Nippon Life
Nature Finance Approach

August, 2025

Nippon Life Insurance Company

NISSAY

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1 Introduction

On the publication of Nippon Life Nature Finance Approach

- Regarding nature restoration, although the urgency of action is extremely high, we recognize that efforts are still on progress in the world and society as a whole due to its complexity compared to climate change, which has an absolute metric such as GHG emissions.
- Under these circumstances, we believe that indicators to evaluate efforts are important in order to further promote corporate efforts toward the restoration of nature, and we have organized a set of practical and simple indicators based on a scientific perspective.
- This Approach, developed as a framework to visualize the direction and impact of efforts to achieve restoration of nature, is not the "final form of the solution." Rather, we consider it a work in progress that will evolve through ongoing discussions with various stakeholders, including constructive criticism. We hope it will serve as a foundation for active dialogue linking corporate activities to nature restoration.

The growing importance of restoring nature

- Before the Industrial Revolution, people often lived in harmony with nature in various situations. For example, during the Edo period (1603-1867) in Japan, although people altered some land through reclamation and irrigation, the diet consisted mainly of rice, fish, and seasonal vegetables, and excessive exploitation of nature resources was largely avoided. Also, even as demand for building materials increased in the populated urban areas like Edo and Osaka and deforestation occurred in some parts of the country, the ideas of "Forestry Policy Theory" spread among feudal lords, and the practices of sustainable forest management were promoted to protect forest resources and secure water sources[1].
- After the Industrial Revolution, however, the scope of economic activities including in Japan expanded as people pursued affluence in their lives and the population rapidly grew. As a result, the pressure on nature has increased significantly. Currently, with the global population growth to 8.2 billion (estimated to reach approximately 10 billion by the end of the 21st century[2]) and the accompanying economic growth have led to deforestation for the purpose of developing agricultural land, etc., causing the loss of nature at an unprecedented rate[3].
- According to the Global Assessment Report on Biodiversity and Ecosystem Services published in 2019 by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (hereinafter, IPBES)[4], 75% of the world's land area has been significantly modified by human activities, 66% of the oceans are under cumulative impact, more than 85% of wetlands have disappeared, and an estimated 1 million species are threatened with extinction.

[1] Forest and Forestry White Paper FY2013 | Forestry Agency *Japanese version only
[2] World Population Prospects 2024: Summary of Results | DESA Publications
[3] National Institute for Environmental Studies *Japanese version only
[4] IPBES Global Environmental Assessment

- In addition, the economic losses associated with the loss of nature are immeasurable. As stated in a report by the World Economic Forum (WEF)[5], more than half of the world's total GDP, $44 trillion, depends on nature and ecosystem services to a certain extent, and the loss of nature and the collapse of ecosystems pose a significant risk to business[6].
- In the WEF's latest report[7], "Biodiversity loss and ecosystem collapse" ranks second among the global risks over the next 10 years (long-term), following "Extreme weather events", moving up in rank from third place the previous year.

Voices of concern despite the adoption of the SDGs and the GBF, and the start of the TNFD

- In response to the warning from an earth science perspective on the nature loss, international frameworks for nature restoration have been developed. Specifically, two goals "Goal 14: Life below water" and "Goal 15: Life on land" were adopted in 2015 as the part of the Sustainable Development Goals. In addition, at CO15 in 2022, the Kunming-Montreal Global Biodiversity Framework (hereinafter, "GBF") was adopted by the 196 Parties of the CBD, which lead to a concrete international framework.
- Furthermore, as a complement to the adoption of the GBF, the TNFD Final Recommendations, a guideline for corporate disclosure on natural capital, was released in September 2023. In response, private sector companies have also been encouraged to take steps toward nature restoration.
- While there has been steady movement regarding nature restoration, there are some issues and concerns that companies are facing. The first issue is the "Insufficient connection with business". Unlike climate change, as nature is highly complex and it is difficult to ensure the linkage with business, many companies are struggling in figuring out what kind of concrete initiatives they should promote. Although sectors that directly utilize natural capital, such as agriculture and food, can easily grasp the relationship with nature, many companies in a wide range of other sectors are still searching for the appropriate approach.
- The second issue is the "Lack of connection with global goals". As the global goals, the GBF's 2030 mission calls for "urgent action to halt and reverse biodiversity loss", and the Stockholm Resilience Centre calls for activities within the appropriate thresholds in nine boundaries that represent the Earth's limits, presenting the concept of the Planetary Boundaries. In fact, it has been warned that one of the nine boundaries, "Biosphere Integrity" has already exceeded "a safe operating space for humanity". On the other hand, despite efforts to disclose information through the TNFD etc., companies tend to have trouble seeing the relationship between its own indicators and targets and these global goals, or find it difficult to explain.
- The third concern is "Complexity of disclosure metrics". Compared to climate change, for which has an only one absolute indicator, GHG, various indicators are required to be disclosed in the nature-related field. Particularly, indicators related to the "State of Nature" have not yet been defined even by the TNFD, leaving many companies uncertain about what information to collect and disclose.

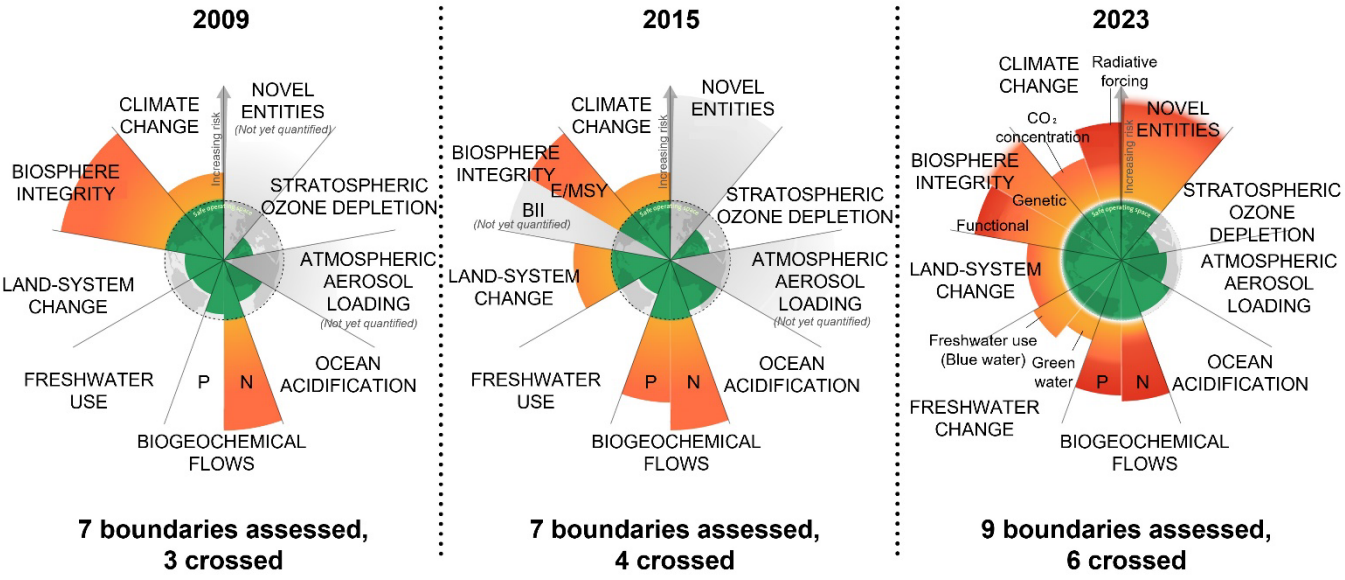
[5] The Future of Nature and Business 2020 | World Economic Forum
[6] World Economic Forum
[7] Global Risks Report 2025 | World Economic Forum

- Still, the loss of nature continues to progress rapidly today, even when companies are still struggling to find a way to cope with the situation. Even though international discussions remain unresolved, it is now essential to build a field that encourages discussion involving diverse companies in various sectors, presenting a foundational idea that provides clues to clarify the connection between corporate activities and nature restoration to accelerate both the implementation of urgent nature restoration efforts and the mobilization of related funding.

Presenting "biodiversity (ecosystems and species) impact indicators" that are scientifically valid and can be used for a wide range of companies' nature restoration efforts

- As a starting point for linking corporate activities and nature restoration, we first focused on the "complexity of disclosure indicators" mentioned earlier as the third issue facing companies. The measurement indicators related to the "State of Nature (SoN)" are particularly complex and are currently being developed by the Nature Positive Initiative (NPI), which was established in September 2023 and has taken over the SoN metrics development from the TNFD. After presenting a draft of the indicators in January 2025, the NPI is currently implementing a pilot program with companies.
- While taking these latest discussions into account, we have attempted to organize a set of practical and simple indicators that companies can immediately apply. Specifically, we focused on "the amount of energy used by living organisms for their survival and growth (≈ one of the fundamental sources of life)". We consider this indicator to be a representative, as the amount of energy greatly affects the quality of the ecosystems to which various animals and plants belong.
- Living organisms, including humans, consume carbohydrates (glucose, etc.) besides air (oxygen, carbon dioxide, etc.) and water to function. Carbohydrates are initially produced through photosynthesis by plants and are then consumed as nutrients by a wide variety of organisms through the food chain (our daily diet also originates from the energy produced through photosynthesis by plants). In this nutrient cycle, the carbohydrates initially produced by plants are referred as NPP (Net Primary Production) in the scientific community. Notably, NPP is the most fundamental function of ecosystems, categorized as a "Supporting service" under the classification of ecosystem services in the United Nations Millennium Ecosystem Assessment.
- NPP-based indicators are also used in the "Biosphere Integrity" of the Planetary Boundaries by the Stockholm Resilience Centre. Specifically, it calls for keeping the "HANPP (=Human Appropriation of Net Primary Production)", which is "the amount of NPP used by humans" low enough to ensure sustainability of the Earth.
- By utilizing NPP, an indicator of "energy available to living organisms", we have attempted to interpret various corporate activities in the common context of the natural restoration including their relationship with the global goals. Although details are provided in Chapters 3-4, we believe that by using the amount of energy required for living organisms as an indicator, we can interpret various corporate activities in terms of "increasing NPP" and mitigating or avoiding human-induced reduction of NPP (HANPP)" based on the assumption that the increase in this energy is strongly linked to the restoration.

- In formulating this Approach, the following points were taken into consideration: (1) to maintain consistency and complementarity with the Nature Positive Initiative and other efforts to develop and disseminate indicators related to the “State of Nature”, (2) to minimize the burden on companies, and (3) to provide benefits of contributing to business activities. In other words, it is intended to be used as a guideline for financing and corporate-investor engagement to create new flows of finance and economy that mainstream nature restoration efforts, while supporting the sophistication of corporate information disclosure.
- Ideally, this Approach will contribute to fostering a shared understanding of nature and facilitating integrated financial flows towards its restoration.

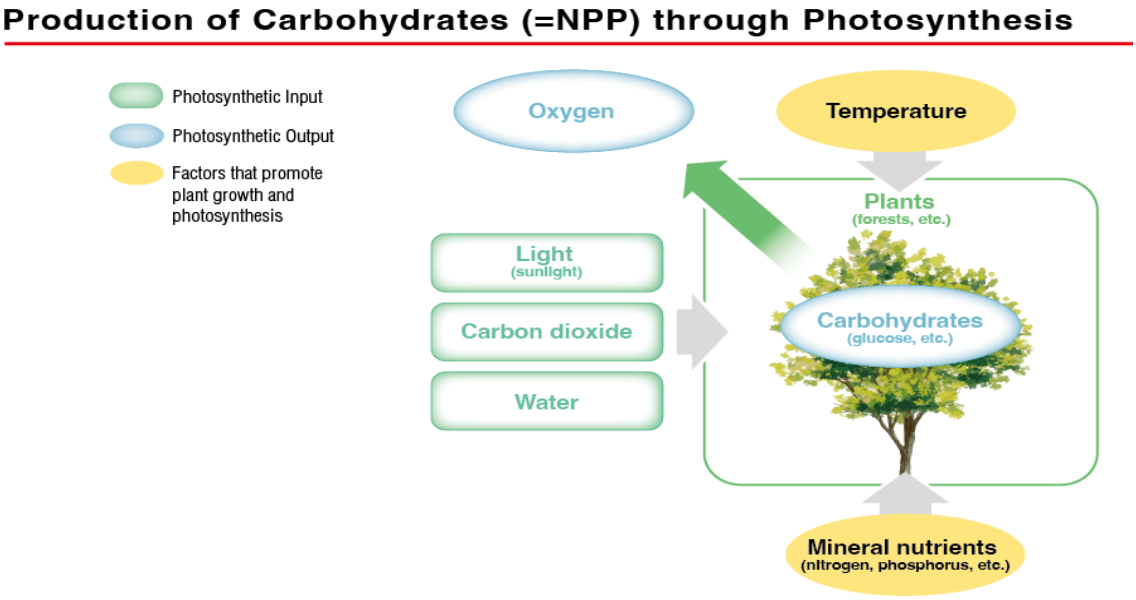


Source: “Planetary Boundaries”, Stockholm Resilience Centre (Prepared by the company based on the source)

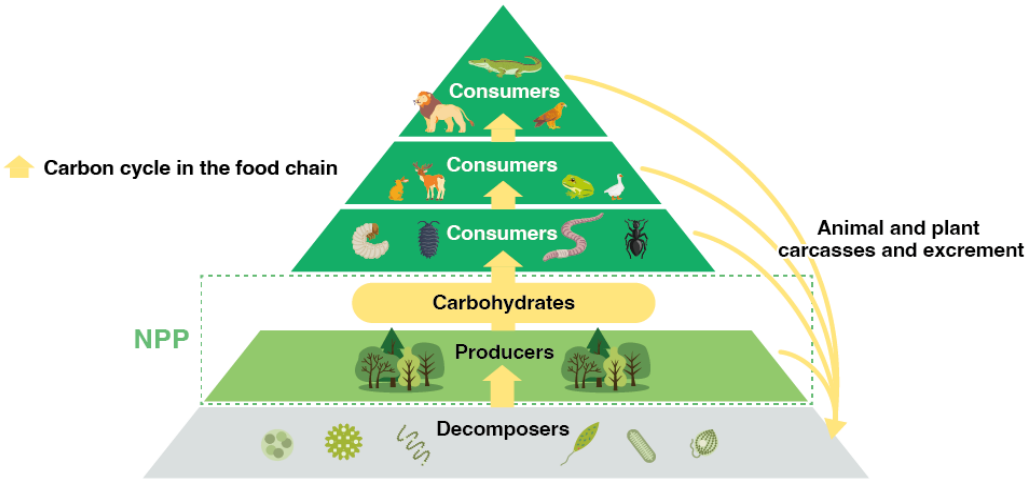
Column: What is NPP (Net Primary Production)?

Earlier, in "Chapter 1 Introduction", we introduced the concept of NPP (Net Primary Production), which is carbohydrates produced by plants, as the amount of energy used by animals for their survival and growth (≈ one of the fundamental sources of life). We would like to explain the NPP itself and its implications using more simple scientific knowledge.

First, photosynthesis is the mechanism by which plants produce carbohydrates. In photosynthesis, plants use light energy to convert carbon dioxide and water into carbohydrates (such as glucose) while releasing oxygen. The term "Primary Production" is used, focusing on the "production" of these carbohydrates. Then, defining it in more detail, as plants themselves consume carbohydrates as energy for their own activities, we call the remaining amount of carbohydrates "Net Primary Production (NPP)".



