Distr.
GENERAL

CBD/SBI/3/5/Add.2
18 June 2020

ORIGINAL: ENGLISH

Convention on Biological Diversity

SUBSIDIARY BODY ON IMPLEMENTATION
Third meeting
Quebec City (to be confirmed), Canada, 9-14 November 2020
Item 6 of the provisional agenda*

ESTIMATION OF RESOURCES NEEDED FOR IMPLEMENTING THE POST-2020 GLOBAL BIODIVERSITY FRAMEWORK

PRELIMINARY SECOND REPORT OF THE PANEL OF EXPERTS ON RESOURCE MOBILIZATION

I. INTRODUCTION

1. In decision 14/22, paragraph 14, on resource mobilization, the Conference of the Parties at its fourteenth meeting affirmed that resource mobilization would be an integral part of the post-2020 global biodiversity framework to be adopted by the Conference of the Parties to the Convention at its fifteenth meeting, and decided to initiate preparations on this component at an early stage in the process of developing the framework, in full coherence and coordination with the overall process for the post-2020 global biodiversity framework. In paragraph 15(c) of the same decision, the Conference of the Parties tasked a panel of experts on resource mobilization:

> To estimate the resources from all sources needed for different scenarios of the implementation of the post-2020 framework, taking into account the needs assessment of the Global Environment Facility, as well as costs and benefits arising from the implementation of the post-2020 framework.

2. In the light of this decision and the fact that the development of the post-2020 global biodiversity framework is ongoing, the present document provides a preliminary report of the Panel of Experts on this topic. An updated and final report will be prepared for consideration by the Conference of the Parties at its fifteenth meeting.

3. The *Global Assessment Report on Biodiversity and Ecosystem Services* of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), released in 2019, described in detail how nature and its contributions to people have deteriorated globally at a rate unprecedented in human history, due to the acceleration of direct and indirect drivers in the last 50 years. During this period, significantly more resources have been allocated to expenditure harming biodiversity than to conserving it.[1] It is thus vital to assess the economic impact of this decline and to mobilize the resources needed to reverse this trend.

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* CBD/SBI/3/1.

[1] For example, harmful expenditures for biodiversity in agriculture and fisheries only in OECD countries are estimated at US$ 107 billion, based on OECD data on support to agriculture (PSE database) and fisheries (FSE database). Considering also support to fossil fuels and water use/treatment, the total value of subsidy programmes with significant environmental footprints approaches US$ 1 trillion (see https://www.oecd.org/env/resources/biodiversity/biodiversity-finance-and-the-economic-and-business-case-for-action.htm).

4. To reduce biodiversity loss, adequate resource mobilization is central to the post-2020 global biodiversity framework. An important determinant of biodiversity conservation is the amount of resources from all sources committed to finance biodiversity policies, programmes and projects. Higher levels of resources do not guarantee higher levels of conservation, but research has shown that, on average, a higher allocation of resources into biodiversity programmes and projects is associated with reduced biodiversity loss.[2]

5. The present document provides an overview of advanced or completed analyses, underlying methodologies, and resulting estimates of the funds needed for the implementation of the post-2020 global biodiversity framework, or of elements of such a framework (sections IV and V). It also reviews the potential costs and benefits arising from biodiversity conservation and sustainable use, based on different scenarios (section III). Key messages are presented in section II, and final results and discussion in section VI.

6. Three different analyses on resource needs are included in the present document, providing relevant methodologies and recent estimates. One analysis, led by Professor John Tobin of Cornell University (United States of America), is based on estimating resource needs aggregated by activities and investments in key economic sectors necessary to achieve biodiversity sustainability by 2030. It calculates the net present value of resources needed for protecting 30 per cent of the land and marine areas, conserving coastal and urban areas, management of invasive species, and transforming key economic sectors into sustainable sectors by 2030. It provides a range of global annual estimates that include financial costs for implementing conservation projects but also foregone income paid from changing practices in economic sectors (opportunity costs).

7. Another analysis, led by Professor Anthony Waldron of Cambridge University (United Kingdom of Great Britain and Northern Ireland), forecasts economic outcomes into 2040 and 2050 based on expanding protected areas from the current levels (15 per cent of land and 7 per cent of marine areas) to 30 per cent by 2030 in a total-economy framework where multiple economic sectors compete for the use of land and marine areas. It estimates annual investments in protected areas and expected revenues in agriculture, fishery, and nature tourism sectors, considering also the net benefits in risk reduction from increases in ecosystem services, social benefits from higher protection levels of lands of indigenous peoples and local communities, and compensation costs from expanding protected areas. Compensation or opportunity costs express the losses in income incurred from conserving biodiversity, in terms of potential lost in economic benefits, in addition to the direct financial cost of undertaking biodiversity projects or activities.

8. Both analyses incorporate some type of compensation or opportunity costs in their estimation. Those are essential to consider from a welfare point of view, but they do not necessarily “translate”, or not completely, into direct financial costs; that is, financial resources that need to be raised in order to undertake measures to support the conservation and sustainable use of biodiversity. Including this type of cost necessarily leads to a larger estimate. Nonetheless, the latter analysis, based on expanding protected areas, provides a dissected estimation with and without compensation costs, which allows consideration of only financial needs.

9. An analysis conducted by the Panel of Experts to complement the previous two analyses is presented in section V. It uses statistical modelling to estimate biodiversity expenditures and financial needs per country, based on information reported in the financial reporting framework of the Convention,[3] and projecting scenarios to 2030 based on different levels of GDP, CO_2 emissions, and agricultural land. Given that this analysis is based on past expenditures by country, it includes opportunity cost only to the extent that this cost was reflected, in past expenditures, in actual compensatory payments of benefits lost due to biodiversity policies. The scenarios used would implicitly assume an expansion of such payments;

[2] Conservation investment reduced biodiversity loss in 109 countries (signatories to the Convention on Biological Diversity and the Sustainable Development Goals), by a median average of 29 per cent per country between 1996 and 2008 (Waldron et al. 2017. Reductions in global biodiversity loss predicted from conservation spending. *Nature*, 551(7680), 364-367).

[3] Decision XII/3, annex II.

however, due to the highly aggregated nature of the underlying data from the financial reporting framework, their precise share cannot be quantified.

10. Although there is wide variation among the estimates, due to these different cost concepts and other methodological differences, as further explained below, they all broadly point in the same direction by indicating a need for financial resources to increase substantially from current levels in order to "bend the curve" on biodiversity loss.

