Annexes

Decent Work
in Nature-based
Solutions 2024

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ANNEX A
Estimating current and future employment in nature-based solutions

Introduction

Cambridge Econometrics' global E3ME model provides an economic framework with which to evaluate the effects of a wide range of policies. Behavioural relationships in the model are estimated using econometric time-series techniques applied to a database that covers the period from 1970 onwards, on an annual basis. A core feature of the model is its treatment of technology, which will be key to meeting many of the world's policy challenges. E3ME extends its treatment of the economy to cover physical measures of energy, food and material consumption. The main data sources for European countries are Eurostat and the International Energy Agency (IEA), supplemented by the Structural Analysis (STAN) database of the Organisation for Economic Co-operation and Development (OECD) and other sources, where appropriate. For regions outside of Europe, additional sources of data include the United Nations (UN), OECD, World Bank, International Monetary Fund (IMF), International Labour Organization (ILO) and national statistics. Gaps in the data are estimated using custom software algorithms.

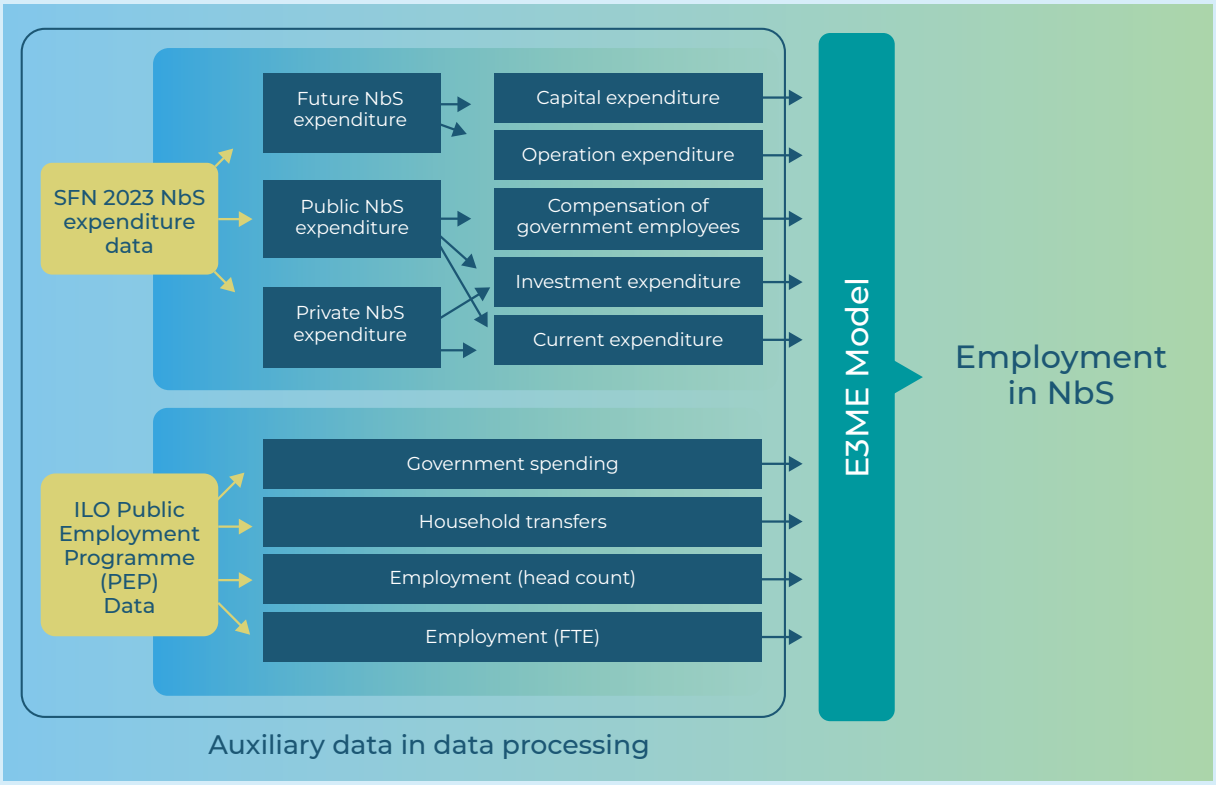
While land-use models can help estimate the potential for global implementation of NbS, a global economic model is necessary to assess the economic benefits of such activities. The E3ME model is a sophisticated econometric tool that captures the feedback loops between the economy, society and the environment, making it well-suited for analysing the employment and other economic benefits resulting from NbS investments. E3ME is used extensively for policy evaluation, forecasting and research due to its empirical foundation and minimal restrictive assumptions. It offers a comprehensive analysis of the labour market and covers 71 global regions, including all G20 and EU Member States individually as well as additional regions to complete global totals, with 43 economic sectors represented in each region. This enables a detailed assessment of the current state of NbS-related employment.