The NPP produced as described above is the starting point of the food chain and is subsequently consumed through the feeding of each animal, large and small (known as "consumers" in contrast to plants, which are "producers"). Additionally, animal carcasses, feces, and fallen leaves are decomposed by microorganisms (≒"decomposers"), and in this process, nutrients such as nitrogen and phosphorus are generated and utilized for plant growth. In this way, NPP (carbohydrates produced by plants) plays a significant role in the nutrient cycle of living organisms.



2 Trends in international efforts toward nature restoration and today's challenges for companies

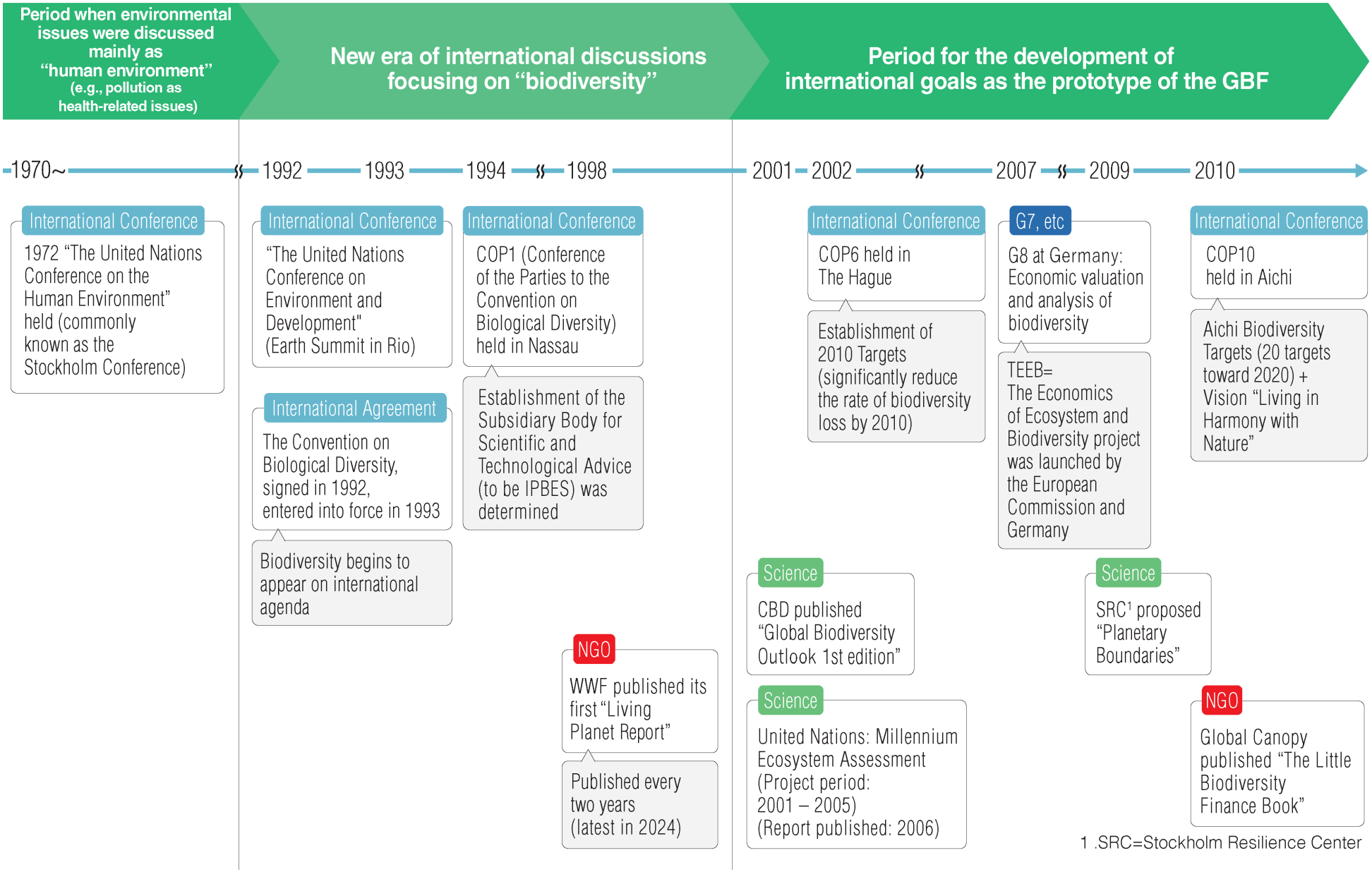
2-1. History of nature-related initiatives (from the late 20th century to the adoption of the GBF)

- Many studies and efforts have been made around the world to address the critical situation of nature, which has increased rapidly since the 20th century.
- In the 1960s and 1970s, a number of papers and reports were published including "The Economics of the Coming Spaceship Earth (1966)" by Kenneth Ewart Boulding, "The Limit to Growth (1972)" by Donella H. Meadows, Dennis L. Meadows and others under the auspices of the Club of Rome, which argued for the finite nature of the Earth's resources. In 1972, the United Nations Conference on the Human Environment was held in Stockholm, and both the scientific society and the international community sounded the alarm about the critical state of the environment. However, during this period, international discussions primarily focused on environmental issues that affect human health, except for the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), also known as the Washington Convention, and the Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat, which both entered into force in 1975.
- The concept of biodiversity became a focal point in international discussions when the Convention on Biological Diversity (CBD) was signed along with the United Nations Framework Convention on Climate Change (UNFCCC) at the United Nations Conference on Environment and Development (commonly known as the Earth Summit), held in Brazil in 1992. The First Ordinary Meeting of the Conference of the Parties to the CBD (COP1) was held in Nassau, The Bahamas in 1994, one year earlier than the COP1 for climate change.
- On the other hand, as for the establishment of a permanent intergovernmental body on the science, the world needed to wait until the IPBES was established in 2012. In this regard, the nature sector lagged behind the climate change sector, with the Intergovernmental Panel on Climate Change (IPCC) established in 1988 and awarded the Nobel Peace Prize in 2007, especially in involving a wide range of international actors such as the business and financial communities as well as consumers.
- From 2000 to 2010, can be seen as the period when a prototype for the vision and goals of the GBF adopted in 2022 had been formed. Although IPBES did not yet exist, various notable scientific findings were provided mainly for policymakers through the "Global Biodiversity Outlook 1st edition (2001)" published by the CBD, the "UN Millennium Ecosystem Assessment (MA) (2006)", which analyzed a wide range of biodiversity and ecosystem loss, and the Planet Boundaries (2009) proposed by the Stockholm Resilience Centre. Based on these scientific findings, the 2010 target to "significantly reduce the current rate of biodiversity loss by 2010" was adopted at the COP6 held in The Hague in 2002. In addition, at the COP10 held in Aichi, Japan in 2010, a long-term vision of "living in harmony with nature by 2050" was adopted as well as 20 short-term targets related to "taking effective and urgent action to halt the loss of biodiversity by 2020". In marking these milestones, international trends related to nature first progressed mainly through international conferences.
- As scientific findings became more widespread and pervasive, initiatives were gradually launched by some international organizations involving business and financial communities. This is a key characteristic of the "Period of Aichi Biodiversity Targets" of the 2010s. For

example, UNEP-FI announced the "Natural Capital Declaration" at the Rio+20 Summit in 2012, the 20th anniversary event of the Earth Summit. In the same year, "The Economics of Ecosystem and Biodiversity (TEEB) for Business Coalition" was established, which was reorganized into the Natural Capital Coalition (NCC) in 2014. In 2016, the Natural Capital Protocol was published by the NCC. Until around this time, it can be interpreted that the movement for the economic valuing of natural capital was the main focus (its origin was the TEEB project proposed at the G8 Summit held in Germany in 2007).

- On the other hand, during the time when the post-Aichi Targets (2021-2030) were being discussed, there was an accelerating movement that was aligning with the trend toward sustainability information disclosure and emphasizing the "dependency" of corporate activities on nature to create connecting points between "nature and biodiversity" and "business and finance". Specifically, the SBTN, established in 2019 published "Science-Based Targets for Nature: Initial Guidance for Business (2020)", and the Taskforce on Nature-related Financial Disclosures (TNFD) was established in 2021. Further in 2020, the WEF published its "New Nature Economy Report", which conveyed the message that $44 trillion out of the global GDP depends on ecosystem services, raising awareness of private sector stakeholders in the nature-business relationship and the sustainability of ecosystem services. Furthermore, even at the government level, the G7 nations also announced the "2030 Nature Pact" at the G7 Summit held in Cornwall, UK in June 2021, calling for the transition to a nature-positive economy.
- In the course of these concerted movements, through the collaboration among governments, science, academia, and the private sector, the GBF was adopted at COP15 in 2022. Under this Framework, a certain common field was built to involve not only countries, but also businesses and financial communities. The GBF's 2030 mission is "to take urgent action to halt and reverse biodiversity loss to put nature on a path to recovery for the benefit of people and planet", reaffirming the urgent global need to reverse the trend of nature loss. It is also encouraged that member countries to develop National Biodiversity Strategy and Action Plan (NBSAP) and promote their efforts to fulfill this mission. Among the 23 GBF targets, Target 15 calls for "progressively reducing negative impacts on biodiversity, increasing positive impacts, reducing biodiversity-related risks to business and financial institutions through assessment and disclosure", and Target 19 calls for "mobilizing $200 billion annually from various sources".
- In summary, in the period after the adoption of the GBF in 2022, companies are required to disclose nature-related information, and financial institutions and investors are highly expected to use this information to support business activities that restore nature with the power of finance. In this respect, it cannot be denied that the movement of nature restoration is a little behind the curve compared to the climate change issue, but we are now in a situation where a full-scale movement involving the private sector is expected. However, due to the high complexity of nature-related impacts in information disclosure, it is unlikely that the involvement of the private sector and the flow of new funds be realized until the issues of "what indicators to use and how to present them" are resolved, even to a certain degree. In the next section, we will present our recognition of key issues and the direction of solutions.

International Trends in Nature and Biodiversity (1/2)

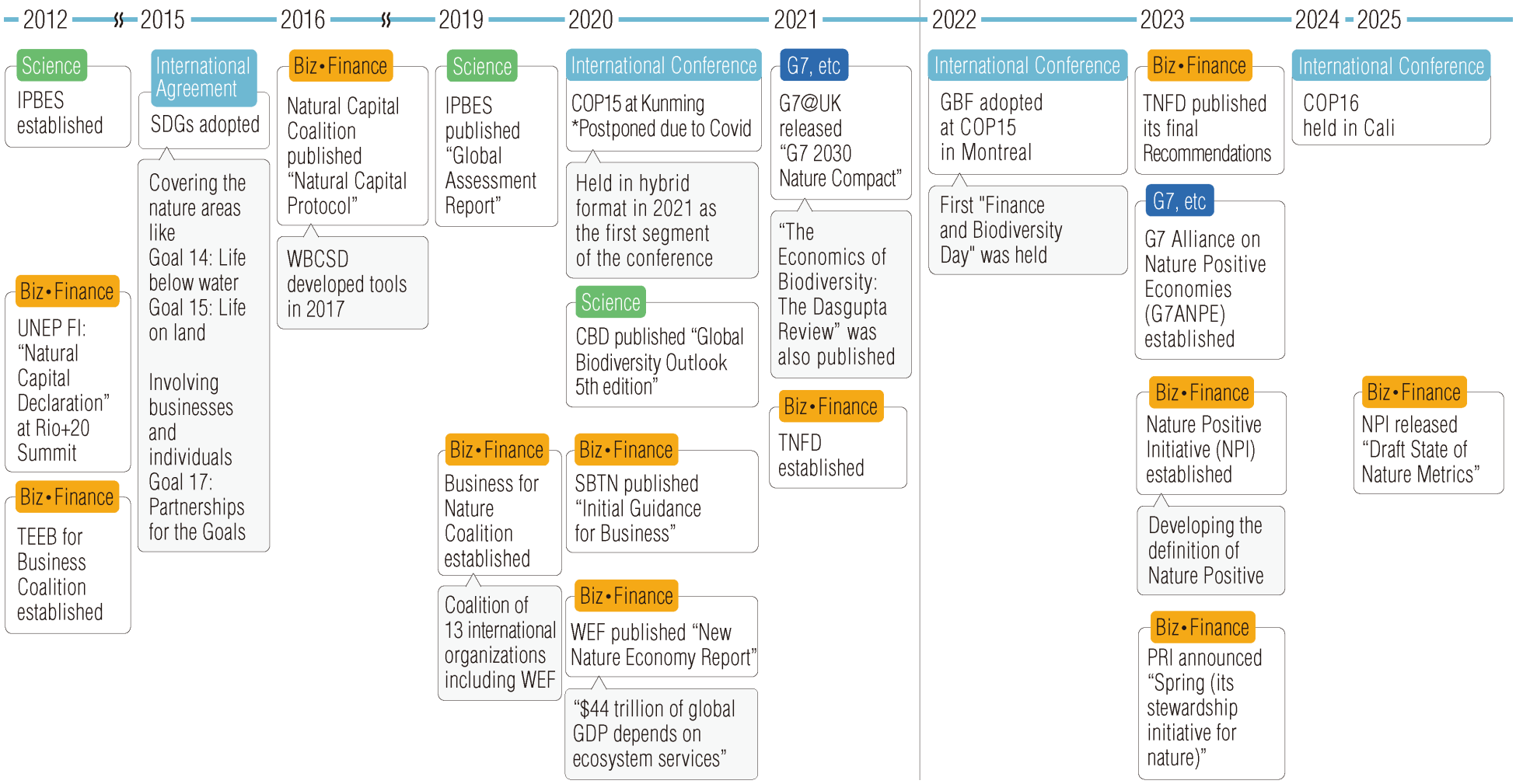


1 .SRC=Stockholm Resilience Center

International Trends in Nature and Biodiversity (2/2)

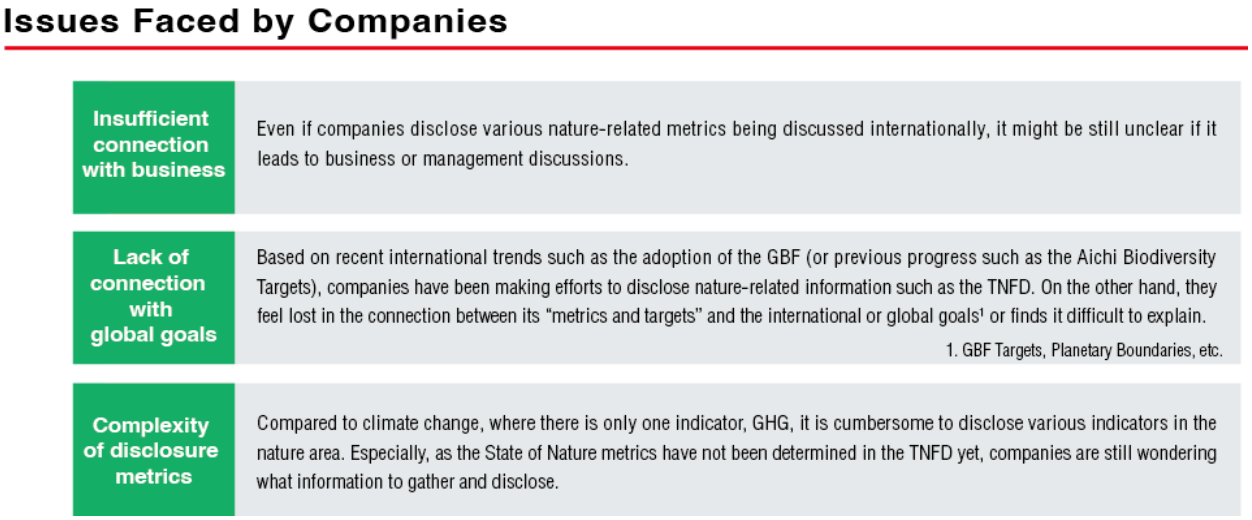
Period of the Aichi Biodiversity Targets
(The launch of various private sector initiatives triggered by international organizations and governments)

Period of the GBF
(Dawn of business and finance involvement)



2-2. Our perspective on corporate challenges and solution hypothesis

- Since the adoption of the GBF, various efforts have been underway in the private sector in each area, with a focus on information disclosure. In terms of the TNFD, more than 600 companies worldwide have announced their commitment (as of July 2025), including 184 in Japan, 110 in the EU, and 76 in the United Kingdom. In the context of the TNFD, companies are required to understand their own "dependency" and "impact" on nature through LEAP analysis or other means, and to collect and analyze various information to identify nature-related "risks" and "opportunities".
- However, this private sector movement has only just begun, and many companies appear to be struggling and hesitant in the face of the complexity of information. Specifically, the figure below shows the issues and concerns that companies likely facing.



