were financed by international sources.

Currency:

Year	Domestic expenditures	Overall confidence
2006		
20xx		
20xx		
20xx		
20xx		
Average		

4.2 Information on sources and categories

Please indicate which sources and categories were covered under 4.1 above, by ticking the appropriate cells. For sources and categories not covered, please leave the cells empty.

Numbers above cover: (tick appropriate cells)	Expenditures directly related to biodiversity (1)	Expenditures indirectly related to biodiversity (1)
(2) Government budgets – central		
(2) Government budgets – state/provincial		
(2) Government budgets – local/municipal		
(3) Extra-budgetary		
(4) Private/market		
(5) Other (NGO, foundations, academia)		
(6) Collective action of indigenous and local communities		
(7) Additional methodological information, including sources of data: ( )		

Additional explanations:

(1) Funding for biodiversity includes not only funding for direct actions to protect biodiversity but also funding related to actions across different sectors (e.g. agriculture, forestry, tourism) to promote biodiversity-friendly initiatives that have other primary purposes (e.g. ecosystem-based approaches to climate-change mitigation and adaptation). Please tick

the appropriate box if numbers provided include resources directly related or indirectly related to biodiversity.

(2) Government budgets include public money spent by government or government agencies to address domestic biodiversity issues. You are encouraged to include information from all relevant levels of government but provide central budget information at a minimum. When providing information relating to different government levels, please ensure that funds transferred between the different levels of government are only counted once.

As the focus is on expenditures, budgetary support received by international flows should be included.

(3) Extra-budgetary expenditures include project-related expenditures funded by ODA or OOF.

(4) The private sector comprises private companies.

(5) Other represents funding that is neither public sector nor private companies. Non-governmental organizations include non-profit organizations representing major groups and that are legally constituted organizations that operate independently from government. Foundations are non-profit organizations that typically either donate funds, provide support to other organizations, and/or directly provide funding for their own charitable purposes. Academia refers to all institutions aimed at advancing knowledge development, including educational and research institutions. The unifying factor between these three types of organizations is their not for profit status.

(6) The contribution of collective action of indigenous and local communities towards biodiversity conservation and customary sustainable use, insofar as it can be appropriately measured and expressed in monetary terms, can be reported here. For instance, the Conceptual and Methodological Framework for Evaluating the Contribution of Collective Action to Biodiversity Conservation suggests performing a conversion of the total land area conserved by local communities to the equivalent in public funds spent on conserving an equivalent area within the government's protected areas. See also question 4.3 below.

(7) Please provide information on the methodologies applied to estimate these numbers, in particular those on expenditures indirectly related to biodiversity and those outside of central government budgets. The Biodiversity Finance (BIOFIN) Workbook provides methodological guidance. In past reporting under the preliminary reporting framework, Parties made reference to public expenditure review methodologies, and also pointed to the environmental protection expenditure accounts, under their environmental economic accounting (EEA) system. One methodology for estimating subnational expenditures consists in calculating the ratio of biodiversity-related expenditures of a select sub-set of provincial governments or municipalities, and subsequent application of this ratio to total sub-national government budgets.

4.3 Role of collective action and non-market approaches

4.3.1 Has your country assessed the role of collective action, including by indigenous and local communities, and non-market approaches for mobilizing resources for achieving the objectives of the Convention?

(1) no such assessment necessary ( )

(2) not yet started ( )

(3) some assessments undertaken ( )

(4) comprehensive assessments undertaken ( )

If you ticked (3) or (4) above, please provide additional information under question 4.3.2 below.

4.3.2 Please provide additional information on your assessment of the role of collective action undertaken by your country. Please provide also an assessment of your confidence in the estimation (high, medium low; alternatively provide a range of estimates). If possible, provide data for several years.

Measurement Unit (1):

Year	Contribution (1)	Overall confidence
20xx		
20xx		
20xx		
20xx		
20xx		
Average		

Methodological information:

As applicable, methodology used to assess the role of collective action and non-market approaches: ( ) Conceptual and Methodological Framework for Evaluating the Contribution of Collective Action to Biodiversity Conservation; ( ) other (please specify): ( ).

Other methodological observations/comments, including experiences and lessons learned in applying methodologies, and on sources of data: ( )

Additional explanations:

(1) Please provide the selected measurement unit under your methodology. For instance, the Conceptual and Methodological Framework for Evaluating the Contribution of Collective Action to Biodiversity Conservation suggests using, amongst others, as a quantitative indicator, the total land area conserved by collective action within indigenous and local communities.