11. More broadly, the incremental impact of a conservation policy or project can be assessed in terms of increasing well-being for nature and humanity. To increase well-being, it is necessary that benefits (in a broad sense, not just commercial or pecuniary benefits) exceed costs. This document reviews the latest analyses developed to appreciate the costs and benefits of conservation efforts to curb biodiversity loss, based on ecosystem services valuation and expansion of protected areas from current levels. The first methodology, reported by WWF in its *Global Futures* report,[4] estimates the economic impact from changes in six global ecosystem services under three scenarios up to 2050 (business-as-usual, sustainable pathway, and global conservation). The second methodology, being used by the World Bank Group, further develops this modelling by including feedbacks from the economy into nature. The third methodology, being used by Waldron and colleagues, estimates the resources needed for protected areas expansion as mentioned above, but also provides a significant analysis on how investing in biodiversity generates not only large financial revenues for key economic sectors, but more importantly, social net benefits. These analyses provide strong evidence, based on state-of-the-art methodologies, that benefits in human and natural well-being could be significant if ambitious conservation efforts are taken over the next 30 years. Conversely, insufficient action would generate large losses for humanity.

12. As the financial mechanism of the Convention, the Global Environment Facility (GEF) is a key component of resource mobilization for the post-2020 global biodiversity framework. As requested by the Conference of the Parties in decision 14/23, an assessment of the financial needs for the eighth replenishment of the GEF Trust Fund (GEF-8) is currently under way and will be made available for consideration by the Conference of the Parties at its fifteenth meeting. The assessment will take into account the latest national reports, national biodiversity strategies and action plans (NBSAPs) and financial reports, as well the information provided by Parties through the pertinent questionnaire that was made available by notification 2020-021;[5] consequently, the final version of the present report will also consider the results of the GEF-8 needs assessment.

II. KEY MESSAGES

13. The current level of ambition for conserving biodiversity and using it sustainably is clearly not sufficient. All analyses reviewed indicate that failure to raise adequate resources for effectively implementing an ambitious new framework and not being able to use these resources efficiently will have significant global economic costs. Purely from an economic standpoint, continuing at current levels of conservation funding will lead to economic losses. The WWF *Global Futures* report estimates conservatively that more than US$ 500 billion are lost annually in terms of reduced economic growth (0.67 per cent of global GDP annually). In contrast, just investing in expanding protected areas to 30 per cent by 2030, it is estimated that future global revenues from the agriculture, fisheries, and nature tourism sectors would be larger than the necessary global investments. Even with the limited information and data available at this stage, there is thus a compelling economic argument to allocate more resources for biodiversity conservation. Implementing an ambitious framework will produce not only a potential change in rates of biodiversity loss (i.e. bending the curve on biodiversity loss) but will generate significant economic net benefits for current and future generations.

[4] https://www.wwf.org.uk/sites/default/files/2020-02/Global_Futures_Technical_Report.pdf; https://www.wwf.org.uk/sites/default/files/2020-02/GlobalFutures_SummaryReport.pdf.

[5] Ref. No. SCBD/IMS/JMF/NP/YX/8870.

14. Recent estimates on future funding needs differ significantly, varying from lower estimates of US$ 103 billion to US$ 178 billion to higher estimates of US$ 613 billion to US$ 895 billion annually. The differences are mainly due to (a) different (narrower or broader) concepts of relevant types of costs, in particular financial cost and opportunity cost, the latter driving total costs significantly upward; (b) different (narrower or broader) concepts of what constitutes biodiversity-relevant expenditures or investments; and (c) genuine methodological differences (see below). Given these differences, each estimate should be appreciated and understood separately.

15. The smaller global estimate (US$ 103 billion to US$ 178 billion annually) is based only on investments in terrestrial and marine protected areas if coverage were increased from current levels to 30 per cent by 2030 (without considering any compensation costs). This would be an increase of 4.7 to 7.3 times from the current estimates of expenditures (US$ 24.5 billion annually). The methodology used is based on estimating future scenarios including investments in management, establishment of new protected areas, and compensation costs. These latter costs are included only for the welfare analysis. It uses current budgets per hectare in developed countries of protected areas to estimate the resource needs for expansion of future protected areas, with no increase in management efficiency after 2030.

16. In contrast, the larger global estimate (US$ 631 billion to US$ 895 billion annually) is based on funding per focal activity using a broad holistic concept of relevant expenditures related to the post-2020 global biodiversity framework. It estimates resources needed for protecting 30 per cent of global land and oceans by 2030, and also by converting the agricultural, fishery, and forestry sectors into sustainable sectors, conserving biodiversity in urban and coastal areas, management of invasive species, and urban water quality protection. It applies a broader notion of economic costs, considering also the opportunity costs incurred for moving these key economic sectors towards sustainable production in the next three to four years, keeping the same level of production and income in the future. Opportunity costs express the losses in income incurred from conserving biodiversity, in terms of potential loss of economic benefits, in addition to the direct financial cost of undertaking biodiversity projects or activities. Including this type of cost necessarily leads to a larger estimate. Considering only financial costs could lead to a much lower estimate, given that transforming the agricultural sector alone would entail paying US$ 323 billion to US$ 436 billion in compensation for lost income, some 50 per cent of the total aggregated cost estimate.

17. Moreover, inclusion of opportunity costs raises an important methodological issue. They are likely to be calculated based on a status quo incentive landscape, including not only a significant amount of non-internalized negative environmental externalities but also a significant amount of biodiversity-harmful incentives and subsidies; such incentives and subsidies are estimated at, on average, US$ 100 billion per year in OECD countries[1] for the agriculture sector alone. For these reasons, observed price signals are distorted and will lead, other things being equal, to an overestimate of opportunity costs. As regards harmful subsidies, the first and third reports of the Panel of Experts therefore underline the importance of redirecting subsidies towards the enhancement of biodiversity and not merely reducing or eliminating them.

18. An additional estimate (US$ 151 billion to US$ 182 billion annually),[6] based on analyses conducted specifically for the present report, used the expenditure and funding needs data as reported by Parties in their financial reporting frameworks, to extrapolate the funding needs based on those provided by countries in the financial reporting framework, across different scenarios.[7] It has the advantage of a bottom-up approach projecting resources based on data reported by Parties and thus reflecting country characteristics. Being based on NBSAPs, the financial needs indicated by Parties through the financial reporting framework arguably are based on a broader notion of biodiversity-relevant expenditures, and include opportunity costs only insofar as they are already reflected in actual financial expenditures.

[6] Based on PCA and MLR-2 models respectively (discussed in section V), for a business-as-usual scenario.

[7] The Panel of Experts wishes to thank Professor Anthony Waldron for inspiring discussions and to acknowledge with appreciation the valuable research assistance provided by Ph.D. candidates Ms. Rishman Chahal Jot (Indian Institute of Technology Kanpur), Ms. Emily Wise (University of Wyoming) and Ms. Bethany King (University of Wyoming). In particular, we owe to Ms. Jot the idea of using principal components analysis (PCA), and to Ms. Wise and Ms. King for data analysis.

19. The analysis shows that, if a more sustainable growth trajectory is followed, the financial resources needed will be substantially less than if the world remains on a business-as-usual trajectory. This is in line with the findings and recommendations of the first and third reports of the Panel of Experts, which stress the need for transformative change to social and economic systems, and propose a strategic approach to resource mobilization built around three core components: (a) reducing or redirecting resources causing harm to biodiversity; (b) generating additional resources from all sources to achieve the three objectives of the Convention; and (c) enhancing the effectiveness and efficiency of resource use.