- First, there is a "Insufficient connection with business". From a company's perspective, the most significant remaining issue is whether there are any business benefits. If additional effort is made to collect and analyze information about the State of Nature, it is natural to want to be able to "use these figures to tell a story that represent the characteristics of my business in a way that is useful to internal and external stakeholders", and to "use that information to strengthen the competitiveness of my business and create new nature-related businesses". Even if information such as the number of species, forest area, and the number of trees and their species and numbers is collected and disclosed, it can be assumed that it will improve only the image from a CSR perspective, but companies may find it difficult to imagine that it will be possible to develop a discussion that leads to business.
- Secondly, there is "Lack of connection with global goals". As emphasized in the LEAP analysis in the TNFD, nature is more important to understand and analyze the situation on a location basis compared to climate change. Nevertheless, in order to achieve major international economic and financial flows (i.e., mainstreaming biodiversity, achieving a nature-positive economy), it is essential to make decisions and take action while understanding the relationship with global goals.
- In this regard, we considered it would be useful if we could clarify the relationship between the "indicators and targets of Biosphere Integrity" set out by the Stockholm Resilience Centre in its Planetary Boundaries and the indicators and targets disclosed by companies. Although it may appear challenging to put this into practice, we have proposed a possible solution (see Chapter 3 for detail).

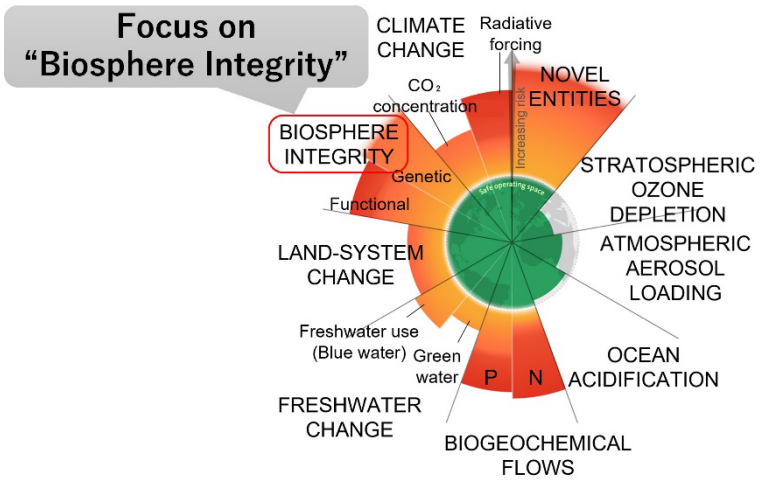
- Third, there is "Complexity of disclosure indicators". When we look into the reasons why many companies are still clueless about what information to collect and disclose about nature, we believe that it comes down to the "complexity of indicators". This is because, whereas climate change has only one indicator (GHG) to be controlled, the diversity of nature and living organisms means that there are numerous and interrelated indicators, and it has been taking time to set indicators that can be incorporated into an international consensus on actions to be taken.
- In fact, although the TNFD sets out lots of specific recommended disclosure indicators, the "State of Nature" metric has not yet been determined (treated as a placeholder). In such circumstances, it can be difficult for companies to gather relevant information, or some might be at a loss. Of course, as the NPI has proposed some "State of Nature" metric and is conducting pilot projects with various firms, it is expected that significant progress will be made in this area in the near future. However, even in such a situation, we would like to contribute to companies' nature-related efforts, including information disclosure, by presenting indicators for ecosystems and species in a manner that is consistent with and complementary to the NPI's initiatives in an overall direction.
- As described above, while international discussions are steadily progressing, there is still no established, integrated, and concrete interpretation of how much corporate efforts are contributing to the restoration of nature, or what and how far we should do to restore the environment to a state where humans can safely live. With this understanding of the issues, we would like to propose "NPP (Net Primary Production)" and "HANPP (Human Appropriation of Net Primary Production)" as indicators for measuring the quality of ecosystems (particularly terrestrial ecosystems), which could be a solution to those issues. NPP is carbohydrates (glucose, etc.) produced by plants through photosynthesis, as explained in previous column of this chapter, and HANPP indicates the amount of NPP used by humans.
- There are several benefits for companies to disclose the information.
  First, for example, the concrete information about "forests" alone tends to narrow the scope of ideas in relation to business, but by introducing the abstract concept like NPP (and its change), it is possible to broaden the scope of ideas and collaboration on topics such as the creation of business opportunities related to natural capital and ecosystem services and the risk management related to nature. In addition, the ideas that emerge from this process can be used to create a unique story that effectively expresses the characteristics of each company (refer to Chapters 4 and the case studies in Chapter 6 for more details).
- Second, it allows us to grasp the relationship between global goals and corporate activities. In the Planetary Boundaries, HANPP (the amount of NPP used by humans) is used as an indicator to measure the anthropogenic impact on the sustainability of ecosystem services, and its global-level target value is provided. In relation to the global goal, the effectiveness of the company's HANPP reduction efforts can be assessed (refer to Chapters 3 and 4).
- Finally, as will be described later, NPP calculations are highly practical in that they can be carried out with relatively low cost and effort if information on the location and area of the forest is known.
- Over the past year, we have been exploring key ideas and ways of balancing "scientific legitimacy" and "practical flexibility". We believe that this Approach will help resolve the aforementioned issues for companies and we hope that the contents of this Approach will serve as a catalyst for the expansion of companies' nature-related initiatives in a variety of ways.

3 Solution for “Indicators and Targets” for nature restoration Attempt to apply the Planetary Boundaries concept into practice

- As we have seen in the previous chapters, based on the historical background that "only with a foundation of scientific knowledge it is possible to involve various actors", we have utilized the concept of the Planetary Boundaries to organize a method that is as simple as possible to understand the entire process of nature restoration. We believe this Approach can overcome such issues as “diversity and complexity of indicators” and “lack of connection with global goals”. In a nutshell, this is an attempt to "rethink nature restoration efforts based on the Planetary Boundaries".

3-1. What are the Planetary Boundaries (PB)?

- First of all, what are the Planetary Boundaries?
- The Planetary Boundaries (PB) is a theory proposed by Johan Rockström of the Stockholm Resilience Centre and 28 internationally renowned researchers in 2009 to raise public awareness of the critical situation of the global environment. Since its publication, it has been used as a scientific foundation in various international settings. Regarding climate change, it has also been adopted by the IPCC and served as the basis for the Paris Agreement. In the field of biodiversity, it is also a concept that is consistent with the GBF (e.g., Vision 2050), being addressed in the IPBES Global Assessment Report. Additionally, in the "Metrics and Targets" section of the TNFD recommendations, alongside the GBF, the Paris Agreement, and the SDGs, the Planetary Boundaries is listed as one of the examples of global targets that companies are encouraged to provide explanations in connection with their own goals.
- Specifically, it identifies nine planetary boundaries (the Earth's limits) within which humanity can continue to develop and enjoy well-being in the future, with each boundary value quantified. The nice planetary boundaries are: 1) Climate Change, 2) Biosphere Integrity, 3) Land-System Change, 4) Freshwater Change, 5) Biogeochemical Flows, 6) Ocean Acidification, 7) Atmospheric Aerosol Loading, 8) Stratospheric Ozone Depletion, and 9) Novel Entities. It is believed that exceeding these limits could result in large-scale, abrupt or irreversible environmental changes, with serious consequences for humanity.
- According to the 2023 update, six of the nine boundaries have been transgressed and the pressure is increasing on all boundary processes except ozone depletion. In the next section, we will focus on Biosphere Integrity.



(Source: “Planetary Boundaries”, Stockholm Resilience Centre (Prepared by the company based on the source))

3-2. The state of "Biosphere Integrity" within the PB

- Among the nine planetary boundaries, the one related to nature is "Biosphere Integrity". Furthermore, among the six boundaries already transgressed, Biosphere Integrity is considered to be one of the most important boundaries, along with climate change, and thus requires urgent action.
- "Human Appropriation of global terrestrial Net Primary Production(=HANPP)" and "Species extinction rate" are set as indicators to assess Biosphere Integrity. Below, we will look at the damage situation and the limit level (=boundary value) for HANPP and Species extinction rate respectively.

Relevance to Global Goals: Planetary Boundaries (PB) "Biosphere Integrity"

Employ "HANPP" as an indicator for ecosystems' quality and "Extinctions per million species-years" as an indicator for species. With these scientifically legitimate indicators, investors can link financing decisions toward corporates with global goals.

Two Aspects of the "Biosphere"	Indicators	Target Value (PB value)	Past results: Preindustrial Holocene base value	Past results: 2020
Functional (=Ecosystem)	・HANPP[2] = Amount of NPP used by humans →The residual from the overall NPP is energy available to ecosystems	・5.6 billion tonnes = less than 10% of the preindustrial Holocene century-mean NPP	・1.1 billion tonnes = 1.9% of the preindustrial Holocene century-mean NPP	・16.8 billion tonnes = 30% of the preindustrial Holocene century-mean NPP
Genetic (=Species)	・Extinctions per million species-years ※Expressed as E/MSY[1]	・<10 E/MSY	・1 E/MSY	・>100 E/MSY ※Conservative estimate. Ranges from 100~1,000 E/MSY, depending on studies.

1.E/MSY=Extinctions per Million Species-Years 2. HANPP=Human Appropriation of global terrestrial Net Primary Production,

(Source: Earth beyond six of nine planetary boundaries | Science Advances)

<Human Appropriation of global terrestrial Net Primary Production (HANPP)>

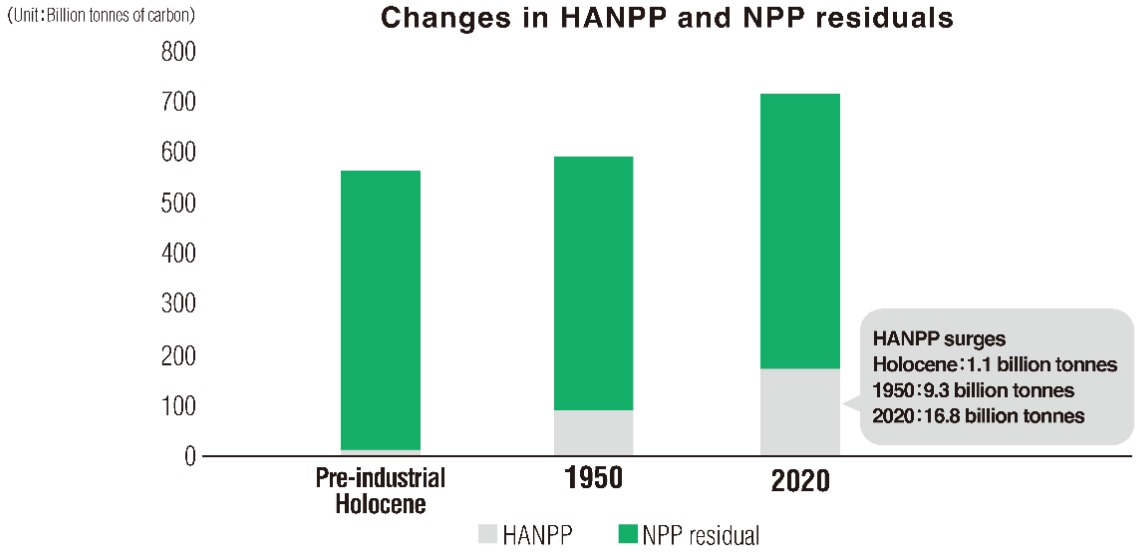
- In analyzing the indicator, "Human Appropriation of global terrestrial Net Primary Production (HANPP)", it is necessary to understand the NPP produced by plants beforehand.
- As explained in the column after Chapter 1, plants perform photosynthesis using inputs of light (sunlight), carbon dioxide, and water, and convert the absorbed carbon dioxide into glucose etc. These carbohydrates, expressed in terms of carbon, is the amount of energy produced by plants and is called "Gross Primary Production (GPP)". Since plants consumer energy through their respiration to metabolize and grow, the consumed amount is subtracted from GPP, resulting in "Net Primary Production (NPP)".
- NPP is described in parallel with carbon sequestration as the most fundamental function of ecosystems in the IPBES "Global Assessment Report (2019)". In the "United Nations Millennium Ecosystem Assessment (2006)", Primary Production is also positioned as one of the "Supporting Services" among the four categories of ecosystem services, which is a concept and indicator that represents a fundamental function of ecosystems. Thus, there is

legitimacy and utility in examining the impact related to nature restoration based on the concept of NPP, which is frequently cited in the scientific community.

- HANPP is also a paired concept with NPP and is an indicator of how much of the NPP produced by land plants (forests, etc.) is used by humans (in addition to harvesting or consumption/use of agricultural and forestry products, it includes land use changes by other economic and social activities). If the ratio of human use is too high, the energy available for other living things will be reduced, resulting in a decrease in the number of species and ultimately, a negative impact on the sustainability of various ecosystem services.
- The relationship between NPP and HANPP as well as their changes are shown in the chart below. The graphs show NPP and HANPP in the pre-industrial Holocene as the base value, and changes between 1950 and 2020. Specifically, the annual average NPP and HANPP in the pre-industrial Holocene period were estimated to be 55.9 billion tonnes and 1.1 billion tonnes, respectively (with HANPP accounting for 1.9% of the total). Since then, with population growth and economic development, HANPP had increased to 9.3 billion tonnes in 1950 and 16.8 billion tonnes in 2020[8,9].
- The target value for HANPP is indicated as 5.6 billion tonnes in the 2023 Planetary Boundaries update assessment. This is set as 10% of the average annual NPP of 55.9 billion tonnes in the pre-industrial Holocene period. It is implied that this level is similar to the one in the second half of the 19th century (shortly before 1900). As the HANPP in 2020 was 16.8 billion tonnes, or equivalent to 30% of the average annual NPP in the pre-industrial Holocene base value, it has already exceeded the boundary value.