5. Reporting funding needs, gaps, and priorities

Please indicate your annual estimated funding need (for instance, based on your revised NBSAP) and calculate the estimated funding gap by subtracting estimated available resources. Indicate actions for priority funding.

Please start with the year which is most appropriate for your own planning purposes. Leave rows empty if not needed or if it is not yet possible to report thereon.

Currency:

Year	(1) Funding need	(2) Estimated available resources	(3) Estimated funding gap	(4) Actions for priority funding
2014				
2015				
2016				
2017				
2018				
2019				
2020				
Additional methodological observation/comments, including sources of data: ( )				

Additional explanations

(1) The funding need could be calculated based on the revised national biodiversity strategy and action plan (NBSAP). You may wish to further differentiate into one-time investments and recurrent expenditures, and calculate annual resource requirements accordingly.

(2) For estimating future resource availability, you may wish to extrapolate the average number provided under question 4.1 above. In undertaking this extrapolation, please do not include the additional resource mobilization activities that were already undertaken, or are planned to be undertaken, pursuant to your national finance plan.[36]

(3) Estimate the funding gap by subtracting (2) from (1).

(4) Indicate actions, for instance from among those covered by the revised NBSAP, for priority funding.

6. National finance plans

Please provide a brief synthesis of your finance plan, by indicating, in the table below, your planned resource mobilization, by source, and their respective planned contributions towards your identified finance gap.

Please add additional rows to the table as needed.

Please start with the year which is most appropriate for your own planning purposes. Leave columns empty if not needed or if it not yet possible to report thereon.

Currency:

[36] The online version of the reporting framework could provide a tool for undertaking simple extrapolations using percentage increases, where percentage points could be freely chosen, and the resulting numbers would be inserted automatically.

Year	2014	2015	2016	2017	2018	2019	2020
(1) Expected funding gap							
(2) Domestic sources (total)							
Source 1							
Source 2							
Source 3							
(3) International flows (total)							
Source a							
Source b							
Source c							
(4) Remaining gap							
Additional methodological information/comments, including sources of data: ( )							

Additional explanations

(1) The expected funding gap would be taken from column (3) under question 5.[37]

(2) The planned contribution towards the identified funding gap by domestic sources. You may wish to further specify the planned sources that you wish to mobilize and their respective contribution. In this case, please replace the 'placeholders' and add more rows as needed. Possible domestic sources may include: (i) additional government allocations; (ii) earmarked funds from environmental fiscal reform, including new forms of environmental taxation or fee structures; (iii) earmarked funds from the elimination, phase out or reform of harmful incentives, including subsidies; (iv) various biodiversity funding mechanisms such as payments for ecosystem services, offsets, markets for green products, business-biodiversity partnerships, etc. (v); the mobilization of collective action by indigenous and local communities; etc.

Possible concrete actions for mobilizing domestic resources are provided in annex IV to decision XII/3.

(3) The planned contribution towards the identified finance gap by international sources. You may wish to further specify the sources and their respective expected contribution. In this case, please replace the 'placeholders' and add more rows as needed. Possible sources may include: (i) bi- and multilateral ODA/OOF; (ii) REDD+ or similar initiatives, including alternative policy approaches such as joint mitigation and adaptation approaches; (iii) ABS agreements, etc.

[37] The online version of the reporting framework could carry over the pertinent numbers automatically.

(4) The remaining gap is calculated by subtracting (3) and (2) from (1).[38]

7. Has your country taken measures to encourage the private sector as well as non-governmental organizations, foundations and academia to provide domestic support for the implementation of the Strategic Plan for Biodiversity 2011-2020?

(1) no

(2) some measures taken

(3) comprehensive measures taken

If you ticked (2) or (3) above, please provide additional information here.

You may wish to provide cross-references, as applicable, to your reply to question 8 of the fifth national report guidelines, or to your report on progress in achieving Aichi Biodiversity Targets 1, 2, 3, 4, 16, 18, and 19 under question 10 of the fifth national report guidelines:

( )

8. Availability of financial resources for achieving targets

Please tick the appropriate boxes.

Did your country have adequate financial resources:

(1) to report domestic biodiversity expenditures? ( ) yes; ( ) no;

(2) to report funding needs, gaps and priorities? ( ) yes; ( ) no;

(3) to prepare national finance plans for biodiversity? ( ) yes; ( ) no.