20. There is, furthermore, a need to concentrate efforts not only on raising global resources from all sources for biodiversity, but also on the specific funding mechanisms and their distributional impacts. As shown in the *Global Futures* and IPBES reports, not all regions have the same benefits or the same opportunity costs from increasing investment in conservation. For example, Droste et al. (2019)[8] proposed a new global biodiversity financial mechanism in order to share financial burdens of biodiversity conservation through intergovernmental transfers. This mechanism would be guided by the principle of fiscal equivalence: those who benefit from the good in question should also pay for the costs of provision.[9] This is essentially an application of the incremental cost reasoning which GEF is applying in its allocation of resources.

21. Despite the current work to understand the costs, benefits and funding needs for biodiversity conservation, as summarized above, more data and research is needed to provide accurate assessments of resource mobilization and its benefits. For instance, it is already known that expenditures harmful for biodiversity are significantly higher than beneficial expenditures.[10] Reducing or eliminating these harmful expenditures will generate short-term costs, for instance for communities that depend on them. How high are these costs? And how high are the biodiversity benefits that can be expected from a given amount of harmful subsidy elimination? Attempting to quantify these effects, and to answer how the incremental benefits of removing harmful expenditure compare with their incremental costs, is an urgent priority for further research.

III. COSTS AND BENEFITS ARISING FROM IMPLEMENTING A POST-2020 GLOBAL BIODIVERSITY FRAMEWORK

22. The IPBES *Global Assessment* in 2019 alerted us to how human-driven pressures are affecting nature, ecosystem services, and biodiversity. Negative trends in biodiversity and ecosystem functions are projected to continue or worsen in many future scenarios, in response to indirect drivers, such as rapid human population growth, unsustainable production and consumption, and associated technological development. The *Global Assessment* recommends five main interventions that can generate transformative change by tackling the underlying indirect drivers of the deterioration of nature.[11] Implementing these interventions will require funding.

23. As ecosystem functions continue to worsen, current levels of conservation and resource mobilization are not ambitious enough, as shown by the WWF *Global Futures* report (2020). The cost for the world's economy from the loss of nature in a business-as-usual scenario would be a cumulative loss of US$ 9.9 trillion (in discounted terms), over the period from 2011 to 2050. This translates into US$ 479 billion annually or a drop of 0.67 per cent in annual global GDP by 2050. Developing countries would bear the largest share of this cost.

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[8] Designing a global mechanism for intergovernmental biodiversity financing, *Conservation Letters.* 2019;12:e12670. https://doi.org/10.1111/conl.12670.

[9] Such a financial mechanism could incentivize nations to supply global benefits of conserving biodiversity through protected areas. The analysis showed that the socioecological design that combines the extent of protected area per country and each nation's development status would provide the strongest median incentive for states which are farthest from achieving the target.

[10] OECD (2019). *Biodiversity: Finance and the Economic and Business Case for Action*.

[11] The five interventions proposed by the IPBES Global Assessment are: (a) incentives and capacity-building; (b) cross-sectoral cooperation; (c) pre-emptive action; (d) decision-making in the context of resilience and uncertainty; and (e) environmental law and implementation.

24. This estimate considers the economic values of six key ecosystem services: coastal protection (of US$ 327 billion annual loss); carbon storage (US$ 128 billion annual loss); water yield (US$ 19 billion annual loss); pollination (US$ 15 billion annual loss); forest productivity (US$ 8 billion annual loss); and fish productivity (US$ 17 billion annual gain). However, if 30 per cent of land, marine and coastal areas were protected in a comprehensive, ecologically coherent and effectively managed network of protected areas, under the global conservation scenario of the *Global Futures* report, there would be a cumulative benefit of US$ 230 billion or US$ 11.3 billion annually (0.02 per cent of global GDP by 2050). The 0.69 per cent difference in GDP between these two scenarios represents a net gain from conservation. The large negative asymmetry or skewness between scenario results shows that ambitious conservation measures are necessary if the world wants a positive economic impact.

25. The *Global Futures* analysis covered 140 countries in a state-of-the-art model that links the InVEST valuation model[12] with the GTAP model[13] to assess the economic impact resulting from changes in key ecosystem services and associated land-use change, under several development scenarios. The three scenarios – business-as-usual (BAU), sustainable pathway (SP), and global conservation (GC) – are based on the IPBES *Global Assessment* and the Shared Socioeconomic Pathway scenarios (SSP)).[14] The modelling consisted of defining land-use scenarios based on SSP drivers, assessing how drivers affect natural assets and their ecosystem services, defining how changes in ecosystem services affect economic activity, and measuring the economic impact from those changes.

26. There are some limitations to this methodology, which make the estimations conservative. There is not sufficient data on many ecosystem services provided by nature. This results in an underestimation of effects as well as significant biases against countries whose primary ecosystem services are not considered in the model, or other ecological impacts not related to ecosystem services. Also, the model does not take into account all the possible ways that natural capital is affected by the reduction in economic activity, and neither does it consider thresholds of irreversible changes. There are, however, some important advantages from using this methodology. It considers most of the economic activity and countries globally. It also includes changes in prices in the economy and the adaptation and substitution effects that soften the shocks from lower levels of ecosystem services. When there is a shock in the quantity provided from ecosystem services, people tend to adapt and substitute those services.

27. Building on the WWF *Global Futures* report, the World Bank Group is expanding the analytical work by looking at how alternative policy scenarios compare in mitigating the impacts of ecosystem services loss on the economy. This is achieved by building a "feedback" version of the integrated InVEST-GTAP model in which a set of scenarios is applied to the GTAP Agroecological Zones (AEZ) model whose outputs are used as inputs in the InVEST model. The results of the InVEST model are then fed into a second run of the GTAP-AEZ model. This modelling framework allows, through successive runs in which changes to policies are introduced, evaluation of the impact of policy reforms on the model predictions. In fact, a feature of the GTAP suite of models is that it allows for productivity shocks that are the result of policy reforms.

28. Policies reforms analysed include (a) the elimination or repurposing of subsidies harmful to biodiversity; (b) the intensification of agriculture; (c) the application of border adjustments to the trade of goods whose production is associated with drivers of biodiversity and ecosystem loss; and (d) the establishment of payment for ecosystems services schemes following different criteria. The model is able to predict the impact of alternative policy packages on value added, on income distribution and on production, among others. Model results will provide key insights on the relevance of post-2020 global

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[12] InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) is a suite of 20 ecosystem service models extensively used around the world, developed by the Natural Capital Project (https://naturalcapitalproject.stanford.edu/software/invest).

[13] The Global Trade Analysis Project (GTAP) Computable General Equilibrium (CGE) model is well-established and VERY widely used global economic trade model. Developed and hosted by Purdue University, it covers 140 regions / countries and all key industry sectors (www.gtap.agecon.purdue.edu/models/current.asp).