HANPP＝Human Appropriation of NPP

HANPP increased from an average of 1.1 billion tonnes in the pre-industrial Holocene to 16.8 billion tonnes in 2020; the 2020 level is 30% of the average NPP volume in the pre-industrial Holocene value of 55.9 billion tonnes (reference: HANPP in Holocene is 1.9%)



Source: Earth beyond six of nine planetary boundaries | Science Advances., Numerical values for 1950 estimated by ERM alongside Global human appropriation of net primary production doubled in the 20th century - PMC (nih.gov)

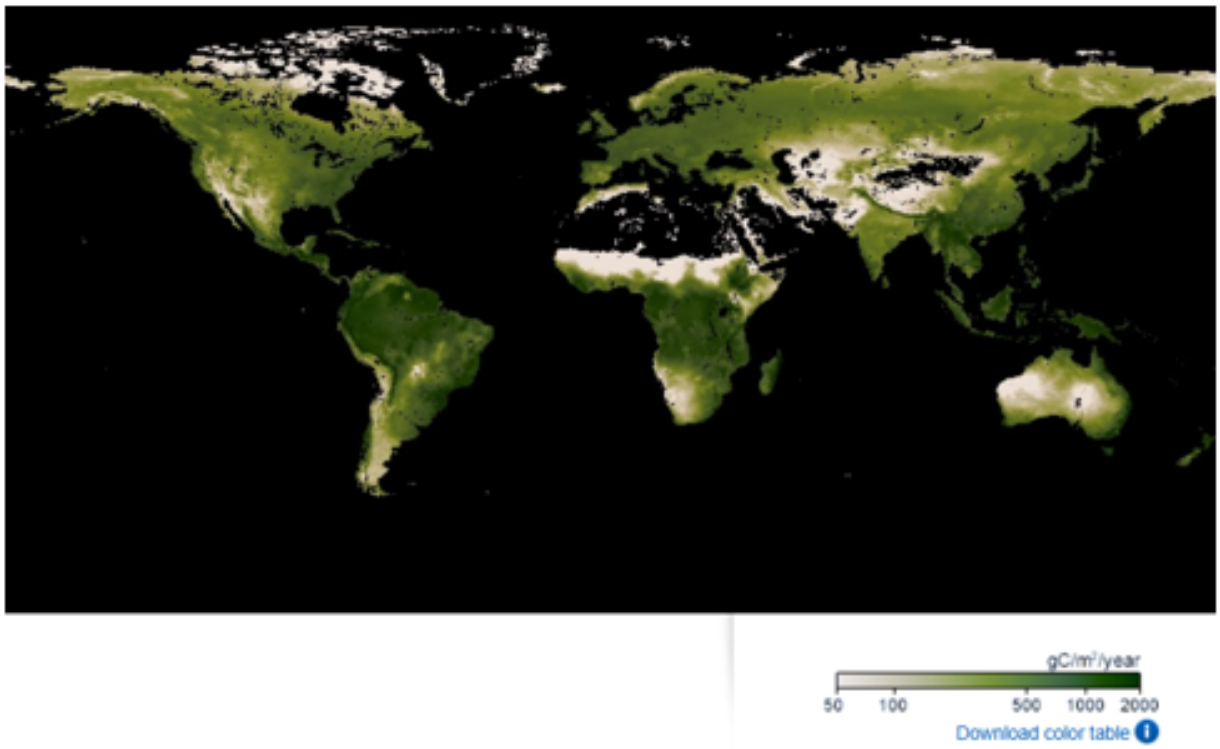
- The background and reasons for the growth in NPP from 1950 to 2020 as shown in the chart above, despite the decrease in forests caused by human use, are mainly explained by the

[8] Earth beyond six of nine planetary boundaries | Science Advances
[9] Global human appropriation of net primary production doubled in the 20th century - PMC

acceleration of plant photosynthesis due to increasing atmospheric CO_2 and rising temperatures (so-called "CO_2 fertilization").

- However, the increase in NPP due to "CO_2 fertilization" is expected to decrease in the future. Specifically, the global trend toward decarbonization is expected to lead to large-scale CO_2 emission reduction and atmospheric CO_2 removal. CO2 emission reductions and atmospheric CO2 absorption and removal are expected to progress in the context of global decarbonization. In addition, as has already been noticeable in recent years, the effect of forest burning due to the increased frequency of wildfire outbreaks, which could lead to the reduction of potential NPP, is expected to be non-negligible.
- Lastly, we would like to visually capture the distribution of NPP on Earth. As shown in the figure below, the geographical distribution of NPP is published by NASA, and the density of green on the map corresponds to the amount of NPP. In terms of the amount of NPP, the importance of the regions such as South America (Brazil, etc.), Southeast Asia, and sub-Saharan Africa can be clearly seen. This is the reason why it is widely said that "in the perspective of preserving biodiversity, it is important to protect the tropical rainforests of the Amazon and Southeast Asia from development".

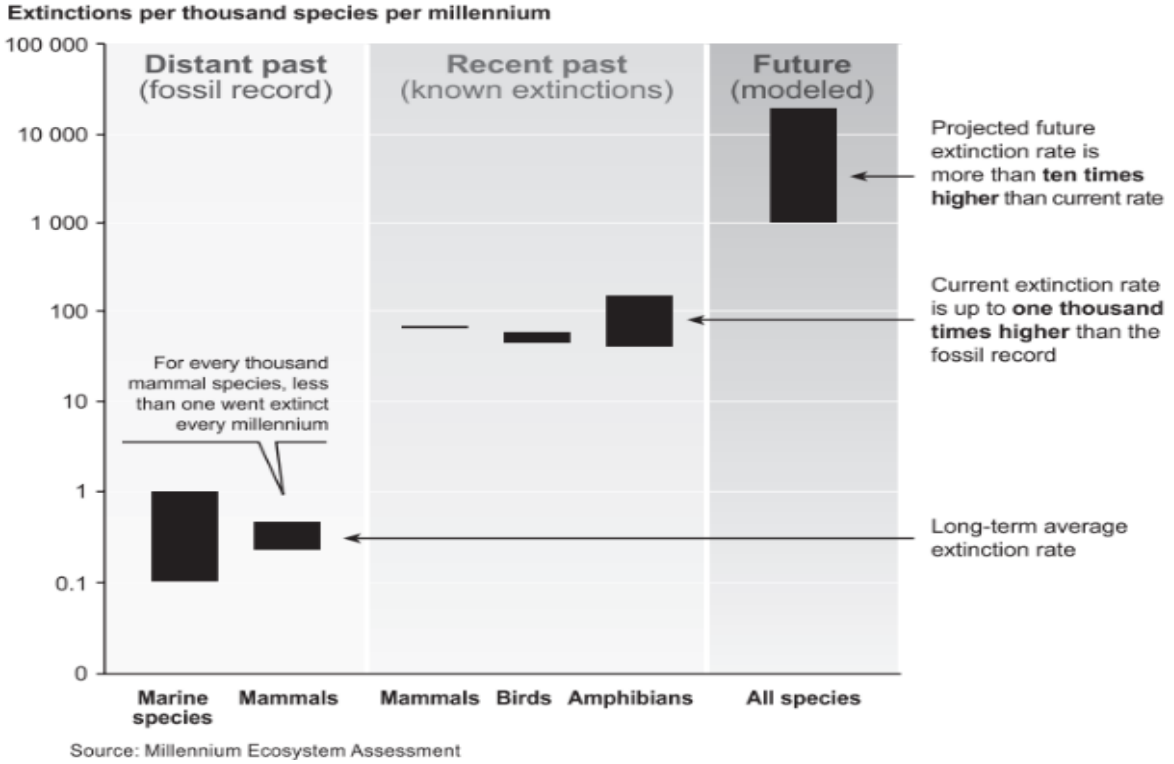
Net Primary Production Mapping by NASA



(Source: https://neo.gsfc.nasa.gov/view.php?datasetId=MOD17A3H_Y_NP)

<Species extinction rate>

- To understand the "Species extinction rate" presented by the Planetary Boundaries, it is necessary to consider the baseline extinction rate into account. Based on calculations inferred from fossils, it is believed that each species existed on Earth for an average of one million years in the absence of human influence. In terms of extinction rate per year, the probability of one particular species becoming extinct is 1 in 1 million, which means that if there were 1 million species on Earth, they would go extinct at a rate of one species per year. Based on this idea, Planetary Boundaries uses the indicator called "Extinctions per million species-years (E/MSY)[10]".
- The Planetary Boundaries set the boundary value for "Species extinction rate" at < 10 E/MSY (less than 10 species becoming extinct per year out of 1 million species). The number of species on Earth is estimated to range from as 2 million to 8 million depending on the surveys and studies, and the corresponding boundary values are less than 20 and 80 species that become extinct in a year, respectively.
- In contrast to such a target level, the 2023 Planetary Boundaries update states that "the current situation (as of 2020) is conservatively above 100 E/MSY". This number is consistent with the analysis in the United Nations Millennium Ecosystem Assessment published in 2006, as shown in the figure below. The analysis at that time projected that the estimates were approximately 100 E/MSY when considering mammals, birds, and amphibians, and over 1,000 E/MSY when considering all species (including insects and other invertebrates, plants, fungi and protists) in the future[11].
- These figures indicate a serious situation where expanding human economic and social activities are accelerating the extinction of species. Species declines could lead to a reduction of the biodiversity that is inherent to the Earth, and an imbalance in natural capital and ecosystem services, which are based on complex relationships.



[10] Extinction Over Time | Smithsonian National Museum of Natural History
[11] Earth beyond six of nine planetary boundaries | Science Advances

- Species threatened with extinction are compiled by the IUCN in the form of a Red List, which includes names, photographs and brief descriptions. This list is continually being developed and updated from species assessed through the field surveys, but it is not exhaustive of the model estimates described previous page. As of 2025, more than 170,000 species have been assessed (the target is 260,000), and 47,000 endangered species have been identified[12].
- The table below shows the "estimated number of species", the "number of species evaluated by the IUCN", and the "number of threatened species" for each species category. The coverage of the IUCN evaluation has wide variabilities: it is extremely high for vertebrates such as mammals, birds, reptiles, amphibians, and fish, ranging from about 80% to 100%, while it is just 1% for insects and fungi/protists. This may reflect the degree of difficulty in ascertaining the population and survival status of species. This would be helpful as a sense of perspective when measuring the impact of species in the future.
- This IUCN Red List is an important reference when monitoring the impact of corporate activities on species to evaluate endangered species populations and their changes.

Source of number	Item	Vertebrates					Invertebrates		Plants	"Fungi /Protists"	Total
		Mammals	Birds	Reptiles	Amphibians	Fishes	Insects	Others			
Number referring to various papers	Number of species	6,736	11,195	12,386	8,863	37,109	1,003,612	470,955	425,865	162,521	2,139,242
Number of species researched by IUCN	Number of assessed species	6,025	11,195	10,316	8,009	28,866	13,442	15,498	74,751	1,318	169,420
	Number of endangered species	1,363	1,311	1,846	2,873	4,046	2,565	4,105	28,661	417	47,187
	The coverage of the IUCN assessment	89%	100%	83%	90%	78%	1%	3%	18%	1%	8%

[12] IUCN Red List of Threatened Species

3-3. Reexamining corporate activities that interface with nature from the PB perspective

- Given the status of the Planetary Boundaries, we believe it beneficial to capture the relationship between company's efforts and nature restoration using the two indicators: "HANPP (or NPP)" and "species extinction rate". This idea is the cornerstone of the Approach.
- There are the two key approaches to promoting the restoration of nature: (1) reducing HANPP, and (2) increasing NPP and species. For the use of HANPP, it is relevant to companies in diverse sectors that have an interface with forests in its business operation, including supply chains. In addition, HANPP has also a solid footing in relation to international goals like the GBF. Specifically, GBF Target 14 ("Integrate Biodiversity in Decision-Making at Every Level") has HANPP as its complementary indicators alongside CO_2 emission, and water use.[13] Therefore, it is expected that HANPP will be used for business and investment decisions by companies in a wide range of sectors.
- As pointed out in Chapter 2, "Insufficient connection with business" is one of the issues faced by companies. By shedding light on the importance of HANPP reduction through efficient use of resources (e.g., natural capital such as lands, minerals, water, forests), we believe it will drive discussions about the creation of new business or the reform of existing business that contributes to a nature-positive future across companies, financial institutions, and investors.
- Furthermore, the use of HANPP is beneficial for companies as it solves another issue of "Lack of connection with global goals". Considering HANPP of 5.6 billion tonnes per year as the target value defined by the PB, each company can understand how much its HANPP-reducing initiatives contribute to this ultimate goal of putting the Earth back to a safe operating space for humanity.
- Next, we elaborate our thoughts on increasing NPP and species. Even though the PB does not define a global goal for NPP, it can be considered that increasing NPP is desirable in the general direction as it is energy available to ecosystems and species. In addition, NPP could be useful information added to the area of forest conservation or afforestation in corporate disclosures as it indicates the quality of ecosystems to some extent. So, NPP could solve the issue of "Complexity of disclosure metrics" mentioned in Chapter 2.
- On the other hand, it should be noted that an increase in NPP might not necessarily lead to ecosystem or species diversity. For example, planting eucalyptus trees quickly increases NPP but planting a single species will reduce the degree of diversity. On top of that, such fast-growing trees could also deprive plants in surrounding areas of nutrients, which in turn reduces ecosystem diversity (in this case, the eucalyptus trees are considered an invasive alien species). So, we believe NPP increase needs to be accompanied by species increase in order to ensure biodiversity. That is the reason why the impact assessment of this Approach on forest conservation and restoration projects consists of both NPP and species increase (the details explained in Chapter 4).
- There are other benefits of including species in the impact assessment of this Approach. First, it is aligned with the recommendations by the TNFD, the NPI, etc. So, it is expected to be the baseline of market expectations for corporate disclosure in the near future. Another

[13] Target 14

benefit is that the result can be interpreted as a contribution to the global target of below 10 E/MSY (extinctions per million species-years) proposed by the PB.

- As described above, it is useful for business and finance communities to reconstruct their views on the relationship between corporate activities and nature restoration using the PB's concept and indicators. It could effectively address the issues that companies are facing (see Chapter 2). Furthermore, we believe our Approach with the proposed indicators will encourage lots of companies to take urgent actions in a direction to "halt and reverse biodiversity loss" as the GBF 2030 mission illustrates.
- Based on this understanding, in the next chapter, we will explain how to incorporate this Approach into its investment decision-making and operations in more details.

4 Concept of Nippon Life's Nature Finance

- This chapter explains the key concept of our Nature Finance (framework for screening target projects, impact measurement methods, etc.) based on the ideas described in Chapter 3 (especially, 3-3.).
- Through our Nature Finance, we aim to achieve the following:

  ① It can be asserted with certain evidence that corporate business or initiatives aligned to this framework with scientific rationality contribute to the conservation and restoration of nature (especially 'State of Nature' referred to in the TNFD, etc.)".

  ② As mentioned in ①, by clarifying the relationship between various companies' business activities and the conservation and restoration of nature to a certain extent, we will promote activities that contribute to nature restoration in a wide range of sectors.

  ③ On top of ① and ②, we will build a large ecosystem of corporate activities and finance flows toward nature restoration, providing companies with insights for new value of their own businesses and initiatives from nature angles, and inducing financing actions from financial and investors institutions who positively evaluate it.

4-1. Framework for screening target projects

- As shown in the next figure, the framework for selecting projects that leads to the conservation and restoration of nature only covers terrestrial plants (e.g. forest), which is the basis for NPP and biological species, as its subject area. Then, it has the basic structure with two categories: "mitigating and avoiding deforestation", which can be interpreted as "Decrease in HANPP" and "increasing forests", which can be interpreted as "Increase in NPP".
- The reasons why this Approach only covers land among all four realms of nature (land, ocean, freshwater and atmosphere) as its subject area are twofold:
  - Among the many efforts for nature restoration, terrestrial plants (forests, etc.) are considered to be the most powerful leverage point.
  - We have classified ocean, which can be seen as another leverage point alongside land, as the subject area for future studies because it is more difficult to measure impact due to various reasons including the complexity in rights of ocean and fisheries (see Chapter 7).