This Annex sets out the main assumptions used in estimating employment in NbS. The sections that follow set out, in turn, the assumptions that entered the E3ME model: data sources; assumptions related to NbS expenditure (public, private and future); treatment of direct employment from public employment programmes (PEPs) of the ILO; and employment results.

Concerning the current employment estimation resulting from this modelling exercise, the estimated values are not linked to any particular year. The dynamics in E3ME mean that it takes time for the full impact of sustained NbS expenditure to be realized. The E3ME econometric equations estimate a short-run and a long-run equation with an error-correction mechanism. Under this specification, the direct response of employment to change in gross output is likely to be different in the short-run and the long-run. The induced impacts of NbS expenditure also take time to be fully realized in E3ME, given the short-run and long-run dynamics of, for example, changes in household consumption expenditure compared to real income changes.

Figure 1 provides a simplified overview of the treatment of expenditure data in the modelling of NbS employment:

Figure 1: Summary of the methodological approach



SOURCE: Cambridge Econometrics.

Nature-based solutions definitions

Throughout this document specific terms related to nature-based solutions (NbS) are used to refer to elements of the modelling exercise or its underlying data processing. This section provides explanations of these terms:

NbS expenditure: refers to the amount of spending dedicated to NbS activities. This is the core variable used in the modelling exercise, and the State of Finance for Nature (SFN) dataset is the main source of data that was processed in the model inputs.

NbS employment: refers to employment allocated in a country for NbS activities. Estimating NbS employment though E3ME modelling was the main objective of this modelling exercise and underlying data processing.

NbS activity: refers to specific economic activities that are considered to be included within the scope of NbS. This is the most fine-grained economic disaggregation for NbS. In the SFN 2023 dataset, future NbS expenditure was disaggregated by 13 NbS activities and by region. The dataset also contains two additional activities with limited data, which is why they are not considered in the analysis of future NbS expenditure. The 13 NbS activities are:

1. Protected areas
2. Avoided deforestation
3. Avoided peatland conversion
4. Avoided mangrove conversion
5. Avoided grassland conversion
6. Avoided seagrass conversion
7. Reforestation
8. Reforestation of peatland
9. Reforestation of mangrove
10. Reforestation of saltmarshes
11. Reforestation of seagrass
12. Agroforestry – silvoarable
13. Agroforestry – silvopasture

NbS category: refers to a broader categorization of NbS activities, grouping several activities of similar nature together. NbS employment is also reported in terms of NbS category for future NbS expenditure (beyond being reported in aggregate terms of total NbS expenditure). There are, in total, three NbS categories:

1. Protected areas/avoided conversion
2. Restoration
3. Sustainable land management

NbS finance flows: refers to the disaggregation of categories of NbS in the global current expenditure (both public and private) available from the SFN 2023 dataset. It should be noted that the categories used in public and private current expenditure differ. The former consist of six distinct categories, while the latter account for nine. The categorization of public current expenditure is also referred as 'government functions', corresponding to five different sectors in the Classification of the Functions of Government (COFOG) (OECD 2023), plus official development assistance (ODA).