[14] Described in Rozenberg et al. (2014). Building SSPs for climate policy analysis: a scenario elicitation methodology to map the space of possible future challenges to mitigation and adaptation. Climatic Change 122, 509-522.

biodiversity framework targets in the context of growth and development. At the time of preparation of the present preliminary report of the Panel of Experts, results from this work were not yet available. These will be included in the updated version of the report, for the consideration by the Conference of the Parties at its fifteenth meeting.

29. In addition to the work described above, a group of researchers led by Anthony Waldron at Cambridge University, with support from Campaign for Nature and National Geographic, estimated expected benefits and costs from expanding protected terrestrial and marine areas to 30 per cent from current levels. According to their estimations, the implementation of expanding protected areas is expected to generate net global financial and social benefits in all the scenarios projected (and larger than no expansion of protected areas). At the time of preparation of the present preliminary report of the Panel of Experts, this work had not yet been published.[15] Any changes in estimations or updates in the methodology will be included in an updated version for the Conference of the Parties at its fifteenth meeting.

30. In order to accomplish this, a set of global maps were created from a broad range of biodiversity experts, and 12 scenarios were then created with 7 different forecast models, ranging from no protected area expansion (business-as-usual) to prioritizing biodiversity with reallocation of production sectors, passing through scenarios that accommodate biodiversity conservation with economic production. Four different integrated assessment models were used to estimate the potential revenues from the agricultural sector. In these models, prices and production change according to a set of production and market functions to forecast how much land will be assigned to crops or livestock production at any given time. For the fishery sector, models estimate the expected catch and catch values based on protected areas imposed on fishing. For the nature tourism sector, data was collected on number of visitors to current protected area networks and their revenues, along with multiple factors that influence the number of visitors, to develop statistical models to predict the known number of visitors and revenues. A statistical model, based on online postings from visitors to protected areas around the world, was then used to forecast future visitors and revenues for 2040 and 2050.

31. In terms of financial benefits, the protected areas expansion would generate annual gross revenues (not considering any opportunity costs) between US$ 100 billion and US$ 312 billion from the three sectors considered: nature tourism, agricultural, and fisheries. All the “expansion” scenarios consistently outperformed the no-expansion scenario. In addition, the expansion would generate avoided annual losses that directly affect national economies from increase in ecosystem services (e.g. protection from coastal storm-surge damages, soil erosion, flooding) from larger tropical forest and mangroves areas in the range of US$ 150 billion to US$ 210 billion. The differences in projected revenues depend on the scenario chosen, based on the growth rate of the three sectors, especially due to the growing importance of the nature tourism sector. In terms of social benefits, it is also expected a significant reduction in global biodiversity extinction risks, and between 63 and 98 per cent (37 million to 70 million square kilometres) more protection of lands of indigenous peoples and local communities.

32. In terms of costs of implementation, the investment needed is estimated in the range of US$ 112 billion to US$ 390 billion annually including compensation costs (of between US$ 9 billion and US$ 212 billion, depending on the scenario). This is divided into US$ 87 billion to US$ 359 billion for terrestrial areas and US$ 25 billion to US$ 31 billion for marine areas. These investments include, in addition to compensation costs, the financial resources needed in adequate funding for management of current protected areas, and addition of new protected areas. Without considering compensation costs, which could be considered a type of opportunity costs, the range of expected investment lowers to US$ 103 billion to US$ 178 billion. It uses current budgets per hectare in developed countries of protected areas to estimate the needs for expansion of future protected areas, with no increase in management efficiency after 2030. Assuming increased in efficiency, of course, will lower projected

[15] For news of its expected release, see https://www.campaignfornature.org/protecting-30-of-the-planet-for-nature-economic-analysis.

financial needs. It also assumes that biodiversity aid will double by 2050 from current levels to reach 0.01 per cent of global GDP, but will remain a small proportion of current flows to protected areas.

33. Given that the nature tourism sector of the economy competes with the agricultural and fishery sectors for the use of land and sea, the main contribution from this analysis is to show that expanding protected land and marine areas is an economically efficient decision due to all three sectors generate significant higher revenues, especially the nature tourism sector (5 to 6 per cent average annual growth rate in the next 30 years). According to this analysis, the cost of expanding protected areas would not be a net burden for the economy, it would be an investment that (a) generates higher revenues that contribute to the global economy, (b) reduce of risks from natural disasters and diseases, (c) and increase social benefits in terms of higher biodiversity, protection of lands of indigenous peoples and local communities, and lower carbon emissions. It is important to notice that compensation costs tend to increase dramatically, as expansion scenarios considering a compromise between biodiversity and today's agricultural and fisheries needs.

34. All the estimations are reported in terms of annual revenues and costs. The report provides an extensive explanation on why discount rates and thus net present values are not valuable information for this type of analysis. Given that overall revenues are always higher than costs at any period of time, discounting those values becomes trivial. What counts is the comparison between revenues and costs in constant dollars each year.

35. Ultimately, the recommendations of the second report of the High-level Panel on resource mobilization[16] in 2014 continue to be valid. The report made a strong case for how investments in biodiversity conservation around the world have had significant net benefits. Biodiversity conservation investments not only strengthen the provision of ecosystem services on which vulnerable communities depend, they also provide insurance against uncertain and future environmental change, and contribute to climate change mitigation, adaptation and resilience. The report showed with several cases how monetary and non-monetary benefits of biodiversity conservation outweigh the costs. It concluded that "the average global per capita investment needed for biodiversity action is between approximately US$ 20 and US$ 60.[17] This translates to investment requirements ranging from 0.08 to 0.25 per cent of global GDP". Given the global aggregated value of ecosystem services and the expected net gain of 0.69 per cent of GDP between the business-as-usual and global conservation scenarios as estimated in the *Global Futures* report mentioned above, investments in biodiversity would likely generate net benefits for humanity.

36. From all approaches evaluated, there is a clear message that the global economic costs from biodiversity loss are significant. Even with the limited data available, an ambitious approach to biodiversity resource mobilization is likely not only to bend the curve on biodiversity loss but also to generate economic net benefits for both present and future generations.

IV. CURRENT WORK ON RESOURCES NEEDED TO IMPLEMENT A POST-2020 GLOBAL BIODIVERSITY FRAMEWORK

37. The most recent analyses relevant to estimation of financial needs for the post-2020 global biodiversity framework, or for elements of such a framework, were undertaken by groups of researchers led respectively by Anthony Waldron of Cambridge University and John Tobin of Cornell University. Though the resulting estimates are not equivalent or directly comparable, both analyses give relevant insights into the funding needed for biodiversity conservation.

38. As part of the global projections on protected areas described in the previous section, Waldron and colleagues estimated the resources needed to expand terrestrial and marine protected areas globally from current levels to 30 per cent by 2030. To estimate the investment necessary for the expansion, data

[16] Second report of the High-level Panel on Global Assessment of Resources for Implementing the Strategic Plan for Biodiversity 2011-2020 (https://www.cbd.int/financial/hlp/doc/hlp-02-report-en.pdf).