  Furthermore, freshwater on land (surface water such as rivers and lakes, and groundwater stored in the soil) is covered in the context and scope related to terrestrial plants. In addition, forest enhancement can also lead to freshwater source recharge, so in this sense, there is a positive contribution to the freshwater domain in the current scope.
- As for potentially eligible projects, in the category of "Decrease in HANPP", they are not limited to forestry and forest product-related businesses but can be businesses in various sectors that put a burden on nature including its supply chains. The key examples are:
  - Agriculture and related sectors
  - Sectors involving the exploitation and utilization of natural resources, such as mining
  - Sectors related to urban infrastructure development

  On the other hand, regarding projects for "Increase in NPP", forest conservation and restoration are the main examples. We will explain them in more detail later in this section.

- Regarding a project's impact to be evaluated, in the category of "Decrease in HANPP", we will confirm if the project mitigates or avoids the reduction in NPP that could have been caused by human economic and social activities. On the other hand, since it is difficult to directly observe how much the project (for example, avoiding the expansion of agricultural land that involves deforestation) has avoided declines in numbers and population of species, we treat it out of scope from our impact assessment.
- For the case of "Increase in NPP", we will check an increase in species population in addition to an increase in NPP to ensure an enhanced biodiversity. In terms of species, as you can see the PB sets the " Extinctions per million species-years" as its indicator and target (<10 E/MSY) in Chapter 3 (3-2.), we will conduct an assessment primarily focusing on changes in the population of endangered species. Furthermore, placing emphasis on endangered species in the impact assessment is consistent with the ideas behind the proposed metrics by the TNFD (, which recommends measuring Species extinction risk as a core global disclosure indicator although it is a Placeholder indicator[14]) and the Nature Positive Initiative (, which recommends measuring "Species extinction risk scores and trends" in addition to "Change in the number and proportion of priority species").

[14] Recommendations-of-the-Taskforce-on-Nature-related-Financial-Disclosures

Concept of our Nature Finance

Target Area	Types of Nature Restoration	Projects (Examples)	Perspectives of eligibility assessment: NPP/HANPP	Species	DNSH
Terrestrial Plants (Forest)	Decrease in HANPP	**1 Projects that mitigate or avoid the expansion of agricultural lands and pasture with deforestation** ▶Agriculture or husbandry that efficiently uses lands (e.g. regenerative agriculture) ▶Development of alternatives to agricultural or livestock products (e.g. alternative protein)	Avoided HANPP *Evidences are needed for this claim	N/A *Due to difficulty in observing the avoidance of species decrease	No significant negative impact from the environmental and social perspectives
		2 Projects that mitigate or avoid the development and use of natural resources (minerals, fiber, rubber, water, etc.) with deforestation ▶3R[1] projects or initiatives for relevant natural resources ▶Development of alternatives to natural resources (e.g., synthetic minerals, etc.)			
		3 Projects that mitigate or avoid urban infrastructure development with deforestation ▶Projects that develop high-rise residential buildings in cities that expand into surrounding forested areas ▶Development of alternative infrastructure (e.g., alternative transportation networks to roads utilizing air and sea routes, etc.)			
	Increase in NPP	**1 Forest conservation and reforestation (e.g., afforestation, tree thinning)** ※Covers a wide range of profitable forestry projects[2] that are not limited to public or charitable activities	Increased NPP	+ Increased population of target species *Put a focus on endangered species	

If a project results in even a small decrease in HANPP, or a small increase both in NPP and species populations, it will qualify for our Nature Finance.

1. 3R= Reduce, Reuse and Recycle, 2. Wood and pulp, carbon credits, beverages from water sources recharged by forests, real estate with natural landscapes, nature-related recreational services ,etc.

Potentially eligible projects related to "reducing HANPP"

- In general, we consider projects with HANPP reduction to be those involving business operations that will avoid new deforestation as much as possible, while facing the reality that a certain amount of land development entailing in the past were unavoidable to produce and supply goods that meet people's daily needs. Broadly, we believe there are three types as shown in the previous figure ①~③.

- Regarding ① "Projects that mitigate or avoid the expansion of agricultural lands and pasture with deforestation", in addition to agriculture and husbandry sectors, the activities of companies along related value chains are covered. Since they are sectors that could cause deforestation in the form of agricultural and grazing land expansion, potentially eligible projects are required to avoid such situations. For one, there may be a project with an operation to increase productivity per unit area of existing farmland or pastureland to meet people's demand while avoiding the expansion of new agricultural land. For example, with regard to the palm oil production, there are lots of attempts by small and micro farmers with low productivity to secure higher yields by expanding new farmland, which will result in deforestation. So, by increasing the productivity of these small-scale farmers in a sustainable manner complementing key know-how, it is possible to mitigate and prevent deforestation.

- Other businesses related to ① include the development and production of alternatives to agricultural and livestock products. Here are some examples: a business that manufactures alternative proteins in factories without using agricultural land, or a business that develops alternative materials to palm oil.

- As for ② "Projects that mitigate or avoid the development and use of natural resources (minerals, fiber, rubber, water, etc.) with deforestation", corporate businesses that lie in value chains of developing and utilizing natural resources (minerals, fiber, rubber, water, etc.) are covered. Sectors could range from mining, textile and apparel, and tire manufacturing to water-intensive businesses (e.g., semiconductors, data centers, green hydrogen production, etc.). For example, if land alteration due to mining development causes deforestation, it is important to promote efforts to avoid additional mining development as much as possible through more efficient use of mineral resources. A business activity that recovers and recycles gold, rare metals, etc. from discarded electronic devices and batteries is one of such examples. A project with the production of alternative minerals (e.g., synthetic diamonds, etc.) would be another example.

- Finally, in regard to ③ "Projects that mitigate or avoid urban infrastructure development with deforestation", construction and real estate development, etc. are covered. Suppose the need for housing supply increases in a city with a rapidly growing population. If residential land development could potentially expand into surrounding forest areas, a real estate developer might be able to mitigate or avoid deforestation by promoting development projects of high-rise housing complexes (≒as part of measures to effectively utilize limited land, increasing the number of residences per unit area). In this context, as those projects can be interpreted to contribute not only to the effective use of land but also to the reduction of HANPP, they could be eligible projects under this Approach.

- Other examples for the type of ③ include the development of alternative infrastructure (e.g. drones and "flying cars" used for creating an alternative transportation network to roads by utilizing air routes).

Potentially eligible projects related to "increasing NPP"

- Activities to increase NPP corresponds to forest conservation and reforestation projects as shown in ④ in the previous figure. Those projects are expected to increase species as well as NPP through the growth of trees, in terms of both number (the number of trees) and quality (e.g., size, types), in the subject areas. Details of impact measurement and evaluation methods will be explained in 4-3. and 4-4.
- In terms of the businesses that are potentially eligible for our Nature Finance, we assume a variety of forestry projects run by private companies, rather than purely public sector forest conservation and restoration projects, such as the following:
    - Projects that generate business revenues by putting economic value on forests' ecosystem services (including associated water sources).
        - Provisioning services: the supply and sale of wood and pulp, etc.
        - Regulating services: the creation and sale of carbon credits, the supply and sale of beverages using water sources recharged by forests
        - Cultural services: the supply and sales of real estate with natural scenery, the provision of nature-related tourism and recreational services
    - Afforestation and forest conservation (e.g., thinning) projects as part of giving back earned profits to society.
- For your reference, some of the projects listed here (in the types ①～④) are further described as case studies in Chapter 6.

4-2. Approach to eligibility assessment

- This section explains how to evaluate the "eligibility" of projects that contribute to the restoration of nature.
- As mentioned in 4-1., for projects in the category of “Decrease in HANPP”, the amount of avoided NPP reduction will be evaluated. However, it is necessary to have a certain evidence or logic that the avoidance of a decrease in NPP has been realized by the project. In other words, it is highly important that there was reasonable evidence to believe that deforestation would have been inevitable “without” this project. We believe this point must be explained by a candidate company to receive the Nature Finance, providing appropriate information.
- On the other hand, regarding forest-related projects in the category of “Increase in NPP”, for projects to be eligible, they need to achieve both 1) an increase in NPP, and 2) an increase in the population of species, especially endangered species (species abundance and species richness).
- So, how much of the contribution in HANPP, NPP, and species population is required for a project to be evaluated as eligible? Ideally, it would be determined by a backcasting from the global goals: when the world needs to bring the Earth back within the Planetary Boundaries, how much of the breakdown will be allocated to each country and sector, how fast each company needs to move forward relevant initiatives, and what level of contribution each business or project is required to make. In that sense, although the GBF adopted the goals of halting and reversing biodiversity loss to put nature on a path to restore by 2030 and living in harmony with nature by 2050, a breakdown of targets with timelines for each country and sector has not yet been determined internationally.
- In this background and context, we have decided that a project will qualify for our Nature Finance if it results in even a small decrease in HANPP, or a small increase both in NPP and species populations, which implies getting closer to the targets set by the PB illustrated in Chapter 3. For example, in the case of “Decrease in HANPP”, a project that contributes to reducing annual HANPP even by a small amount to 5.6 billion tonnes, which is 10% of the average annual NPP of 55.9 billion tonnes in the Holocene period, will be eligible. Furthermore, as for the case of “Increase in NPP”, a project that increases NPP of any amount will be eligible while the PB has neither its target value nor upper limit for NPP.
- In addition, with regard to an increase in species (or the prevention of a decline in the number of endangered species), a project that contributes to getting closer to the PB’s threshold of <10 E/MSY (less than 10 species become extinct annually out of 1 million species) will be eligible. Specifically, it is the case in which an increase in the population of endangered species through the project is confirmed or estimated.
- However, while positive effects on “State of Nature” such as “HANPP reduction”, “NPP increase”, and “species increase (e.g., the population growth of endangered species)”, are the basis for eligibility assessment, these criteria alone are not sufficient. The concept of “Do No Significant Harm (DNSH)”, which means that the project activity does not have a significant negative impact on nature in general, is also applied. Mainly, it will be checked based on the framework of “Land/freshwater/ ocean-use change”, “Pollution”, “Resource use”, “Climate change”, and “Invasive alien species” as described in “Drivers of Nature Change” in the TNFD and “Pressures on Nature” in the SBTN.

- For specific example, even in the case of reforestation that leads to an increase in NPP, as the use of non-native tree species (e.g., eucalyptus), which are different from local tree species, may have a negative impact on the local ecosystem and biodiversity, a prior evaluation is required (this is a scrutiny from the angle of "Invasive alien species"). From the perspective of "Pollution", for a project of recycling minerals from electronic devices, it is also necessary to confirm whether there is no pollution due to chemical leakage from e-waste. In another case of an urban high-rise housing development project, we need to check whether serious problems such as soil contamination and water pollution are not caused by inadequate management of wastewater and waste from the project.
- The DNSH principle in this Approach also includes social aspects. Therefore, in making investment decisions, it is also necessary to confirm that the project does not have a significant adverse impact on indigenous peoples and local communities (IPLCs).
- Among the projects that satisfy the above-mentioned criteria of "Decrease in HANPP", "Increase in NPP", "Increase in species (endangered species)", and "DNSH principles", we will select eligible projects to be funded by our Nature Finance, considering our own priorities and the limit of our funding amount. In addition, we would like to review the eligibility criteria if the breakdown of the global targets into individual countries and sectors is determined and agreed internationally at COP, etc.
- In the following sections, we will elaborate impact measurement methods for NPP and species as questions will arise to lots of readers in conducting the eligibility assessment described above.

4-3. Impact measurement: HANPP and NPP

- The increase in NPP and the reduction in HANPP can be estimated using the formula "Change in forest area" x "NPP per unit area". This might be similar to the GHG emissions calculation in the sense that the "amount of activity" is multiplied by a "specific factor" (In the case of GHG, the emission factor corresponding to the amount of activity specific to each project or initiative is multiplied.)
- The amount of change in forest area is identified using surveying and aerial/satellite photos. On the other hand, the NPP per unit area (expressed in terms of carbon weight) will vary depending on the surrounding environment, including tree species, tree growth conditions, temperature and humidity. Here, we present a measurement and calculation method that utilizes the NPP dataset, which is freely available from NASA, as a method that is relatively easy to implement in practice.
- NASA calculates NPP over land areas worldwide through satellite imagery and releases the data annually (500m x 500m mesh resolution)[15]. NASA also has land cover data that can be used to distinguish between forests, grasslands, cultivated land, and urban areas[16]. For example, forests can be classified into five categories: Evergreen Broadleaf Forest, Evergreen Needleleaf Forest, Deciduous Broadleaf Forest, Deciduous Needleleaf Forest, and Mixed Forest. This NPP data and land cover data are used along with geographic information system (GIS) software to calculate NPP per unit area in the target area of an investment project.

Measurement of NPP increase

- First, determine NPP per unit area based on the vegetation of a project site. For example, in Indonesia, the trees are mainly evergreen broadleaf, which produce approximately 1,100 tonnes C/km^2 of NPP per year.
- The amount of NPP increased due to a project may not be calculable depending on the characteristics and limitations of NASA's data. For example, if the baseline is a vacant plot (e.g., abandoned agricultural land) and the project is to plant new trees on it, NASA satellite data can capture the amount of change over time. On the other hand, if the baseline is already a forest land and the project aims to increase NPP through forest management such as thinning, satellite data alone may not be sufficient. In such cases, changes in NPP should be separately measured by other methods based on the details of individual projects (e.g., sampling specific plots of forest and extending estimate based on tree species, tree size, etc. in the sample plots).
- In addition, if the target area for which NPP is to be measured is smaller than 500m x 500m (= 250,000m^2 = 0.25km^2 = 25ha), is not possible to measure NPP directly for the target area itself. In such cases, it is necessary to find a way to estimate NPP by calculating the average NPP per unit of forests in similar regions and multiplying it by the area for the subject project.
- For example, our "Nissay Green Foundation" promotes the "Nissay Forests" project, which conducts afforestation and forest conservation activities. As of October 2024, the average area per site of the 209 sites it owns nationwide, covering approximately 480 ha (based on contracted area), is just 2 ha, which is smaller than one square of NASA's NPP data. Therefore, when we calculated the NPP generated by the "Nissay Forests" project, we took an adjusted approach.

[15] https://neo.gsfc.nasa.gov/view.php?datasetId=MOD17A3H_Y_NPP
[16] Land Cover Classification (1 year) | NASA

- Specifically, we calculated NPP per unit area of each prefecture, incorporating information on its land cover of forests (evergreen broadleaf forest, evergreen needleleaf forest, deciduous broadleaf forest, deciduous needleleaf forest, and mixed forest, etc.), and applied it to the area information of each "Nissay Forests" project. As a result, we found out that the 480 ha of forest produced approximately 4,000 tonnes of NPP per year (about 1/50,000 of the total NPP produced in Japan), supporting local ecosystems.