Public:

1. Protection of biodiversity and landscape
2. Sustainable agriculture, forestry and fishing
3. Wastewater management
4. Pollution abatement
5. Environmental policy and other
6. ODA

Private:

1. Biodiversity offsets and credits
2. Sustainable supply chains
3. Impact investing
4. Payments for ecosystem services (PES)
5. Conservation non-governmental organizations (NGOs)
6. Carbon markets
7. Famers' investments
8. Philanthropy
9. Private finance mobilized by ODA

NbS archetype: refers to an NbS categorization based on the five abovementioned COFOG sectors. It is used mainly for data processing – i.e., for the process of disaggregating SFN data across regions and economic sectors. NbS employment is also reported in terms of NbS archetype for current NbS expenditure (beyond being reported in aggregate terms of total NbS expenditure). The five archetypes are as follows:

1. 0402: Agriculture, forestry, fishing and hunting
2. 0502: Wastewater management
3. 0503: Pollution abatement
4. 0504: Protection of biodiversity and landscape
5. 0506: Environmental protection not elsewhere classified (n.e.c.)

Initial research to inform the inputs to the model

Beyond the SFN and PEPs data provided by ILO, a search and review of additional information was performed to inform the model inputs and enhance the methodology and processing of data vis-à-vis the previous modelling exercise as reported in ILO, UNEP and IUCN 2022. This research involved the identification of evidence to support assumptions around three key aspects:

1. Employment multipliers
2. Mapping NbS expenditure to E3ME economic sectors
3. Regional disaggregation of NbS expenditure

Employment multipliers

Employment multipliers refer to estimates of the job impacts of NbS expenditure – i.e., the number of direct jobs created by US$1 million spending on the NbS category. In the context of this modelling exercise, they differ by region and NbS category.

These estimates aim to improve the modelling of the employment impacts of NbS spending. In the ILO, UNEP and IUCN 2022 report, NbS employment modelling used employment coefficients based on the macro-econometric estimation within the E3ME model. In the current report, Cambridge Econometrics improved the employment estimates by using NbS-category-specific employment multipliers based on findings from existing literature.

This review of employment multipliers used, as a starting point, a comprehensive literature review that had been carried out for/by the ILO. This review had compiled a long list of publications on NbS (and NbS-related) research, identifying evidence from those sources that provided insights on quantitative information on the employment impacts of NbS. This information was then compiled and developed in a structured way to generate an overview of direct employment multipliers (of US$1 million invested) by region and NbS activity. Given the data limitations in terms of lacking information for specific countries and/or specific NbS activities, the information that was available was aggregated at the broader region and NbS category levels presented in the SFN data.

Besides the information gathered from the literature review conducted by/for the ILO, Cambridge Econometrics reviewed a number of additional publications with the aim of filling data gaps.

To align with the regions and expenditure types used within the SFN dataset on estimated NbS expenditure[1], the estimated employment multipliers were also organized by those categories. Table 1 presents the triangulated and aggregated information on employment

1 The SFN dataset is one of the main sources of information on NbS expenditure used in this study for estimating NbS employment.

effects and current employment found in the literature, aggregated at regional and NbS levels. The allocation of employment multipliers from the literature to NbS categories was based on the description of activities involved – i.e., their alignment with the definitions of NbS categories used in the SFN dataset. Ranges in estimates indicate that employment effects may differ, depending on the specific characteristics of the NbS activity. In some instances, when the source information was not explicitly in the desired format (i.e., jobs per US$1 million), calculations were made to derive estimates based on the figures available in the source. While the direct employment effects were the inputs used in the modelling, other information (indirect and induced effects) were also gathered and used to contextualize/ compare the modelling results. Indirect and induced effects were generated directly within the model, based on the sector mapping (more information on this below).