III. REPORTING ON PROGRESS TOWARDS 2020

This section provides the framework for reporting progress made in implementation of the financial targets until 2020.[39]

Identification of respondent

Please complete the following table:

Country:	Name of respondent:
Please indicate on whose behalf this is being completed:	☐ National Focal Point ☐ Focal point for resource mobilization ☐ Other. Please specify:
Title and Department of respondent:	

[38] The online version of the reporting framework could undertake this calculation automatically.

[39] Reporting on this section will take place in conjunction with the sixth national reports, in accordance with paragraph 26 of decision XII/3.

Organization of respondent:	
Email address:	
Telephone contact:	
Date of completion and submission of completed framework:	

1. Monitoring progress in mobilizing international financial flows

1.1 Please indicate the amount of resources provided by your country in support of biodiversity in developing countries, in particular least developed countries and small island developing States, as well as countries with economies in transition.

Please indicate, as appropriate, the amount of financial resources provided by source as well as the total amount. Please also indicate your degree of confidence in the estimated amount or, alternatively, provide a range of estimates.

In order to ensure data consistency and comparability, please make sure, as feasible, to apply the same methodology as under question 1.1 of section I above.

Currency:

Year	ODA (1)	OOF (2)	Other flows (3)	Total
2016				
2017				
2018				
2019				

Methodological information:

(4) ODA includes: ( ) bilateral; ( ) multilateral

(5) ODA/OOF: ( ) commitments; ( ) disbursements

(6) ODA/OOF includes: ( ) directly related; ( ) indirectly related

Other flows include: ( ) directly related; ( ) indirectly related

(7) As applicable, methodology used to identify official resource flows: ( ) OECD DAC 'Rio markers'; ( ) other (please specify): ( )

(8) As applicable, coefficient used for resource flows indirectly related to biodiversity, when calculating total numbers: ( )%

(9) (Average) confidence levels (please indicate high, medium, low):

ODA: ( )

OOF: ( )

Other flows: ( )

(10) Other methodological observations/comments, including sources of data: ( )

Additional explanations:

(1) Official Development Assistance (ODA) refers to flows of official financing administered with the purpose of promoting economic development and welfare of developing countries as the main objective, and which are concessional in character with a grant element of at least 25 per cent (using a fixed 10 per cent rate of discount).

Where resources are provided or received for general budget support rather than for specific activities, an estimate of resources provided/received for biodiversity may be calculated from the proportion of the recipient country's budget devoted to such activities.

(2) Other official flows (OOF) refers to transactions by the official sector with countries on the List of Aid Recipients which do not meet the conditions for eligibility as Official Development Assistance or Official Aid, either because they are not primarily aimed at development, or because they have a Grant Element of less than 25 per cent.

For the purpose of this reporting framework, information on resources provided by other, "non-donor" countries, i.e. through "South-South Cooperation", would also be included in this column, as appropriate.

(3) 'Other flows' refer to resources mobilized by the private sector as well as non-governmental organizations, foundations, and academia. If you do not have reliable data, please leave this row empty. See also question 1.2.

(4) ODA can be bilateral or multilateral. Bilateral ODA refers to contributions of donor government agencies, at all levels, to developing countries. Multilateral ODA refers to funds provided through international financial institutions such as the Global Environment Facility, the World Bank and United Nations funds and programmes. Please include the categories that you used in completing question 1.1 under section I.

(5) You may report on either ODA/OOF commitments or actual disbursements. Please apply the same category as used in question 1.1 of section I above.

(6) Funding for biodiversity includes not only funding for direct actions to protect biodiversity but also funding related to actions across different sectors (e.g. agriculture, forestry, tourism) to promote biodiversity-friendly initiatives that have other primary purposes (e.g. ecosystem-based approaches to climate-change mitigation and adaptation). Please tick the appropriate box if numbers provided include resources directly related or indirectly related to biodiversity. Please apply the same category as used in question 1.1 of section I above.

(7) In past reporting under the preliminary reporting framework, many members of the OECD DAC used the 'Rio markers methodology' under the OECD CRS database, to report on ODA directly related to biodiversity ('principal' marker) and indirectly related to biodiversity ('significant' marker). Please indicate if you did apply this methodology and, if not, please provide a brief explanation on the methodology you applied.

(8) If you provided a total amount that includes resources indirectly related to biodiversity, indicate the coefficient used to aggregate amounts directly and indirectly related to biodiversity. Please use the same coefficient as used in question 1.1 of section I above.

(9) Please provide (average) confidence levels (high, medium, low).

(10) You may provide any other methodological observations or comments here.