Measurement of HANPP reduction

- Next, we discuss how to measure HANPP reduction.
- The key to HANPP reduction is to estimate the hypothetical anthropogenic reduction in forest area that would have occurred in the absence of the target project (operational transformation, new business development, etc.). If specific planning information of agricultural land expansion, mining development, urban development, etc. that entails deforestation is available, it should be used.
- On the other hand, without such specific planning information, if it is possible to roughly estimate the area where deforestation would have occurred due to conventional "Business-as-usual" practices, we will use that value. For example, even if it is difficult to determine specific locations of farmland cleared by thousands of the small-scale oil palm farmers in Indonesia, in the case when it is evident that forests in somewhere Indonesia would have been cleared for new agricultural land development "without" the project funded by the Nature Finance, the area of potential deforestation can be estimated.
- Based on this decrease in forest area that would have hypothetically occurred, you can estimate the amount of HANPP avoided or reduced by multiplying by the NPP per unit area. Using the previous example, NPP per unit area in Indonesia is about 1,100 ton/km^2 per year. If 1km^2 of deforestation associated with the expansion of agricultural land for oil palm production has been prevented, 1 km^2 x 1,100 ton/km^2 = 1,100 tonnes of HANPP is considered to have been prevented.
- Please refer to the case studies in Chapter 6, where the measurement for NPP and HANPP described above is illustrated with some specific figures.

4-4. Impact measurement: Species

- The basic method for measuring the impact on species is field surveys of flora and fauna. Specifically, the number of species and populations of inhabiting and endangered species will be recorded and changes over the survey period will be evaluated. In particular, from the perspective of positive contribution, we will confirm that the population of endangered species will increase, and from the perspective of DNSH, we will confirm that the number of invasive alien species and their populations will not increase due to a project funded.
- When making investment and decisions based on this Approach, it is needed to confirm the baseline and future forecast. For the baseline, species to be selected for field surveys are generally taxa that are easy to survey, such as birds, mammals, and amphibians. Among them, major species will be selected based on ecological characteristics of the project location and the feasibility of the field surveys (it is assumed that the investee company or fund will select the species in consultation with a local biological research company).
- There are no specifications regarding the number of species to be targeted, but rather it is expected to be determined by considering the survey method, man-hours and costs, and expected results (e.g., representativeness of the species selected as the sample). For example, one method could be using only one umbrella species that is representative of the ecological pyramid of the area. However, at least one endangered species needs to be included because it is necessary to determine the population trend of endangered species (i.e., whether the risk of extinction is decreasing or not).
- As for projections, it may be difficult to estimate the population of specific species in the future. Even so, as the projects that require the measurement of species are forest conservation and reforestation, we would like to see an estimate of the likelihood of species population growth to some extent, accompanied by the information regarding a forest management plans such as “thinning will promote reforestation and increase species” or "old trees will be periodically cut down and reforested”, which will also increase the number of species. Of course, we think it would be better if investee companies could show us predicted population of species using biodiversity “big data” and etc.
- The frequency of monitoring species should be determined by balancing labor and costs of surveys, while annual monitoring is desirable from an investor's perspective. Since the result of an increase in species population is not immediately apparent, it may be realistic to set the frequency to once in several years.
- For field surveys of flora and fauna, it is recommended that an investee company or fund select a biological survey company that is knowledgeable about the local ecosystem and has experience in conducting surveys for governments, municipalities, and companies. For reference, field surveys of flora and fauna will be conducted as follows.
    - Mammals: use automatic cameras and optional transects because they are wary of people or are nocturnal. Other methods include investigating animal sounds, droppings, footprints, and other traces.
    - Birds: Select and implement the following method as appropriate
        - Line census (setting up a survey route through various environments, recording bird calls, visually confirmed species, and number of birds within 25m (or 50m) on one side of the route, along with the environment)

        - Point census (staying at a fixed point for about 30 minutes, recording bird calls, visually confirmed species, and number of birds, along with the environment), and voluntary surveys
    - To determine whether a species is qualified as endangered, refer to the IUCN Red List and the Red List species listed in each national or regional publication. Similarly, in identifying invasive alien species, reference should be made to the Global Invasive Species Database (GISD) and the species listed in each national or regional publication.

- We described the mainstream measurement methods at present, but other technologies may potentially be utilized as a complementary method if they advance further in the future (e.g., environmental DNA, etc.).
- Based on the research described above, we expect to be able to confirm that the species populations have increased compared to the baseline as a result of the projects funded by Nature Finance. However, the number of living organisms does not necessarily increase linearly or mechanically even if something meaningful is done. Therefore, even if the population of a species does not increase as expected or, conversely, decreases, we, as an investor, do not consider this to be an immediate problem, as long as the implementation of adequate forest management is confirmed, which will presumably lead to an increase in the population in the long run. We believe that it will be important to take a long-term perspective of approximately 10 years to confirm population increase as the ultimate result.
- We would also like to help achieve the ultimate goal of nature restoration, identifying the causes of failure to achieve the expected results despite proper forest management (e.g., deforestation outside the project site, etc.) and encouraging consideration of measures to resolve such problems (e.g., encourage prevention of deforestation outside the site, or purchase and manage that site as well, etc.).

5 Review of this Approach (key benefits, caveats)

- In Chapter 3 and Chapter 4, we explained the basic concept of the Approach and the framework for eligibility assessment of our Nature Finance. Bringing on it, in this chapter aims to address the question, “What are the benefits of this Approach for companies?” We will also discuss key considerations when applying this Approach to investment and financing activities, which contribute to nature restoration and offer advantages to companies.

5-1. Benefits from the application of this Approach

- In Chapter 2, we referred to the challenges faced by companies, including “Insufficient connection with business”, “Lack of connection with global goals”, and "Complexity of disclosure metrics”. Given that this Approach will solve these issues to some extent, one key benefit of this Approach is that it clarifies the “vector (= the direction and distance)” by which each company can identify which of its current and future business contribute to nature restoration.

  This is almost equivalent to creating an internal taxonomy related to nature, and through this, companies can involve many stakeholders in discussion on business transformation, new business development, and resource allocation from the perspective of contributing to nature restoration (or the avoiding of nature destruction).

  In practice, some ideas encouraged during this process may initially seem unrealistic. However, indicators such as NPP and HANPP will serve as a “catalyst for imagination to create new value from nature restoration (e.g., new economic value of ecosystem service functions)”, and we hope to foster forward-looking and constructive discussions. In parallel, this is also expected to broaden and deepen the quality of dialogue between companies and financial/investors institutions.

- Another benefit of this Approach is related to information disclosure.

  Specifically, by using of NPP as a representative indicator for disclosing the “State of Nature”, in particular the quality of ecosystems, companies can disclosure information in a simple and meaningful way. Moreover, through the PB targets (“less than 10 extinctions per million species per year” for species, and “HANPP less than 10% of average Holocene NPP (=less than 5.6 billion tonnes)” for ecosystems), this Approach enables companies to clarify the direction they should take and their contributions towards these goals.

- While impact metrics related to nature restoration have yet to be internationally standardized, our company has proposed NPP and HANPP as impact indicators, respecting approximately 20 to 30 years of scientific knowledge on nature.

  As a life insurance company, we hope that applying NPP, which represents an essential source of “life” energy, in our investment and financing activities will encourage many companies across various sectors to energize economy.

5-2. Caveats on the application of this Approach

- Here we would like to introduce some caveats or points that should be kept in mind when applying this Approach.

① DNSH considerations (Environmental aspects)

- As indicated in Chapter 4 (4-2.), projects eligible under this Approach for Nature Finance must not only demonstrate positive impacts in terms of HANPP, NPP and species, but also ensure they do not cause significant adverse impacts on other environmental aspects. In addition to project-level DNSH confirmation, this chapter also address DNSH assessment at the corporate level in this chapter.

- At the corporate level, the primary reference is the TNFD, verifying whether significant negative impacts and appropriate mitigation measures are reported. However, the TNFD does not necessarily describe comprehensive information of the company due to its characteristics, which recommends narrowing down priority businesses and regions through location analysis and proceeding with analysis and disclosure where currently feasible. Therefore, as a complementary measure for DNSH review at the corporate level, we will cross-check using ESG risk evaluation providers to identify any cases of significant controversy in nature-related areas through the information.

- In that way, we will try to manage significant negative impacts from multiple perspectives, while evaluating the "Pressures on nature" that could be caused by a candidate company and its operations.

② DNSH considerations (Social aspects: "Just Transition in Nature")

- The concept of Just Transition, becoming increasingly important in climate change, also relates to nature. In investment and financing, beyond general social considerations, engagement with Indigenous Peoples and Local Communities (IPLCs) is also important. Recognizing the diverse values of nature and its impacts on local people, we believe it is important to promote activities that incorporate the wisdom and practices of IPLCs that have maintained long-term positive relationships with nature in their regions.

- The important role of IPLCs in sustainable nature management is internationally acknowledged. Therefore, for the projects targeted by this Approach, meaningful engagement and collaboration with local IPLCs during planning and implementation are required.

③ Dialogue and engagement

- We believe it is important to closely support companies and project implementers as each initiative for improving nature impact is a long-term endeavor.

- Accordingly, this Approach promotes dialogue and engagement with companies that encourage impact monitoring and disclosure throughout the Nature Finance implementation period, contributing also to the GBF Target 15).

- Simultaneously, collaboration with diverse stakeholders beyond companies is important. We aim for this Approach to be effectively utilized to facilitate such field-building.

- Regarding NPP (including HANPP), which is the axis of this approach, we recognize the following limitations.

  - NPP dataset from NASA has the advantage of being freely available to the public. However, the minimum mesh resolution is 500 m x 500 m and it may not be able to capture conditions at the micro level, such as in cases where the target area is small, or where the baseline is already forest land and the amount of changes over time is captured.

  - In the measurement method that uses satellite images to determine the type of land cover in specific area and measure NPP, the actual NPP could differ from the measured NPP due to factors such as soil that cannot be recognized by satellite images.

  - Global warming is almost caused by a single factor, GHG, and the causal relationship between corporate activities and the indicator is clear. However, since the restoration of nature is composed of multiple factors, there are limitations to using a single indicator to measure. On the other hand, we believe that NPP (including HANPP) can explain many of these factors.

  Taking into account the basic concept of this approach, which has a practical and simple indicator, we believe that it is one of the best solutions at this moment. However, we will continue to refine these points through future research and technical progress with academia and companies.

6 Case studies

- In this chapter, we present five case studies that are in line with our Approach.
- In general, initiatives for nature restoration tend to be confined to those that do not directly generate revenues, such as nature conservation activities that do not generate direct revenue, but by utilizing the ideas of HANPP and NPP, it is possible to demonstrate that many business initiatives can lead to nature restoration (including the avoidance of nature loss). Through the case studies, we would like to show how to evaluate specific project and provide "insight" into how business and nature restoration can be connected.
- For your reference, the case studies can be organized in relation to the categories ① through ④ as shown in 4-1. of Chapter 4 like below:
    - Case (1) and (2) fall under "① Projects that mitigate or avoid the expansion of agricultural lands and pasture with deforestation"
    - Cases (3) falls under "② Projects that mitigate or avoid the development and use of natural resources (minerals, fiber, rubber, water, etc.) with deforestation"
    - Case (4) falls under "③ Projects that mitigate or avoid urban infrastructure development with deforestation"
    - Case (5) falls under "④ Forest conservation and reforestation (e.g., afforestation, tree thinning)"In this chapter, we present five case studies that are in line with our Approach.

Case (1) HANPP Reduction
Increasing productivity of small-scale oil palm farmers*
to avoid deforestation due to farmland expansion

[Background]

- Palm oil, a vegetable oil extracted from oil palms, is widely used in daily life, including margarine, shortening, processed foods, detergents (soap, shampoo, etc.), and cosmetics. Approximately 80 million tonnes are produced worldwide, and there are concerns that growing demand could cause deforestation.
- It is estimated that 3 to 7 million small-scale farmers account for approximately 25 to 30% of the total palm oil supply. Small-scale farmers are less productive than large-scale plantations, and face difficulties in improving productivity due to a lack of funds and know-how. In this situation, due to the instability of oil palm harvests caused by bad weather and other factors, many small farmers are seeking to expand the area of their farmland to secure a certain level of income[17].

[Assumed Case]

- Food manufacturer A, which sources large quantities of palm oil, procures from thousands of small-scale farmers throughout its entire supply chain. Company A has begun an initiative to work with several companies to prevent deforestation by helping small-scale farmers improve their productivity. Specifically, the project aims to support 1,000 small-scale farmers in Indonesia to increase their productivity by 1.5 times on average by 2030 through capacity development in the sustainable production know-how and the introduction of new technologies.

*Farmers with 100% RSPO certification

[17] Palm-Oil-Barometer-2024 Consultation Paper

- The target farmers as a whole produce 6,000 tonnes of palm oil on 3,000 hectares (ha) of farmland, with the average farmer having an area of 3 ha and producing 6 tonnes of palm oil. If the efforts of Company A and several other companies result in a 1.5-fold increase in productivity as planned, it is expected to produce 9,000 tonnes of palm oil. The 3,000 tonnes of the increased production can be interpreted as avoiding the expansion of farmland that would have required an additional 1,500 ha.

[HANPP Measurement]

- The reduction in HANPP can be estimated using the formula “Change in forest area” x "NPP per unit area”.
- First, as for the “Change in forest area”, hypothetically, 1,500 ha of deforestation due to farmland development would not have happened, which means a zero reduction in forest. Therefore, it can be said that a reduction of 1,500 ha = 15 km^2 of forest has been avoided.
- Next, we consider "NPP per unit area”. The forest type in the vicinity of this project sites was evergreen broadleaf forests, which are the majority of forests in Indonesia. The NPP per unit area of the evergreen broadleaf forests in Indonesia is estimated to be 1,100 tonnes C/km^2 per year according to the NASA data.
- Based on the above information, the reduction in HANPP (i.e., the amount of NPP reduction that avoided) is calculated to be 15 km^2 x 1,100 tonnes C/km^2 per year = 16,500 tonnes C per year.

[Eligibility Assessment]

- We consider that this initiative by Company A provide sufficient benefit to nature restoration, because of its contribution to the goal set forth in the Planetary Boundaries update, which is to reduce 16.8 billion tonnes/year of the 2020 HANPP to 5.6 billion tonnes/year (10% of the pre-industrial Holocene NPP) or less.
- Furthermore, as there were no violations of DNSH principles for both environmental (e.g., pollution) and social (e.g., extreme disadvantages to the local population) aspects, this project is considered eligible for Nature Finance under this Approach.

Case (2) HANPP Reduction
Manufacturing alternative protein products that substitute beef production to avoid deforestation due to pastureland expansion

[Background]

- The world's beef production is approximately 60~70 million tonnes, and the main producing countries are the United States, China, Brazil and Argentina. Vast areas of pastureland are used to graze and raise beef cattle, and the WWF's report "Deforestation Fronts[18]" points out cattle grazing in Latin America as a location and factor in the significant deforestation 2004~2017.
- The production and supply of beef, which is expected to continue to be in demand as the population grows, is a field that requires a renewed focus and response measures in relation to deforestation. Here, we will consider alternative protein manufacturing as one of the measures to deal with the situation.

[Assumed Case]

- Company B is a start-up company that primarily produces beef-type meat substitutes (patties, steaks, etc.) using alternative proteins made from atmospheric carbon as raw materials. Company B's annual shipment of such beef-type meat substitutes, which contain the same level of protein as regular beef, are 400 tonnes.
- Furthermore, information on beef production and the area of pastureland indicates that the amount of pastureland used to produce one tonne of beef is approximately 20 ha on average. Hypothetically assuming that Company B's product replaced beef produced on pastureland that would be developed in the future with deforestation, this could be interpreted as a potential for avoiding deforestation up to 400 tonnes x 20 ha/tonne of beef produced = 8,000 ha.