Table 1: Employment effects of spending on NbS activities by region and NbS category based on existing literature[2]

NBS CATEGORY	REGION	EMPLOYMENT EFFECTS (PER US$1 MILLION)		
		DIRECT	INDIRECT	INDUCED
Protection	Global			
	Middle East and Reforming Economies			
	Oceania			
	North America	13–32	5–6	
	Europe	12		
	Africa	24–38	224–259	374–506
	Asia			
	Latin America			
	Developing countries	285–428		

2 The sources of Table 1's datapoints can be found in the References.

NBS CATEGORY	REGION	EMPLOYMENT EFFECTS (PER US$1 MILLION)		
		DIRECT	INDIRECT	INDUCED
Sustainable land management	Middle East and Reforming economies			
	Oceania	160		
	North America	10–15		
	Europe	120		
	Africa			
	Asia	200–650		
	Latin America	160		
	Developing countries	500"–750		
Restoration	Middle East and Reforming economies			
	Oceania	25.4		
	North America	11–32	4–21	6.3
	Europe	6–33; 12		
	Africa			
	Asia			
	Latin America	36–50		
	Developing countries	200–625		

Based on the available information on employment multipliers from the literature presented above, a complete table with employment multiplier estimates was generated. This was done by using average values across ranges and making assumptions on the similarity between regions and NbS categories in terms of labour intensity to fill gaps. Table 2 presents the multipliers that were used subsequently in the modelling of direct employment impacts of NbS expenditure. The assumptions used to fill the data gaps in Table 2 are explained below.

Protection:

- Latin America set to Developing countries
- Middle East and Reforming economies set to average between North America and Africa

- Asia set to Developing countries
- Oceania set to North America

Sustainable land management:

- Middle East and Reforming economies set to average between Europe and Latin America
- Africa set to Developing countries

Restoration:

- Middle East and Reforming economies set to average between Europe and Latin America
- Africa set to Developing countries
- Asia set to average of Latin America and Developing countries

Table 2: Direct employment effects estimated by region and NbS category (unitary headcount per US$1 million)

REGIONS	PROTECTION	RESTORATION	SUSTAINABLE LAND MANAGEMENT
Middle East and Reforming economies	26.75	31.25	140.00
Oceania	22.50	25.40	160.00
North America	22.50	21.50	12.50
Europe	12.00	19.50	120.00
Africa	31.00	412.50	625.00
Asia	356.50	227.75	425.00
Latin America	356.50	43.00	160.00
Developing countries	356.50	412.50	625.00

SOURCE: Cambridge Econometrics

Mapping NbS expenditure to E3ME economic sectors

On mapping NbS expenditure to economic sectors, a review of existing evidence was conducted to inform a more NbS- and region-specific modelling of supply-chain impacts of expenditure – i.e., the sectors to which the money spent on different NbS activities goes. This information is crucial in the modelling of indirect employment effects of investments in NbS activities. The previous iteration of the NbS employment modelling based this sector-mapping primarily on two sources of information: namely those derived from US spending data[3] and data based on various projects from developing countries on labour and sectoral inputs. These sources were used to derive sector mappings for two categories of countries:

1. Developed countries, using the US-based data
2. Developing countries, using data provided by the ILO

The additional review carried out in the context of sector mapping aimed to obtain new evidence to inform a more detailed sector mapping in terms of regions. An attempt to identify evidence to inform a sector mapping of those regions and NbS activities that make up the largest portions of NbS expenditure was not successful[4].

A dataset that was identified in the search was Eurostat's environmental goods and services sector (EGSS) accounts (Eurostat 2016). This source provides publicly available data on environmental goods and services production by economic sectors, disaggregated by standard economic sectors (NACE Rev.2 at 1-digit level). Output on environmental goods and services was further broken down by Classification of Environmental Protection Activities (CEPA) and Classification of Resources Management Activities (CReMA) (CEPA and CReMA 2020). By identifying the relevant activities, as they relate to the categories of NbS activities, this dataset was leveraged to inform a sector mapping for European countries (further information on how this was done is provided below).