1.2 Has your country taken measures to encourage the private sector as well as non-governmental organizations, foundations and academia to provide international support for the implementation of the Strategic Plan for Biodiversity 2011-2020?

(1) no

(2) some measures taken

(3) comprehensive measures taken

If you ticked (2) or (3) above, please provide additional information here.

You may wish to provide cross-references, as applicable, to the relevant sections of your sixth national report including your report on progress in achieving Aichi Biodiversity Targets 1, 2, 3, 4, 16, 18, and 19.[40]

( )

2. Inclusion of biodiversity in priorities and plans

Has your country included biodiversity in national priorities or development plans?

(1) Not yet started ( )

(2) Some inclusion achieved ( )

(3) Comprehensive inclusion ( )

If you ticked (1) or (2) above, please provide additional information here.

You may wish to provide cross-references, as applicable, to the relevant sections of your sixth national report:[41]

( )

3. Assessment and/or evaluation of values

Has your country assessed and/or evaluated the intrinsic, ecological, genetic, socioeconomic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its components?

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[40] This will be reflected in the guidelines for the sixth national reports in line with paragraphs 26 and 28 of decision XII/3.

[41] This will be reflected in the guidelines for the sixth national reports in line with paragraphs 26 and 28 of decision XII/3.

(1) not yet started ( )

(2) some assessments/evaluations undertaken ( )

(3) comprehensive assessments/evaluations undertaken ( )

If you ticked (2) or (3) above, please provide additional information here.

You may wish to provide cross-references, as applicable, to the relevant sections of your sixth national report, including your report on progress in achieving Aichi Biodiversity Target 2: [42]

( )

4. Role of collective action and non-market approaches

4.1 Has your country assessed the role of collective action, including by indigenous and local communities, and non-market approaches for mobilizing resources for achieving the objectives of the Convention?

(1) no such assessment necessary ( )

(2) not yet started ( )

(3) some assessments undertaken ( )

(4) comprehensive assessments undertaken ( )

If you ticked (3) or (4) above, please provide additional information under question 4.2 below.

4.2 Please provide information on the quantitative assessment of the role of collective action undertaken by your country. Please provide also an assessment of your confidence in the estimation (high, medium low; alternatively provide a range of estimates). If possible, provide data for several years.

Measurement Unit (1):

Year	Contribution (1)	Overall confidence
20xx		
20xx		
20xx		
20xx		
20xx		
Average		

[42] This will be reflected in the guidelines for the sixth national reports in line with paragraphs 26 and 28 of decision XII/3.

Methodological information: As applicable, methodology used to assess the role of collective action and non-market approaches: ( ) Conceptual and Methodological Framework for Evaluating the Contribution of Collective Action to Biodiversity Conservation; ( ) other (please specify): ( ). Other methodological observations/comments, including sources of data: ( )

Additional explanations:

(1) For instance, the Conceptual and Methodological Framework for Evaluating the Contribution of Collective Action to Biodiversity Conservation suggests using the total land area conserved by collective action within indigenous and local communities.

5. Reporting progress in mobilizing resources

5.1 Please indicate, in the table below, the achieved resource mobilization for your country, by source, and their respective actual contribution towards your identified funding gap.

This question refers to the implementation of your national finance plan as provided in question 6 of section I above.

Please add additional rows to the table as needed.

Currency:

Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
(1) Funding gap						
(2) Domestic sources (total)						
Source 1						
Source 2						
Source 3						
(3) International flows (total)						
Source a						
Source b						
Source c						
(4) Remaining gap						
(5) Has the gap been reduced?						
(6) Has the gap been reduced overall? ( ) no; ( ) yes, somewhat; ( ) yes, significantly						
Additional methodological information/comments, including sources of data: ( )						

Additional explanations

(1) The expected funding gap would be taken from column (3) under question 5 of section I.[43] You may wish to update the estimates in light of additional information, including, for instance, a reduced funding need resulting from the elimination, phase out, or reform of harmful incentives.

(2) The actual contribution towards the identified finance gap by domestic sources. You may wish to further specify the actual sources that were mobilized and their respective contribution. In this case, please replace the 'placeholders' and add more rows as needed.

(3) The actual contribution towards the identified finance gap by international sources. You may wish to further specify the actual sources that were mobilized and their respective contribution. In this case, please replace the 'placeholders' and add more rows as needed.

(4) The remaining gap is calculated by subtracting (3) and (2) from (1).[44]

(5) Please provide your assessment as to whether the gap was reduced in the relevant year (no; yes, somewhat; yes, significantly)

(6) Please provide your overall assessment as to whether the funding gap was reduced, by ticking one of the appropriate boxes.