[18] Deforestation Fronts, WWF International, 2021

[HANPP Measurement]

- First, as for the “Change in forest area”, hypothetically, 8,000 ha of deforestation due to pastureland development would not have happened, which means a zero reduction in forest. Therefore, it can be said that a deforestation of 8,000 ha = 80 km^2 of forest has been avoided.
- Next, we consider "NPP per unit area”. It is difficult to pinpoint specific locations on the planet where Company B's alternative protein products have avoided the expansion of pastureland. Therefore, in this case study, we will use average NPP for forests in the United States, China, Brazil, and Argentina, under the assumption that such deforestation avoidance could occur in any of the major beef producing countries. The NPP per unit area of forests in these four countries is estimated to be 1,000 tonnes C/km^2 per year according to the NASA data.
- Based on the above information, the reduction in HANPP (i.e., the amount of NPP reduction that avoided) is calculated to be 80 km^2 x 1,000 tonnes C/km^2 per year = 80,000 tonnes C per year.

[Eligibility Assessment]

- The logical connection between the above alternative protein production business and HANPP reduction may not be necessarily strong, as it is based on various assumptions (i.e. all of Company B’s products would replace beef produced on pastureland that would be developed in the future involving deforestation).
- On the other hand, it cannot be said that the two are completely unrelated. If the business contributes even to a portion of the 80,000 tonnes C/year reduction in HANPP, it can be regarded as the contribution to the goal of keeping HANPP below 5.6 billion tonnes/year. So, we consider that this initiative by Company B will generate benefits in terms of nature restoration.
- Furthermore, as there were no violations of the DNSH principles for both environmental (e.g., pollution, climate change) or social aspects, this project is considered eligible for Nature Finance based on this Approach.

Case (3) HANPP Reduction
Recycling rare metals (Cobalt)
to avoid deforestation due to additional mine development

[Background]

- Demand for rare metals is increasing in various industries. For example, cobalt is growing in use as a cathode material for lithium-ion batteries in cell phones, laptop computers, and electric vehicles.
- Democratic Republic of the Congo accounts for about 75% of the world's cobalt production, and deforestation in the development of its mines is as much of an issue as in the case of other minerals.

[Assumed Case]

- Electronics manufacturer C manufactures and sells personal computers. Each PC uses approximately 50g of cobalt. Company C promotes recycling of its PCs recovering cobalt. From 300,000 computers recycled, Company C collects 50g x 300,000 units = 15,000kg = 15 tonnes of cobalt.
- Based on various statistics, the average deforestation area per tonne of cobalt is estimated to be 0.01 ha/tonne. Thus, the recycling of 15 tonnes of cobalt contributed to avoiding deforestation by 0.15 ha.

[HANPP Measurement]

- First, as for the "Change in forest area", hypothetically, 0.15 ha of deforestation due to mine development would not have happened, which means a zero reduction in forest. Therefore, it can be said that a reduction of 0.15 ha = 0.0015 km^2 of forest has been avoided.

- Next, we consider "NPP per unit area". Assuming that the cobalt recycling project by Company C has avoided new mining development in Democratic Republic of the Congo, the average NPP per unit area is calculated for the main land covers in the country: evergreen broadleaf forests, deciduous broadleaf forests, and mixed forests. The NPP per unit area of forests in is estimated to be 1,200 tonnes C/km^2 per year according to the NASA data.
- Based on the above information, the reduction in HANPP (i.e., the amount of NPP reduction that avoided) is calculated to be 0.0015 km^2 x 1,200 tonnes C/km^2 per year = 1.8 tonnes C per year.

[Eligibility Assessment]

- Although the amount of HANPP reduction from this Company C's initiative is extremely small, it can be regarded as an initiative that generates benefits in terms of nature restoration because it contributes to the goal of keeping HANPP below 5.6 billion tonnes/year. In order to increase the amount of contribution, it would be important to "promote recycling of minerals other than cobalt," "expand collaboration with other companies in the same industry," and "expand efforts in collaboration with other industries (mobile telecommunications, automobiles, etc.). In such cases, it may be a good idea to also work with the government to obtain some policy support.
- Furthermore, as there were no violations of the DNSH principles for both environmental (e.g., chemical leakage from e-waste) or social aspects, this project is considered eligible for Nature Finance based on this Approach.

Case (4) HANPP Reduction
Developing high-rise multi-family residences in an urban area of a developing country to avoid deforestation due to expansion of residential land area

[Background]

- The world's population continues to expand, from 2.5 billion in 1950 to 8.2 billion in 2024, and is expected to exceed 10 billion by the 2050s[19]. In particular, the population in Africa is expected to grow significantly in the future, and the need for housing will increase along with the need for jobs, food, etc.
- As urban areas absorb more population, there is concern that the expansion of residential land area due to the need for housing supply will lead to the destruction of nature (e.g., forests) in the surrounding areas. Along with orderly urban planning, it is also important to consider and promote the efficient use of residential land per unit area.

[Assumed Case]

- A city in Africa still has many forested areas remaining, especially in the suburbs. The population is approaching 10 million and is expected to continue to grow, with a population density of 25,000 people/km^2 per residential area. In that city, real estate developer D decided to develop a cluster of high-rise residential buildings in an existing residential area with a total site area of 250,000 m^2 (= 0.25 km^2) and an estimated 25,000 residents. The population density per residential area is 100,000 persons/km^2, and the project aims to make efficient use of each unit area. Furthermore, the development of this housing facility and area has been planned with careful consideration to ensure that the surrounding environment is not adversely affected (e.g., no reduction in the natural environment, no excessive increase in pollution and waste, etc.).
- As a result of this development, only a quarter of the land area of 1 km^2 have been required for housing 25,000 people. This can be interpreted as avoiding an increase in residential

[19] World Population Prospects 2024: Summary of Results

land area of 1 km^2 - 0.25 km^2 = 0.75 km^2. Although the expansion of residential areas does not necessarily entail deforestation, if we assume that the expansion of residential areas would have entailed forest clearing to provide housing for the new 25,000 people, it can be interpreted that up to 0.75 km^2 of deforestation could have been avoided.

[HANPP Measurement]

- First, as for the "Change in forest area", hypothetically, 0.75km^2 of deforestation due to housing development would not have happened, which means a zero reduction in forest. In other words, it can be said that a reduction of 0.75 km^2 of forest has been avoided.
- Next, we consider "NPP per unit area". The project was assumed to be in several African countries, where the main land covers were evergreen broadleaf forest, deciduous broadleaf forest, and mixed forest. The NPP per unit area is estimated at 1,200 tonnes C/km^2 per year according to the NASA data.
- Based on the above information, the reduction in HANPP (i.e., the amount of NPP reduction that avoided) is calculated to be 0.75 km^2 x 1,200 tonnes C/km^2 per year = 900 tonnes C per year.

[Eligibility Assessment]

- The development project above can be regarded as an initiative that generates benefits in terms of nature restoration because it contributes to the goal of keeping HANPP below 5.6 billion tonnes/year.
- Furthermore, as there were no violations of the DNSH principles for both environmental (e.g., waste, soil contamination, water pollution, etc.) or social aspects, this project is considered eligible for Nature Finance under this Approach.

Case (5) NPP and Species increase
Promoting reforestation by a forest fund (=carbon credit project)
to increase forest, which entails the increase in both NPP and species

[Background]

- In Brazil, activities such as cattle grazing and infrastructure development have led to significant destruction of forests in the Amazon and other regions. Between 2002 and 2024, a total of 33.5 million hectares of virgin forest is estimated to have been lost[20].
- In the future, it will be important to reduce development that involves deforestation, as well as reforestation efforts through afforestation, especially in wastelands (e.g., abandoned pastureland). Such efforts will also contribute to the “30 by 30” target, which is included in the GBF target to "effectively conserve at least 30% of the land and sea by 2030”.

[Assumed Case]

- A forest fund E aims to plant native tree species in a wasteland in Brazil and earn revenue by selling carbon credits obtained from the conservation of the forest. As the target wasteland has been cleared from an area that was originally a forest, it is surrounded by the remaining forests. and after the afforestation that focuses on improving connectivity to the forests, it is expected that the species that inhabit the surrounding forests will move into and inhabit the afforested area as well.
- The total area of the forest to be conserved and reforested is 100 ha. The fund E will not engage in businesses such as timber sales; instead focus solely on carbon credit projects involving carbon absorption and sequestration.

[20] Brazil Deforestation Rates & Statistics | GFW

[Measurement of NPP and species]

(1) Measurement of NPP

- The increase in NPP can also be estimated using the formula “Change in forest area” x "NPP per unit area”. As for “Change in forest area”, the abovementioned afforestation will result in an increase of 100 ha=1km^2 of forest.
- Next, we will consider "NPP per unit area”. In this project, trees corresponding to the local evergreen broadleaf forest will be planted. The NPP per unit area of Brazilian evergreen broadleaf forest is estimated to be 1,100 tonnes C/km^2 per year according to the NASA data.
- Based on the above information, the increase in NPP is calculated to be 1 km^2 x 1,100 tonnes C/km^2 per year = 1,100 tonnes C per year, when the trees will have grown and matured in about 8 years under proper forest management. Since the land before afforestation was assessed as having zero NPP in the NASA data because it is a wasteland (classified as “Barren or Sparsely Vegetated” land cover with little to no vegetation), the estimated NPP amount itself represents the increase.
- The project was judged to be sufficiently beneficial from the NPP perspective due to the expected future increase in NPP at the pre-investment stage. After the investment, we will monitor the annual change in NPP over time by utilizing NASA's NPP data, which will be updated annually.

(2) Species measurement

- Regarding the species, a total of 15 species of mammals, birds, and amphibians that live in the surrounding forests were selected for fixed-point observation. Among them, one endangered species is included in each of mammals and amphibians.
- For the baseline assessment, no specific surveys were conducted prior to the investment. Instead, each population was assumed to be zero based on the status of the abandoned pasture.
- After confirming the fund E's forest management plan (e.g., planting native tree species, creating corridors between surrounding forests, and other measures to increase connectivity, etc.), together with biodiversity big data, it was found that the population of each listed species is expected to increase. So, at the pre-investment stage, it was also determined that there was sufficient benefit in terms of species.
- Regarding monitoring, it was decided to conduct a surveys every three years, taking into consideration the balance between labor, cost, and other factors. In fact, the results of the population increase were not immediate, and the first monitoring survey (three years later) showed little increase in the population. However, by the second survey (six years later), the population of each species slightly increased, and by the third survey (nine years later), some population of endangered mammals and amphibians were confirmed.

[Eligibility Assessment]

- As explained in Chapter 4, 4-2, “Increase in NPP” is considered as eligible if NPP increases, regardless of its size, because no target or upper limit is set in the Planetary Boundaries. In this case, the forest fund E increased NPP by 1,100 tonnesC /year in 8 years by increasing and nurturing trees through afforestation.
- Also, with regard to the “increase in endangered species”, the populations of both endangered mammal and amphibian species have respectively increased, which is in line

with the Planetary Boundaries' target for the “species extinction rate” of "<10 E/MSY (less than 10 species become extinct annually out of 1 million species). Therefore, it can be evaluated that the eligibility criteria are met.

- Furthermore, in terms of the DNSH principles, the use of native tree species instead of invasive alien species, the avoidance of soil and water pollution, etc., were implemented to ensure that there would be no significant adverse environmental impacts. From a social perspective, this afforestation project did not cause significant disadvantages to the local people, but rather, it was carried out in a manner that made use of their knowledge and experience.
- Based on these positive contributions in NPP and species as well as the absence of any cases against DNSH, the project by the forest fund E is considered eligible for Nature Finance under this Approach.

7 For continued enhancement of this Approach

- We aim to realize “a society in which everyone can live their lives with peace of mind” as both a life insurer, which provides insurance products and related services, and an institutional investor. In particular, as a universal owner with approximately 85 trillion Japanese yen in AUM, we recognize the importance of concepts such as the Planetary Boundaries and the Planetary Health, which are compatible with our mission of contributing to People, Communities, and Environment, and we are committed to developing and promoting a financing framework based on system-level thinking to create a stable global environment and a safe social environment. As part of this effort, we published Nippon Life Transition Finance Framework in June 2024. Then, by releasing the Nature Finance Approach this time, we’ve shown the direction of solutions to the two most critical issues of the global environment (climate and nature) to some extent.
- In this Approach, we have proposed specific methodologies to promote corporate activities and related investments and financing aimed at nature restoration, focusing on indicators centered on NPP (including HANPP) and presenting concrete methodologies. While international discussions on these issues continue, this Approach was developed to offer a foundational concept, is not the definitive “final form of the solution” to the complex challenges surrounding nature restoration.
- Another aim of this Approach is to build a field for active discussions through engagement and cooperation across various stakeholders. We hope to create a wave of momentum toward the world envisioned by the Planetary Boundaries concept by continuously improving the methodologies presented here. Especially, we will keep in mind key issues and challenges on the ground that will be identified through dialogues not only with finance sectors, but also with companies, public sector organizations, academic institutions, and NGOs as well as collaboration with international initiatives such as TNFD and the Nature Positive Initiative.
- Through the dialogues so far, we have received the following comment by Professor Ryo Kohsaka from The University of Tokyo.

"Since the adoption of the Kunming-Montreal Global Biodiversity Framework in 2022, efforts by private sector have advanced, and engagement of them has become a norm. Expectations are high for the financial sector, with their cross-sectoral influence. At such a critical juncture, "Nippon Life Nature Finance Approach" is a pioneering initiative aiming for developing indicators for the “State of Nature” ahead of Japan's financial sector. Focusing mainly on NPP, I appreciate that this Approach organizes and presents impact indicators for ecosystems and species with the simplicity necessary for practical application. Further understanding of methodology is awaited. Currently, the IPBES "Business and biodiversity assessment" is underway which will assess the methodologies and their best estimate. I hope that the Approach here will lead to further participation by a wide range of sectors while incorporating discussions from assessments”

Ryo Kohsaka

Professor, Graduate School of Agricultural and Life Sciences, The University of Tokyo

- In terms of the continued improvement of this Approach, once an international consensus is formed on indicators for measuring nature restoration, triggered by the NPI's pilot on its "State of Nature" metrics, discussions to be presented in the "Business and biodiversity assessment" of the IPBES report (to be released by the end of 2025), and the review of the TNFD recommendations, etc., we would like to incorporate any useful ideas generated from these initiatives.
- Furthermore, while this version of the Approach is limited in scope to terrestrial lands, we would also like to develop a financing concept for nature restoration in ocean (e.g. coastal areas), which is also another important natural area, in the future, carefully tracking the development of impact measurement theories, methods, and technologies (e.g., eDNA to determine the habitat status of species, calculating NPP of seaweeds in conjunction with blue carbon measurements, etc.) by academia, international research institutions, and companies.