[17] Based on a global population of approximately 7 billion people.

on budget needs per hectare from current protected areas in developed countries was collected, such as from the "Financial Scorecards" on protected areas system needs submitted to the United Nations Development Programme. Using this data, statistical models for terrestrial and marine protected areas were built to predict the spending per hectare on current protected areas based on local conditions specific to the protected areas like agricultural rent, human pressure, governance, GDP per capita, remoteness, and economies of scale. Then these regressions were used to forecast the likely budget needs of expanding new protected areas (at constant 2015-dollar values) for each scenario, assuming no increase in management efficiency after 2030.

39. It was estimated that the resources needed for the scenarios with expanded protected area coverage range from US$ 103 billion to US$ 178 billion per year. These investments are dissected into US$ 67.6 billion annually for the adequate management of current protected areas and between US$ 35.5 billion and US$ 110.3 billion per year for the addition of new protected areas, depending on the scenario. Including compensation costs (lost-production local opportunity costs and natural-resource-user local opportunity costs), the resources needed would range from US$ 112 billion (US$ 87 billion for terrestrial areas and US$ 25 billion for marine areas) to US$ 390 billion (US$ 359 billion for terrestrial areas and US$ 31 billion for marine areas) per year. The value of land for these compensation costs was estimated for each scenario based on the agricultural rent for the not-yet-protected expansion areas. (As noted earlier, this work had not yet been published at the time of preparation of the present report.)

40. The other group of researchers, led by John Tobin, with support from The Nature Conservancy and the Paulson Institute, estimated the resources needed to achieve an ambitious plan of conservation by 2030. This analysis shows that global aggregate estimates are between US$ 631 billion and US$ 895 billion annually. This aggregation is based on an analysis of resources needed for six activities: (a) protecting 30 per cent of the land and marine areas by 2030; (b) transforming three key economic sectors (agriculture, fisheries, and forestry) into sustainable sectors in three to four years; (c) conserving coastal ecosystems; (d) conserving urban environments; (e) continuous management of invasive species; and (f) water quality protection for urban areas. This work is ongoing; any changes in estimations will be reflected in our final report.

41. Specifically, this work seeks to identify the funds needed to increase protected areas from the current 15 per cent of global land to 30 per cent, and from 7 per cent of marine areas to 30 per cent, by 2030. It is estimated that around US$ 76.1 billion to US$ 100 billion per year are necessary for this coverage. The second important component is to consider the costs of transforming current practices of key economic sectors (agriculture, fisheries, and forestry) towards sustainability. It is estimated that around US$ 376 billion to US$ 618 billion annually are required to transform these global sectors in the next 10 years. The third important component of the analysis is to consider the funds necessary to conserve urban and coastal areas, and to protect water quality. It is estimated that around US$ 142 billion to US$ 177 billion annually is needed to accomplish this by 2030. Finally, the cost of the continuous management of invasive species is estimated at US$ 36 billion to US$ 84 billion per year. Figure 1 below provides a visualization of the separate components of the aggregated estimation.

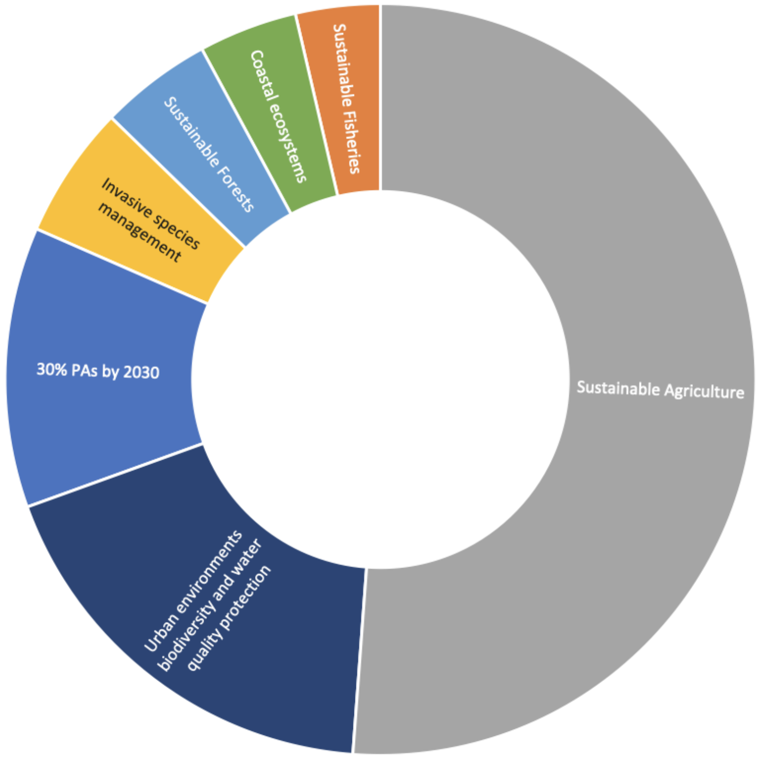

Figure 1. **Distribution of needs per activity**

Note: Agricultural transformation needs are between 49 and 51 per cent of total needs, followed by urban and water quality conservation (16 to 18 per cent), and protected areas (11 to 12 per cent).

Source: Based on unpublished data from Tobin et al.

42. To understand the aggregated needs, several key assumptions are made for each activity. For example, for the lower estimate of financial needs for protected area expansion (US$ 76.1 billion), it is assumed that the focus is on conserving key marine and terrestrial biodiversity areas, migration corridors, core freshwater habitats, and coastal zones for the land and marine protected areas. The highest estimate (US$ 100 billion) is reported directly from Dinerstein et al. (2017 and 2019).[18,19] The range encompassed by these estimations is a bit lower than the range estimated by Waldron and colleagues, but the estimates do not differ much in that resources dedicated for protected areas need to increase significantly from current levels. For the agricultural sector, it is assumed that 100 per cent of the sector receives payments to provide income support for the transition into a sustainable sector. This payment is calculated based on the value of agricultural production per region in US$ per hectare. For fisheries, it is assumed that 100 per cent of the sector is transformed into catch-control based management based on Mangin et al. (2018).[20] The US$ 12.9 billion reported in Mangin et al. for 2012 for 72.4 per cent of global fisheries is transformed into 100 per cent at 2019 prices. For forestry, the annual costs of sustainable managed forest are estimated at US$ 13 to US$ 21.6 per hectare. The forest area is estimated by subtracting protected areas (30 per cent) and already sustainably managed forests (11 per cent) from aggregated global forest areas. For management of invasive species, a 2.5 per cent growth rate of global trade is assumed, based on

[18] Dinerstein E. et al., 2017. An ecoregion-based approach to protecting half the terrestrial realm. *BioScience*, vol. 67, Issue 6, June 2017, pp. 534–545.

[19] Dinerstein E. et al., 2019. A Global Deal for Nature: guiding principles, milestones, and targets. *Science Advances*, vol. 5, number 4, eaaw2869.