5.2 Has your country taken measures to encourage the private sector as well as non-governmental organizations, foundations and academia to provide domestic support for the implementation of the Strategic Plan for Biodiversity 2011-2020?

(1) no

(2) some measures taken

(3) comprehensive measures taken

If you ticked (2) or (3) above, please provide additional information here.

You may wish to provide cross-references, as applicable, to relevant sections of your sixth national reports, including your report on progress in achieving Aichi Biodiversity Targets 1, 2, 3, 4, 16, 18, and 19: [45]

( )

Appendix

ACTIVITY CLASSIFICATIONS

The following is an indicative list of possible classifications of activities related to biodiversity:

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[43] The online version of the reporting framework could carry over the pertinent numbers automatically.

[44] The online version of the reporting framework could undertake this calculation automatically.

[45] This will be reflected in the guidelines for the sixth national reports in line with paragraphs 26 and 28 of decision XII/3.

Transforming Biodiversity Finance: The Biodiversity Finance (BIOFIN) Workbook for assessing and mobilizing resources to achieve the Aichi Biodiversity Targets and to implement National Biodiversity Strategies and Action Plans. Appendices I and J.
http://www.cbd.int/doc/meetings/fin/rmws-2014-04/other/rmws-2014-04-workbook-biofin-en.pdf

Aid targeting the objectives of the Convention on Biological Diversity. OECD Guidance on Rio markers:
http://www.oecd.org/dac/stats/46782010.pdf

The Multilateral Environmental Agreements and the Rio Markers. Information note prepared by EuropeAid E6 Unit – "Natural Resources", September 2010
http://capacity4dev.ec.europa.eu/system/files/file/15/01/2014_-_1445/eu_the_multilateral_environmental_agreeementsand_the_rio_markers_en.pdf.

Appendix C

CATEGORIZATION OF INDICATORS FOR FACTOR ANALYSIS

Indicator	Data-collecting organization				CBD's encouragement		
	CBD	IGOs	NGOs	None	NR guideline	CBD decisions	None
1.1. Biodiversity Barometer			X				X
1.2. Online interest in biodiversity (Google Trends)			X				X
2.1. Number of countries implementing natural resource accounts, excluding energy, within the System of Environmental-Economic Accounting		X					X
2.2. Number of countries that have integrated biodiversity in National Development Plans, poverty reduction strategies or other key development plans				X	X		
3.1. Trends in potentially harmful elements of government support to agriculture (produced support estimates)		X					X
3.2. Agricultural export subsidies		X					X
3.3. Number of countries with national instruments on REDD plus schemes				X			X
16.1. Number of Parties to the CBD that have deposited the instrument of ratification, acceptance, approval or accession of the Nagoya Protocol	X	X					X
16.2. Number of countries that have adopted legislative, administrative and policy frameworks for the implementation of the Nagoya Protocol	X	X					X
17.1. Number of countries with developed or revised NBSAPs	X				X		
19.1. Growth in species occurrence records accessible through GBIF		X					X
20.1. Information provided through the financial reporting framework, adopted by decision XII/3	X					X	
20.2. Official development assistance and public expenditure on conservation and sustainable use of biodiversity and ecosystems	X	X				X	

Indicator	International consensus			Feature of indicator
	BIP	SDG indicators	None	Simple counting
1.1. Biodiversity Barometer	X			
1.2. Online interest in biodiversity (Google Trends)			X	
2.1. Number of countries implementing natural resource accounts, excluding energy, within the System of Environmental-Economic Accounting			X	X
2.2. Number of countries that have integrated biodiversity in National Development Plans, poverty reduction strategies or other key development plans			X	X
3.1. Trends in potentially harmful elements of government support to agriculture (produced support estimates)	X			
3.2. Agricultural export subsidies		X		
3.3. Number of countries with national instruments on REDD plus schemes			X	X
16.1. Number of Parties to the CBD that have deposited the instrument of ratification, acceptance, approval or accession of the Nagoya Protocol	X			X
16.2. Number of countries that have adopted legislative, administrative and policy frameworks for the implementation of the Nagoya Protocol		X		X
17.1. Number of countries with developed or revised NBSAPs	X			X
19.1. Growth in species occurrence records accessible through GBIF	X			
20.1. Information provided through the financial reporting framework, adopted by decision XII/3			X	
20.2. Official development assistance and public expenditure on conservation and sustainable use of biodiversity and ecosystems	X	X		