<Appendix> Overview of key actors in nature and biodiversity

Major Actors	Origins and Objectives / Initiatives
International Organizations	
CBD (Convention on Biological Diversity)	**Origins and Objectives** An international treaty adopted at the Earth Summit in 1992 and entered into force in 1993. The Conference of the Parties, or COP, is held every two years under the CBD Secretariat, with the aims of "conserving biodiversity," "sustainable use of its components," and "fair and equitable sharing of benefits arising from the utilization of genetic resources,". **Initiatives** The Global Biodiversity Outlook 5 was published in 2020 based on country reports and IPBES assessments. Based on this scientific evidence, the Kunming-Montreal Global Biodiversity Framework (GBF) was adopted at COP15 in 2022.
IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services)	**Origins and Objectives** An intergovernmental organization established in 2012 that scientifically evaluates trends related to biodiversity and ecosystem services and prepares assessment reports to support policy-making. **Initiatives** Ahead of COP16, the First Global Assessment Report on Biodiversity and Ecosystem Services was published in 2019.
IUCN (International Union for Conservation of Nature and Natural Resources)	**Origins and Objectives** Founded in 1948, IUCN is an alliance of nations, government agencies, and domestic and international non-governmental organizations. Its vision is a just world that values and conserves nature, and its sole purpose is to "conserve" nature and natural resources (its stance is that "use" should be fair and sustainable). **Initiatives** In addition to supporting developing countries in nature conservation, it also served as the secretariat for the Ramsar Convention. The Species Survival Commission creates the IUCN Red List of Threatened Species and updates it annually.
UNEP-WCMC (United Nations Environment Programme - World Conservation Monitoring Centre)	**Origins and Objectives** Established in 1988 as WCMC by 3 organizations, IUCN, WWF and UNEP, and became a subsidiary organization of UNEP in 2000 as UNEP-WCMC. Its main purpose is to provide information on species conservation, sustainable use and environmental systems. **Initiatives** It provides information services such as specialized technologies and tools, conducts monitoring analysis and early warning on biodiversity, and its policy support. It also cooperates in the development of ENCORE, a tool for analysis of nature-related dependencies, impacts, and risks.
UNEP FI (United Nations Environment Programme Finance Initiative)	**Origins and Objectives** A partnership between UNEP and the global financial sector established in 1992, it aims to encourage the mobilization of private sector funds for sustainable development and to integrate sustainability into financial markets. **Initiatives** At the Rio+20 Summit in 2012, the "Natural Capital Declaration (NCD)" was proposed for financial institutions. In addition to publishing reporting tools for investors and financial institutions, such as the "State of Finance for Nature" in 2023 and the "Finance for Nature Positive Discussion Paper" in 2024, it will formulate sector principles, including the 2006 PRI Principles.
UNDP's BIOFIN (Biodiversity Finance Initiative)	**Origins and Objectives** An initiative launched by UNDP and the European Commission (EC) at COP11 in 2012, with the aim of mobilizing funds for nature. **Initiatives** Through its unique technical assistance, it promotes appropriate government spending to implement National Biodiversity Strategies and Plans (NBSAPs), and has developed policy and spending reviews by governments, as well as Biodiversity Financial Plans (BFPs) and the BIOFIN Workbook (latest edition is 2024).
IFC (International Finance Corporation)	**Origins and Objectives** An international development financial institution established in 1956 as a part of the World Bank Group, and its goal is to support development through the private sector. **Initiatives** In the field of nature and biodiversity, we have issued guidelines such as the "Biodiversity Finance Reference Guide" published in May 2023 and the "Biodiversity Finance Metrics for Impact Reporting" published in October 2024 with the aim of strengthening impact assessments of private investment and mobilizing funds, promoting the expansion of projects by companies and financial institutions.

Major Actors	Origins and Objectives / Initiatives
NGOs / Initiatives	
WWF (World Wildlife Fund)	**Origins and Objectives** An environmental conservation NGO founded in 1961, with the mission of protecting nature and reducing the most pressing threats to the diversity of life on Earth, aiming to be a voice for voiceless creatures and to harmonize human needs with non-human needs. **Initiatives** It implements international conservation programs and promotes and raises understanding through reports. Since 1998, it has published the Living Planet Report (LPR) every two years (the latest edition is 2024).
Conservation International	**Origins and Objectives** A non-profit organization founded in 1987, Conservation International strives to create a sustainable world in which all people can enjoy wellbeing into the future, and holds the idea that it is natural capital that supports the achievement of human well-being. **Initiatives** Active in the formation, implementation and support of conservation projects, policy advocacy, and is also actively involved in partnership projects with business companies (e.g., the establishment of the Restore Fund, a forest conservation fund with Apple). The "Conservation International Annual Report" is updated annually.
Global Canopy	**Origins and Objectives** Founded in 2001, Global Canopy is a data-driven non-profit organization with a vision of transparent, accountable markets in a sustainable and fair global economy for the protection of forests and their ecosystems. The strategy places emphasis on concerted pressure, with financial institutions exerting pressure on business companies, campaign groups exerting pressure on companies and financial institutions, and governments exerting pressure on markets. **Initiatives** Through publications such as The Little Book of Investing Nature (2021) and Due diligence towards Deforestation-Free Finance (2023), they provide leading corporations, financial institutions, governments and campaigning groups around the world with innovative open access data, clear metrics and actionable insights.
TNFD (The Taskforce on Nature-related Financial Disclosures)	**Origins and Objectives** A taskforce established in 2021 by UNEP FI, UNDP, WWF, and Global Canopy, with the aim of shifting capital flows in a direction that is positive for nature and society, and providing high-quality information to business and capital market decision makers through the disclosure of nature-related risks. **Initiatives** As an open innovation approach, we are creating frameworks that incorporate the opinions of a wide range of stakeholders, including business actors, and have formulated various guidance documents, including the "Recommendations of the Taskforce on Nature-related Financial Disclosures," to be published in 2023.
SBTN (Science Based Targets Network)	**Origins and Objectives** A civil society and science-led initiative established by a group of NGOs in 2019, SBTN has a vision of a "global economy in which companies and cities operate within environmental boundaries on a socially equitable basis," and believes it is important to achieve both the 1.5°C target and reversing the loss of nature. **Initiatives** In 2020, the company published "Setting Nature-Related Targets: Initial Guidance for Companies," and in 2022 it will formulate "SBTN Guidance for Companies," providing guidelines for setting science-based targets.
NPI (Nature Positive Initiative)	**Origins and Objectives** An initiative established in 2021 that encourages companies and organizations to take actions that have a positive impact on nature, with the aim of achieving the 2030 Nature Positive Goals. **Initiatives** The initiative places emphasis on demonstrating measurable results for businesses, governments and other stakeholders, and is currently in the process of creating standardized indicators for the state of nature, publishing "Building Consensus on State of Nature Metrics to Drive Nature Positive" in October 2024.

Major Actors	Origins and Objectives / Initiatives
WBCSD (World Business Council for Sustainable Development)	**Origins and Objectives** A coalition of corporate CEOs established in 1995, it aims to achieve sustainable business success with a vision of a world in which more than 9 billion people can thrive within the planet's boundaries by 2050. **Initiatives** We promote sustainable business models for companies and support the progress of corporate initiatives by accumulating best practices, formulating policies and sharing solutions. In 2023, they will publish "The Roadmap to Nature Positive: Foundations for the built environmental system."
BfN (Business for Nature)	**Origins and Objectives** A corporate initiative established in 2019 as a coalition of 13 international organizations including the WEF, with the aim of promoting changes in corporate behavior in order to achieve a nature-positive economy for all by 2030. **Initiatives** Through collaboration with companies, we are developing initiatives to make policy recommendations and raise awareness. In addition to advocacy activities and dialogue with governments, we have published guidance for 12 sectors in 2024 (in collaboration with WEF/WBCSD) and "What Are Nature Strategies and Nature Transition Plans?" (in collaboration with CDP).
FfB (Finance for Biodiversity Foundation)	**Origins and Objectives** A financial sector initiative established in 2021 that aims to support a call to action and collaboration among financial institutions to reverse nature by closing the financing gap for biodiversity. **Initiatives** The company has developed investment standards for biodiversity and implemented educational programs for financial institutions. In 2024, it published the Nature Target Setting Framework for Asset Managers and Asset Owners (2nd edition), a framework for setting nature-related goals for asset managers and asset owners. In the same year, it also produced a discussion paper with UNEP FI, entitled Finance for Nature Positive: Building a Working Model.
NA100 (Nature Action 100)	**Origins and Objectives** An investor-led engagement initiative formed in 2023 to reduce the financial risks posed by the depletion of natural capital and protect the long-term economic interests of investors' clients and beneficiaries. **Initiatives** It supports corporate ambition and action to reverse the loss of nature and biodiversity, and in 2024 it published the Nature Action 100 Company Benchmark Key Findings 2024.
TEEB for Business Coalition	**Origins and Objectives** An initiative established in 2012, originating from the "The Economics of Ecosystems and Biodiversity (TEEB)" project proposed by the European Commission and Germany at the G8+5 Potsdam Meeting of Environment Ministers in 2007. The project aims to visualize the economic value of biodiversity and ecosystems in corporate activities. **Initiatives** The organization has developed frameworks and indicators for companies to assess nature-related risks, make policy recommendations, and share best practices. In 2014, it was reorganized as the Natural Capital Coalition.
Capitals Coalition	**Origins and Objectives** An initiative launched in 2020 through the merger of the Natural Capital Coalition (NCC) and the Social and Human Capital Coalition (SHCC), it advocates for the need to recognize the value of people and the planet with a more holistic approach that takes into account the interconnectedness of the planet's natural, social, human and produced capital. **Initiatives** In 2016, we developed the first edition of the Natural Capital Protocol (revised in 2021) as a decision-making framework to enable organizations to identify, measure and evaluate their impacts and dependencies on natural, social and human capital.
Academia	
Stockholm Resilience Centre (SRC)	**Origins and Objectives** Founded in 2007, SRC is a joint venture between Stockholm University and the Beyer Institute for Ecological Economics of the Royal Swedish Academy of Sciences. It aims to address the sustainability challenges facing humanity through science. **Initiatives** Recognizing the deep connection between humans and nature, it stresses the importance of humanity reconnecting with the biosphere and thriving within the Earth's limits, especially on a planet under pressure. In 2009, it introduced the concept of planetary boundaries in its book "Planetary Boundaries: Exploring the Safe Operating Space for Humanity." In addition, the wedding cake model of the SDGs (a model that breaks down the SDGs to explain that human society and the economy exist on the foundation of the global environment) is also widely known.
Cambridge Institute for Sustainability Leadership (CISL)	**Origins and Objectives** Founded in 1988, CISL is the University of Cambridge's sustainability research institute, with an impact-driven premise, aiming to galvanize global leadership for economic transformation for people, nature and climate. **Initiatives** In 2021, it co-authored the Dasgupta Review with the UK Government Treasury, and also leads groups such as the Natural Capital Impact Group (NCIG), which includes major companies in the infrastructure and food sectors, and the Investment Leaders Group (ILG), a group of institutional investors, to publish reports on impact measurement methods.

<Appendix> Glossary

Term	Explanation
Nature Concepts	
Natural Capital	The stock of renewable and non-renewable natural resources such as plants, animals, air, water, soil and minerals that, in combination, provide benefits to people. *Reference: Capitals Coalition, "Natural Capital Protocol" (2016).
Biodiversity	A comprehensive concept that refers to the rich diversity of biological species on Earth, such as animals, plants, and microorganisms that make up natural ecosystems, as well as the genetic diversity of these species, and the diversity of various ecosystems in each region. Biodiversity can be viewed at three levels: genetic, species and ecosystem.
Ecosystem	A dynamic complex of plant, animal, and microbial communities and the nonliving environment that interact as a functional unit. *References: Convention on Biological Diversity, Article 2; Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Global Assessment Report on Biodiversity and Ecosystem Services (2019).
Ecosystem Service	Contribution of ecosystems to benefits used for economic and other human activities. *Reference: United Nations et al. "System of Environmental Economic Accounting -Ecosystem Accounting" (2021).
State of Nature	A generic term for the overall picture of nature consisting of ecosystems and species.
Pressures on Nature	The concept of Direct Drivers of Nature Change, such as "land and sea use change," "direct extraction (including fishing and hunting)," "climate change," "pollution," "invasive alien species" as described by IPBES. This concept can be viewed as a counterpart to the State of Nature.
AR3T	Framework for Action for Businesses for Natural Recovery. It is divided into the following three levels (SBTN) a) Avoid and Reduce pressures on nature loss. b) Regenerate and Restore so that nature can recover. c) Transform underlying systems in which companies are embedded to address the drivers of nature loss.
Nature Positive	A global societal goal to halt and reverse nature loss by 2030 on a 2020 baseline, and to achieve full recovery by 2050. *Reference: Nature Positive Initiative "The Definition of Nature Positive".
Reports, Papers, etc.	
Millennium Ecosystem Assessment (MA)	Abbreviation for United Nations Millennium Ecosystem Assessment. This is a large-scale comprehensive assessment of ecosystems that shows how changes in ecosystems affect human well-being and provides comprehensive information that is useful for policy and decision-making.
First Global Assessment	The Global Assessment Report on Biodiversity and Ecosystem Services, published by IPBES in 2020, is the first global assessment of biodiversity and ecosystem services covering the entire planet for the period 1970s to 2050.
Dasgupta Review	The Economics of Biodiversity, a report on the relationship between human economic activity and natural ecosystems, was published by the UK Government Treasury in February 2021. It is called the "Dasgupta Review" due to the author's name; Professor Emeritus Persa Dasgupta of the University of Cambridge.
IUCN Red List	List of endangered species (database). Endangered species are classified into several ranks based on the risk of extinction, and information on each species, such as geographical distribution, population size, ecology and habitat, threats and conservation measures, is compiled. Updated about twice a year.
Planetary Health	The idea that the global environment and the social environment are interdependent. Proposed in the report "Safeguards for Human Health in the Anthropocene," published in 2015 by the Planetary Health Commission, founded by the Rockefeller Foundation and The Lancet.

Term	Explanation
Goals and Initiatives at National Level	
NBSAP	Abbreviation for National Biodiversity Strategy and Action Plan. NBSAP are required to be prepared by Parties to the Convention on Biological Diversity and submitted to the Convention Secretariat in accordance with Article 6 of the Convention.
Aichi Targets	An international goal adopted at COP10 held in Aichi Prefecture in 2010. The mission set 20 specific targets to halt biodiversity loss by 2020, but none of them were achieved.
G7 2030 Nature Compact	Commonly known as Nature Compact. A global mission to "halt and reverse biodiversity loss by 2030" (Nature Positive) was stated as an annex to the 2021 G7 Leaders' Communiqué.
G7ANPE	G7 Alliance on Nature Positive Economies. It was established as a forum for sharing knowledge and building an information network regarding the nature-positive economy in order to realize the 2030 Nature Compact.
SATOYAMA Initiative	An initiative led by the Japanese government. Secondary natural areas around the world, such as Satoyama landscape in Japan, are collected and analyzed to develop a common philosophy for sustainable management and use of natural resources in accordance with the local environment, and applied to realize a society in harmony with nature in various regions of the world.
OECM	Abbreviation for Other Effective area-based Conservation Measures. Geographically delineated areas outside of protected areas that are governed and managed in a manner that continues to achieve positive long-term outcomes for biodiversity conservation, associated ecosystem functions and services and, where appropriate, cultural, spiritual, socio-economic and other locally relevant values.
Natural Symbiosis Site	An area where biodiversity is being conserved through the efforts of the private sector. There is a certification system mainly led by the Ministry of the Environment, which of these areas, those that do not overlap with protected areas are registered in the international database as OECMs.
Others	
PRI	Abbreviation for Principles for Responsible Investment. Investment principles developed by UNEP FI and the United Nations Global Compact (UNGC) in 2006. Consists of six investment principles and a preamble that require institutional investors to consider ESG issues in their investment decision-making processes and shareholder actions. PRI Spring was established in 2023 as a collective engagement initiative to address nature-related issues.
GRI	Abbreviation for Global Reporting Initiative. An independent, non-profit organization established in 1997 as an accredited entity of UNEP. It has developed international reporting standards (GRI Standards) for companies and organizations to disclose their economic, environmental, and social impacts.

<Appendix> List of References

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