[20] Mangin T. et al., 2018. Are fisheries management upgrades worth the cost? *PLOS ONE*. 13(9): e0204258. https://doi.org/10.1371/journal.pone.0204258.

the assumptions in the first report of the High-level Panel on resource mobilization (2012) to the Convention.[21] For coastal conservation, only the restoration of mangroves, seagrass, and saltmarshes are estimated. For mangroves, it is assumed that they keep losing 0.26 to 0.66 per cent per year from 2016 levels of 73,624 to 152,607 km^2 and a cost of US$ 10,848 per hectare to restore them. For seagrass, 52,100 to 173,667 km^2 are restored at US$ 124,934 per hectare, and for saltmarshes, 1,831,696 to 5,495,089 hectares are restored at US$ 78,540 per hectare. For urban areas, it is assumed that 41,000 to 80,000 km^2 are protected at US$ 176 to US$ 6,794 per km^2. Finally, for water quality protection for urban areas, it is assumed that there is an additional 10 per cent of sediment and nutrient reductions in 90 per cent of source watersheds for urban areas.

43. The largest estimation arises from the costs of transforming the agricultural sector (about 50 per cent of the global needs estimation). It is assumed that the entire global agricultural sector will be transformed, which does not consider the marginal social costs nor marginal social benefits of land transformation.

44. Currently, agricultural production quantity generates significant negative externalities for biodiversity. In an ideal world, the agricultural sector would assume these extra costs and pay for each unit produced unsustainably. This is equivalent to asserting that market prices for agricultural products are artificially low because they not include the cost inflicted on society from harm caused to biodiversity. If the agriculture sector were to assume this extra cost, final prices would increase according to the elasticity of demand and supply, and the quantity produced would be reduced. On the other hand, to feed everyone with the same agricultural composition, the world needs to keep producing this quantity above ecologically sustainable levels (i.e. higher than the social optimal). In this estimation, it is assumed that the global community would be willing to pay to the sector the whole value of production in three to four years to transform it to a more sustainable production system and thus not reduce quantity produced.

45. One would expect that in an optimal scenario, the total transformation should be when social marginal costs of the last agricultural hectare transformed is equal to the social marginal benefits from that last hectare. This would provide the optimal number of hectares that should be transformed. If marginal social benefits are high enough, it could be the case that 100 per cent of the sector should be transformed, but if marginal costs are higher than marginal social benefits, the optimal number of hectares should be less than 100 per cent. Receiving a payment equal to the whole production value per hectare to provide income support for the transition would be considered an opportunity cost of not continuing with the traditional production system. Many producers would obtain private benefits from the transformation (e.g. higher agricultural prices), so it would be optimal to offer a lower level of compensation than the gross cost of transformation. However, this optimal value is not easy to estimate with precision with current data.

46. One methodological issue with this approach is that unless harmful subsidies are redirected to transform the sector, society will not only bear the cost of the subsidies that allow unsustainable production but also bear the cost of transformation (US$ 323 billion to US$ 436 billion annually). More generally speaking, a status quo incentive landscape which includes not only a significant amount of non-internalized negative environmental externalities but, in addition, a significant amount of biodiversity-harmful incentives and subsidies, would contribute to inflating opportunity costs estimates. In its first and third reports, the Panel of Experts therefore underline the importance of redirecting subsidies towards the enhancement of biodiversity and not merely reducing or eliminating them.

47. Another way of understanding future needs is to look at global natural assets. Policymakers interested in maximizing wealth and well-being should pay more attention to the high rates of return offered by investing in natural assets. The Dasgupta Review on the Economics of Biodiversity[22] is working on understanding these rates of return through answering questions such as "What are the economic benefits of biodiversity globally, and economic costs and risks of biodiversity loss?" and "What

[21] UNEP/CBD/COP/11/INF/20.

[22] https://www.gov.uk/government/collections/the-economics-of-biodiversity-the-dasgupta-review.

is the impact on human health, well-being, and climate change of changes in biodiversity?" Like most of the analyses presented, the Dasgupta Review will consider nature as an asset, like physical and human capital, and the approach will be based on managing all assets more sustainable and efficiently to improve human wealth and well-being. It will therefore seek to understand and address biodiversity loss by viewing it as a portfolio asset management problem. At the time of preparation of this preliminary report, results from the Dasgupta Review were not yet available.

V. ESTIMATING FINANCIAL NEEDS UNDER DIFFERENT SCENARIOS USING DATA FROM THE FINANCIAL REPORTING FRAMEWORK

48. This analysis intends to complement the recent needs assessments summarized in the previous section, by using data on domestic expenditure and financial needs as reported by Parties in their financial reporting frameworks, which are available in an online database.[23] The data is used to fit an econometric model controlling for various country characteristics to estimate, first, financial needs of countries that have not submitted reports to the financial reporting framework and, second, to predict financial needs into 2030 under three different scenarios (inspired by the scenarios in the IPBES *Global Assessment*).

49. Two statistical methods are used to build and compare three models: two variants of multivariate linear regression models (MLR-1 and MLR-2) fitted by ordinary least squares (OLS) and a model based on principal components analysis (PCA). The MLR-1 model uses covariates previously used in the literature; however, we detected significant issues with multicollinearity, leading to potential overestimates, and therefore used an alternative specification of a linear regression (MLR-2) and PCA as alternative methodologies to address multicollinearity in a systematic manner.[24] Each model followed the same six steps[25] to obtain projections of future global financial needs. Supplementary documentation in CBD/SBI/3/INF/5 provides further details of the analysis.

50. Data on domestic expenditures and financial needs were collected from the financial reporting framework of the Convention. Domestic expenditures have been reported from 2006 to 2015 and may include sources from different levels of government (central budget, state budget, local or municipal budget) as well as extrabudgetary sources, non-governmental organizations, the private sector, and collective action of indigenous people and local communities. However, not all Parties report on all years or on all funding sources. Financial needs have been reported between 2014 and 2020, but most Parties did not report data during this time frame. Because of this missing data and lack of balance over years, the average was taken for all years reported by a country.

51. A total of 79 observations was thus obtained for domestic expenditures and 39 observations for financial needs. Overall, 33 high-income countries, 18 upper middle-income, 15 lower middle-income, and 13 low-income countries reported domestic expenditures in the reporting framework. Financial needs data was less reported for all income levels: 9 high-income, 10 upper middle-income, 10 lower middle-income, and 10 lower-income countries reported at least one data point on financial needs between 2014 and 2020. Cross-sectional data was collected per country on 15 characteristics from World Bank databases. Tables 1, 2 and 3 in the supplementary information present the list of data specifications, description, sources, and summary statistics for all the data collected.[26]

52. If current financial needs were reported by all countries, this would provide a sufficient basis to undertake a projection of future financial needs under different scenarios. However, there are not enough

[23] https://chm.cbd.int/search/reporting-map?filter=resourceMobilisation.