Regional disaggregation of NbS expenditure

On the regional disaggregation of NbS expenditure, the SFN dataset is subject to limitations. For most expenditure finance flow types, there was no regional disaggregation available in the dataset. For some types of expenditure, a partial picture is presented by regions, providing expenditure values for the ten largest countries. This was the case for public expenditure on 'protection of biodiversity and landscapes' and 'sustainable agriculture, forestry and fishing' as well as for private expenditure on 'farmer's investments' and 'finance mobilized by ODA'. For all other categories of NbS spending, no regional disaggregation was available. To resolve this limitation, three measures were taken:

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3 USASPENDING.gov, "The official source of government spending data"

4 This involved searching specifically for information on supply chains of investments in the protection of biodiversity and landscapes, and sustainable agriculture, forestry and fishing in China, which represents a large share of NbS spending in the total.

1. In the case of expenditure types in which the SFN dataset does not provide the expenditure shares of the top-ten spending countries, the regional disaggregation of the global expenditure total was made using regional shares from the previous iteration of the SFN dataset (which contained comprehensive regional expenditure information for public NbS expenditure). Public expenditure in ODA is an exception, which is explored in the third bullet point.
2. In the case of expenditure types in which the SFN dataset does provide shares for the top-ten spending countries, the E3ME regions corresponding to said countries were disaggregated according to these shares, while the remaining expenditure was disaggregated across the remaining regions in accordance with using regional shares from the previous iteration of the SFN dataset.
3. For public expenditure on ODA in NbS activities, the OECD dataset – Creditor Reporting System (CRS) data on public ODA – was used to calculate shares of ODA by countries, which were subsequently used to disaggregate the public ODA expenditure in the SFN dataset by countries.

Modelling current NbS expenditure

In the scope of this modelling exercise, multiple datasets of varied sources were used and processed to produce model inputs with the goal of estimating current employment in NbS. Chief among these datasets was SFN 2023 data, which includes current NbS expenditure. This section of the Annex delves into how these datasets were processed and combined in the pursuit of this modelling exercise's goal.

The datasets used in the processing of modelling inputs directly linked to current employment in NbS can be grouped in three categories, based on the scope of their use.

These are:

Data used in the processing of 2023 NbS expenditure

- SFN data 2023
- OECD CRS data on public ODA
- Ethiopian NbS project reports

Data used in the processing of 2021 NbS expenditure (which was then used to process 2023 NbS expenditure)

- SFN data 2021
- IMF NbS expenditure data
- Restoration Barometer data

Other datasets (used in the processing 2023 NbS expenditure data and in the processing of PEPs data)