[24] PCA is a dimension reduction tool used to reduce a large set of correlated predictor variables to a smaller, less correlated set, called principal components, that still contains most of the information in the larger set. It can thus be used to address multicollinearity. See advanced statistical textbooks and lecture notes, for example Perez, L. (2017). "Principal component analysis to address multicollinearity" (manuscript, available at https://www.whitman.edu/Documents/Academics/Mathematics/2017/Perez.pdf); Ringnér, M. (2008). "What is principal component analysis?" *Nature Biotechnology*, 26(3), 303-304.

[25] PCA has an extra step on finding the principal components.

[26] See the accompanying information document, CBD/SBI/3/INF/5.

direct observations of needs to have a good predictive model. For this reason, we first need to estimate the financial needs of non-reporting countries. In order to do so, we use the high correlation observed between reported domestic expenditures and reported financial needs (with a 0.84 correlation coefficient) to help us estimate missing domestic expenditures and, based on this, the financial needs of non-reporting countries. Supplementary information on the entire analysis is provided in the accompanying information note.

53. Past needs are thus estimated using past domestic expenditures and financial needs as reported, as well as the available past values on the country characteristics, as outlined above. The table below shows the aggregated values predicted for past domestic expenditures and financial needs using the three models.

Table. Aggregated global past domestic expenditures and financial needs per year as estimated by the three models

(Millions of United States dollars)

	Aggregated global past domestic expenditures	Aggregated global past financial needs
MLR-1	$117 685	$150 223
MLR-2	$135 926	$177 281
PCA	$119 572	$145 254

54. In order to estimate future needs, we built three scenarios, inspired by the Shared Socioeconomic Pathways (SSP1 and SSP5) of the IPBES Global Assessment (which also formed the basis for the scenarios used in the *Global Futures* report). Under each of our scenarios, specific growth rates are posited for GDP, CO_2 emissions, and agricultural land area:

(a) In the business-as-usual (BAU) scenario, future GDP, CO_2 emissions, and agricultural land are assumed to continue to grow at the same average rate as during the past 10 years of available data (2008 to 2018);

(b) In the sustainable pathway (SP) scenario, future GDP is projected to grow at the same rate as observed on average in the past 10 years, CO_2 emissions are kept constant at 2018 levels, and agricultural land area is expected to be reduced by 10 per cent by 2030, compared to 2018 levels;

(c) In the global conservation (GC) scenario, in contrast with the other two scenarios, future GDP is assumed to grow at half the average rate observed in the past 10 years, while CO_2 emissions and agricultural land area are assumed to be reduced by 30 per cent by 2030, compared to 2018 levels.

Table 10 in the supplementary documentation provides a summary of the assumptions and the narrative description for each scenario.

55. The projected global financial needs for the business-as-usual (BAU) scenario are estimated at US$ 306 billion per year using the MLR-1 model, US$ 182 billion per year using the MLR-2 model, and US$ 151 billion per year using the PCA model. The projected global financial needs for the sustainable pathway scenario do not change significantly compared on average with the business-as-usual scenario (9 per cent lower). They are estimated at US$ 222 billion per year using the MLR-1 model, US$ 175 billion per year using the MLR-2 model, and US$ 136 billion per year using the PCA model. The projected global financial needs for the global conservation scenario, in contrast, are reduced on average by 34 per cent from BAU. They are estimated at US$ 122 billion per year using the MLR-1 model, US$ 169 billion per year using the MLR-2 model, and US$ 105 billion per year using the PCA model.

56. Under business as usual – that is, if GDP, CO_2 emissions, and agricultural land area keep increasing at current rates (2008-2018 average) until 2030 – it is estimated that there would be an increase in financial needs compared with past levels, i.e. for implementing the current NBSAPs. If, instead, CO_2

emissions (global conservation scenario) and agricultural land are reduced (sustainable pathway and global conservation scenarios), most of the countries tend to need marginally fewer resources. In the global conservation scenario, financial needs projected would be even lower than past financial needs. However, bearing in mind the analyses presented by the research groups headed by Tobin and Waldron respectively, opportunity costs would presumably be higher under this scenario. Figure 2 below shows the summary for the three models.

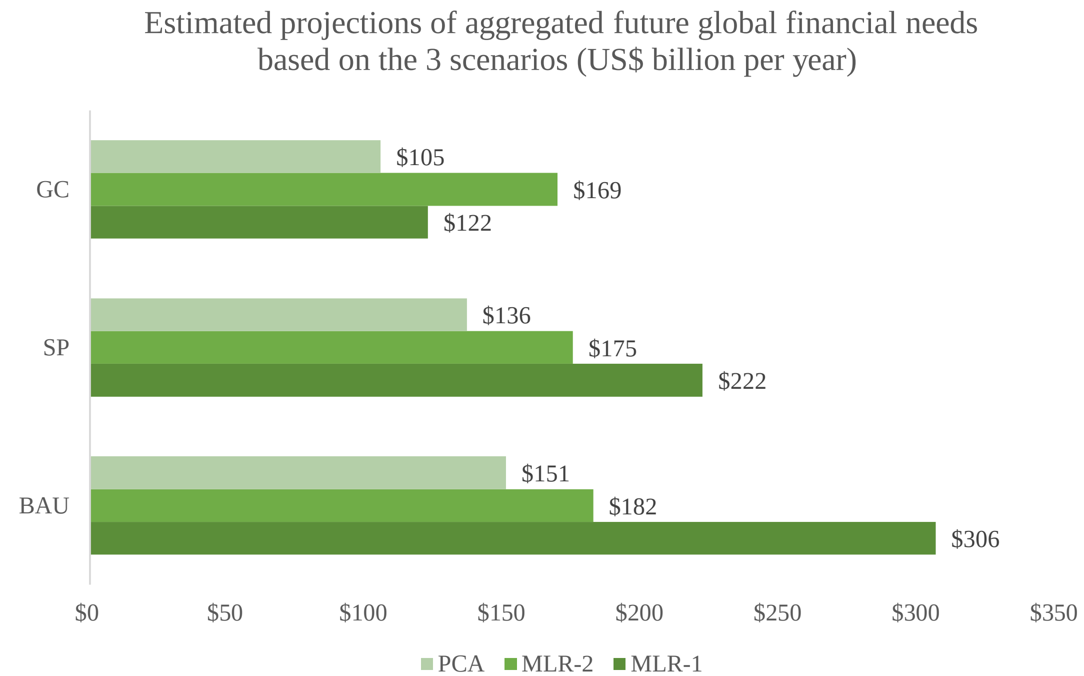

Figure 2. **Aggregated projections for future global financial needs estimated using principal components analysis (PCA) and two multivariate linear regression models (MLR-1, MLR-2)**

Note: Scenarios: GC=global conservation, SP=sustainable pathway, BAU=business as usual.

57. The PCA generates more conservative estimates than the two linear models based on ordinary least squares, and should be given more credence than the other two estimates. PCA can be used as a method to address multicollinearity among the predictor variables and resulting estimation errors. Results of MLR-1 should be interpreted with caution due to the pertinence of multicollinearity, especially given the role of GDP in the scenario building. In addition, PCA includes a larger suite of country characteristics than the MLR models, and MLR-2 controls for oil rents in step 3. As some observations (especially from the oil rents variable) for some islands and small countries are not available, the PCA and MLR-2 models predict fewer countries' expenditures than MLR-1. However, the aggregated projected financial needs in MLR-1 for countries not included in MLR-2 or PCA estimations are only a small fraction of the total aggregate (US$ 1.8 billion per year for business as usual, US$ 1.5 billion per year for sustainable pathway, and US$ 0.8 billion per year for global conservation).

58. Domestic expenditures and financial needs are self-reported in the financial reporting framework. In principle, this could be a disadvantage, due to a possible strategic bias that could lead to overreporting of expenditures or of future financial needs. However, the estimated figures appear to be relatively modest. This could be due in part to Parties not being able to make an accurate self-assessment if, for example, NBSAPs are not an accurate and complete representation of a country's needs for meeting their entire national implementation of the ambitious goals for the post-2020 global biodiversity framework. Reporting countries also tend to have fewer financial needs relative to non-reporting ones, as a proportion of their incomes. More high-income countries have reported their needs on average than low-income countries, and high-income countries with low levels of biodiversity have lower needs as a percentage of

GDP than low-income countries with high biodiversity levels. We also tried including country income classification in our models but did not find that this was a relevant factor for estimating expenditures.

59. In summary, according to this analysis, and bearing in mind the methodological caveats described above, global financial needs would increase significantly from current levels in particular if the world keeps on the same path of emissions, production, and land-use change. If, however, the world were to move to more overall sustainable pathways, for example by promoting sustainable production and consumption patterns and avoiding incentives that contribute to biodiversity loss, it would need a more limited increase of resources specifically devoted to biodiversity in the future, in the range of US$ 105 billion to US$ 170 billion annually. However, while such transitions to sustainable pathways might well also lead net economic savings, there may be also be financial costs associated with the policy measures to effect such transitions, given the structural barriers to such change.

VI. FINAL RESULTS AND DISCUSSION

60. The main key messages from this report can be summarized as follows:

(a) More resources are needed from all sources for the post-2020 global biodiversity framework. Data is still thin overall and not overly reliable, even though the data situation has improved in the last decade. However, despite limitations and methodological differences, the need for more resources seems to be a common conclusion from the different analyses considered, including the one undertaken by the Panel of Experts;

(b) Recent analyses show that undertaking highly targeted conservation measures, in terms of financial cost, does not seem to be prohibitively expensive in terms of the percentage of global GDP implied, and can achieve significant high return on investment or "bang for the buck", pointing to the significant opportunities to achieve cost-efficiencies;

(c) Achieving all three goals of the Convention, including sustainable use by mainstreaming biodiversity across economic sectors, is more expensive but, again in terms of financial cost, is estimated to be achievable with a low three-digit billion-dollar figure;

(d) Scenario-specific results show again the economic opportunities associated with more sustainable and biodiversity-positive pathways, with financial needs being higher under a business-as-usual scenario. It has to be borne in mind that the scenarios modelled here cannot depict the (as yet unknown) full innovation potential of nature-based solutions across economic sectors;

(e) Considering opportunity costs adds an additional layer of complexity. Recent analyses show that they can be significant, and that they are likely to be particularly relevant under the higher conservation scenarios with their required large-scale changes to growth and production patterns;

(f) Not all regions reap the same benefits from increasing investment in conservation, nor do they incur the same opportunity costs. Low-income countries have the highest potential to gain the most and thus are the ones that need most of the investments. Improving funding mechanisms, such as GEF and its application of the incremental cost reasoning, could increase efficiency and return on investments from mobilizing more resources.

61. In general, estimating the value of ecosystem services, return on investment from biodiversity policies, programmes and projects, or current financial needs to implement biodiversity policies, all present challenges in the light of data deficiencies and methodological limitations. Data has improved and research increased significantly compared to a decade ago. Nevertheless, without more and better data, and more research to understand the costs and benefits from nature, real challenges remain in understanding the economic impacts of loss of biodiversity, the quantum of resources needed to meet the ambition of the post-2020 global biodiversity framework, and how Parties should best make use of all the resources available.

62. This final aspect is underlined by the analysis in and conclusions of the first and third reports of the Panel of Experts, particularly the strong emphasis in these on the need for a three-pronged approach to future resource mobilization: reducing and redirecting expenditure harmful for biodiversity, increasing

resources from all sources, and increasing the effectiveness and efficiency of the use of resources. All three reports support the need for more capacity among Parties to make data available through further developing their NBSAPs, national reports, financial reporting, and biodiversity loss statistics. Biodiversity is significantly higher in developing countries, but only 13 per cent of total biodiversity-related spending is allocated to these countries (5 per cent of total conservation spending).[27]

63. GEF will continue to be an important mechanism for resource allocation and will continue to have a crucial role to play in delivering on the post-2020 global biodiversity framework. It has allocated US$ 1.412 billion for the period 2018-2022 for biodiversity and mobilized 3 to 5 dollars for each dollar invested in approved projects.[28] Since its inception, GEF has mobilized US$ 13.5 billion in 1,300 projects for 155 countries for conservation and sustainable use of biodiversity. However, biodiversity-related GEF funding has only increased by about 30 per cent between GEF-4 and GEF-7. Furthermore, country allocations under the GEF System for Transparent Allocation of Resources (STAR) model are primarily driven by a country's potential to generate global environmental benefits.

64. The GEF-8 needs assessment is under way and will be available for the Conference of the Parties at its fifteenth meeting to provide an assessment of resources needed, based on analysing the latest national reports, NBSAPs, financial reports, taking into account the results from responses to an ongoing questionnaire, and all potential data available to provide the best possible assessment.

65. The first report of the Panel of Experts, which reviews and evaluates the strategy for resource mobilization between 2011 and 2020, concludes that the effectiveness of the strategy for resource mobilization was limited and that the resource mobilization component of the post-2020 global biodiversity framework will need to be more efficient and effective to bridge the current gap between resource needs and resources available. The third report of the Panel of Experts, which presents a strategic approach and recommendations for resource mobilization for the post-2020 global biodiversity framework, develops the case that resource mobilization for the post-2020 global biodiversity framework should be built around three key components: (a) reducing or redirecting resources causing harm to biodiversity; (b) generating additional resources from all sources; and (c) enhancing the effectiveness and efficiency of resource use. The examination presented here complements these two reports by showing that the returns from increasing investment in biodiversity and shifting to more sustainable and biodiversity-positive pathways are substantially beneficial, and that a focus on all three of the key components will be essential to achieving the ambitious goals proposed in the post-2020 global biodiversity framework.

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[27] James, A. et al. (2001). Can we afford to conserve biodiversity? *OUP Academic*, vol. 51, No. 1, www.academic.oup.com/bioscience/article/51/1/43/251867. 31, https://www.cbd.int/doc/strategic-plan/Post2020/postsbi/cfn.pdf.

[28] https://www.thegef.org/topics/biodiversity.