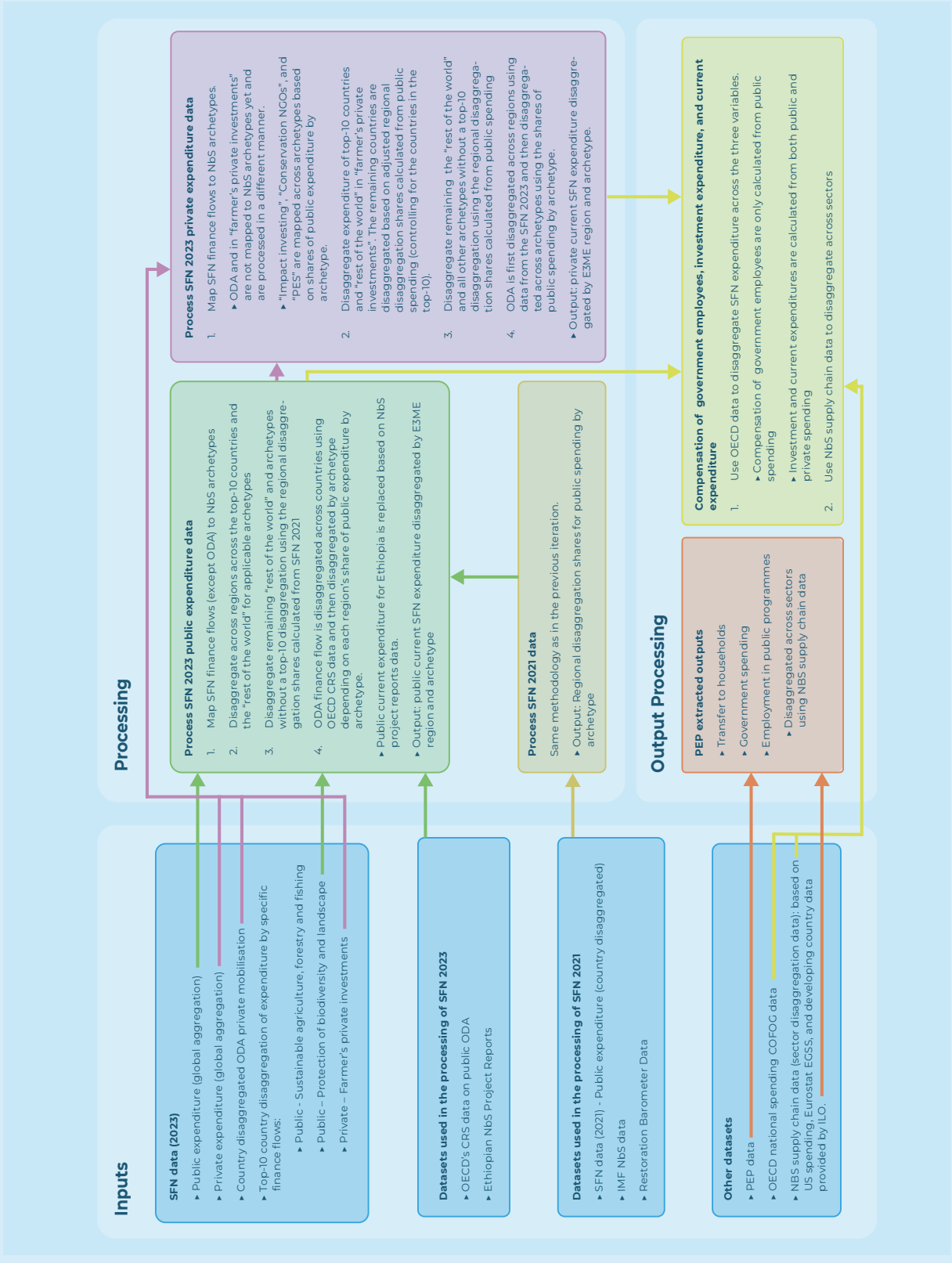
- PEPs data
- OECD COFOG national general government spending data
- NbS supply chain data (US spending data, ILO data from developing countries' projects, Eurostat's EGSS)

Global annual NbS expenditure was estimated at approximately US$200 billion in the SFN 2023 report, to which another US$21 billion was added from selected PEPs. For current expenditure data in the SFN 2023, public and private expenditure data were made available separately. Relative to total current expenditure, 82 per cent was public expenditure, while 18 per cent was private.

Current expenditure along the processing of modelling inputs was, ultimately, further disaggregated into three types: current expenditure, investment expenditure and government employee wages. Each of these spending variables has distinct impacts within the model. In modelling terms, investment expenditure corresponds to Gross Fixed Capital Formation (GFCF) and represents the fixed tangible and intangible assets required for establishing or expanding NbS activities (similar to Capital Expenditures or CAPEX). Current expenditure pertains to the goods and services necessary for maintaining existing NbS solutions (similar to Operating Expenses or OPEX). As NbS programmes are publicly funded, it was assumed that some government employees were involved in managing and running these programmes, and their salaries were included under compensation of government employees, which encompasses wages and salaries along with any employers' social security contributions. The processing of the data is explored in further detail below.

The processing of current NbS expenditure SFN 2023 data (complemented by the other datasets) took place across four sequential phases. This processing can be visualized in Figure 2, it also depicts the processing of PEPs data, which is used to estimate current employment in NbS as well.

Figure 2: Data processing flowchart for SFN and PEPs datasets



SOURCE: Cambridge Econometrics

1) Processing SFN 2021 data

The starting phase of the processing procedure did not use the latest SFN dataset, but SFN 2021 data instead. This was due to the fact that the SFN 2023 dataset did not provide a full country-level disaggregation for either public or private NbS expenditure. For this reason, SFN 2021 was used to calculate, for each NbS archetype, a proxy for each country's public current expenditure shares relative to global current public NbS expenditure.

The processing of SFN 2021 data was consistent with the processing of the previous iteration of the project. Together with the SFN 2021 dataset, this processing also took as inputs complimentary IMF data on NbS expenditure as well as Restoration Barometer data, which were used to adjust the scale of NbS expenditure in some countries.

2) Processing SFN 2023 public expenditure data

The second phase of the processing entailed the entering of SFN 2023 public NbS current expenditure data. This was done in four steps:

First, the global aggregate on public current NbS expenditure was extracted and its finance flow (also referred in the dataset as government function) types were mapped (one-to-one) to their respective NbS archetypes. Please note that the ODA entry, due to being the only current public NbS finance flow that does not correspond to a COFOG category already, is processed differently from the rest of the data – more detail on its processing is described in step four. This mapping was conducted so that it was possible to disaggregate global expenditure across regions using regional shares from SFN 2021 data and, later on, for sectoral mapping of modelling inputs.

Second, the expenditure data was then disaggregated across regions depending on the finance flow's (and, consequently, archetype's) availability of data for the disaggregation of the top-ten spending countries within the SFN 2023 dataset. For public expenditure this was the case for the 'sustainable agriculture, forestry and fishing' as well as 'protection of biodiversity and landscape' finance flows. This allowed for the country disaggregation for the vast majority of global expenditure in the corresponding archetypes: 86 per cent and 90 per cent of the archetypes' global public current expenditure, respectively.

Third, after the previous step followed a continuation of the regional disaggregation of public SFN expenditure by archetype, based on the shares of public current expenditure from the processed SFN 2021 dataset. Concerning the two archetypes for which SFN 2023 did provide a top-ten countries disaggregation, remaining expenditure was disaggregated across the remaining countries using adjusted shares from SFN 2021, controlling for the countries that have already been disaggregated. Concerning the other archetypes, the global aggregate public current SFN expenditure was disaggregated according to SFN 2021 shares alone.

Last but not least, the fourth step pertained to the processing of ODA. Global ODA public current expenditure in the SFN 2023 dataset was extracted and distributed across the various countries, depending on shares calculated from OECD'S CRS data on public ODA

disbursement[5]. Once the geographic disaggregation of ODA was implemented, these disbursements were then distributed across archetypes according to each individual country's weight for each archetype in total expenditure.

With the disaggregation of public NbS expenditure finished, the value for Ethiopia (represented in E3ME within the Rest of East Africa region) was set to be equal to the sum present across the three Ethiopian NbS project reports provided by ILO based on different projects, given that the value was underestimated post-processing. The expenditure across other regions was adjusted in order to match the global NbS expenditure value in SFN 2023.

3) Processing SFN 2023 private expenditure data

The third phase of the processing entailed the processing of SFN 2023 private NbS current expenditure data. This was also done in four steps.

The first step was to map NbS finance flows present in the SFN dataset to NbS archetypes as shown in Table 33. In this initial step, it was important to note that 'Impact investing', 'Conservation NGOs' and 'PES' categories, instead of being assigned to a single archetype, were mapped and disaggregated across all archetypes using the global shares of public spending by archetype. Similarly to public current expenditure, ODA received special treatment, which is explored in more detail in the fourth step. 'Farmer's private investments' were also treated separately, being aggregated with 'sustainable agriculture, forestry and fishing' after regional disaggregation (see step two, below). This mapping was conducted so that it was possible to disaggregate global expenditure across regions using regional shares from public expenditure (step three) and, later, for sectoral mapping of the modelling inputs.

5 OECD n.d. "Data Explorer". The following filters were used: time: 2018–2022; donor: official donor(s); recipient: leave empty (will include all countries); sector: general environment protection; measure: ODA; channel: public sector, multilateral organizations; modality: all modalities; flow type: disbursements; price base: constant prices.

Table 3: Private SFN category to NbS Archetype mapping

SFN CATEGORY	NBS ARCHETYPE				
	AGRICULTURE, FORESTRY, FISHING AND HUNTING	PROTECTION OF BIODIVERSITY AND LANDSCAPE	WASTEWATER MANAGEMENT	POLLUTION ABATEMENT	ENVIRONMENTAL PROTECTION N.E.C.
Sustainable supply chains	100%	-	-	-	-
Biodiversity offsets	-	100%	-	-	-
Impact investing	24%	46%	11%	10%	9%
Conservation NGOs	24%	46%	11%	10%	9%
Private finance mobilized by official development finance interventions					N/A
Philanthropy	-	100%	-	-	-
Carbon markets / Forest and land-use carbon finance	100%	-	-	-	-
PES	24%	46%	11%	10%	9%
Farmer's investments into regenerative agriculture					N/A

SOURCE: Cambridge Econometrics

In the second step, private expenditure for 'farmer's private investments' was disaggregated across its top-ten countries (amounting to 93 per cent of global expenditure) according to SFN 2023 data. The remaining expenditure was spread accordingly to adjust SFN 2023 public current expenditure country shares for 'sustainable agriculture, forestry and fishing'.

Third in line, the private spending already mapped to NbS archetypes in step one was disaggregated across regions according to the archetype's country shares in public current expenditure.

Fourthly, private SFN ODA was also disaggregated across countries and archetypes. The geographic disaggregation was based on SFN 2023 data, whilst the disaggregation across archetypes was made according to each country's expenditure by archetype shares. Once this was done all private expenditure was at last aggregated to their respective archetypes.

4) Output processing

There were two main components to this phase of the data processing: processing PEPs data into the model inputs and finalizing the processing of current NbS expenditure-based model inputs.

Current NbS expenditure model inputs

Continuing the processing of SFN data, expenditure was split across three model inputs: current expenditure, investment expenditure and compensation of government employees; with public expenditure being disaggregated between the three pathways, while private expenditure was only between the first two pathways.

The share of each of these pathways was based on OECD COFOG national general government spending data (for the United States (US) it was based on US spending data). Where data were not available for a country in the OECD COFOG data, then the average for the Euro Area countries was used.

Investment and current expenditure were also disaggregated across sectors through the NbS supply-chain mapping and shares. This mapping contained differing shares across NbS archetype, current and investment expenditures, and region. The NbS supply chain is explored in a later section of the Annex.

To model government expenditure on the compensation of employees, employment is added exogenously to the public administration sector (ISIC O). The number of jobs created is calculated using E3ME data for employment cost (average wage and employer social security contributions) in the public administration sector.

The gross domestic product (GDP) accounting in the modelling assumed:

1. government current expenditure on the compensation of employees contributes directly to GDP
2. government current expenditure on NbS contributes directly to GDP
3. investment expenditure on NbS, private and public, contributes directly to GDP
4. current expenditure by the private sector does not contribute directly to GDP – this is intermediate consumption

The modelling methodology did not account for the source of private expenditure; the cost of intermediate consumption is not attributed to any sector. There were no impacts on production costs and, therefore, to sectoral prices. This dynamic is appropriate where private finance is sourced from philanthropy or spent by conservation NGOs. Where private

expenditure should be accounted as a cost to production, the methodology did not model the cost and price implications of NbS expenditure.

Current NbS expenditure model inputs were processed in two ways: first, NbS expenditure was aggregated across all archetypes; secondly, the model inputs were processed separately for each of the five NbS archetypes. These two ways permitted the assessment of both the impact of total current NbS expenditure as well as the specific impact of expenditure in each of the NbS archetypes.

Public employment programmes

Though public employment programmes (PEPs) inputs were processed independently from those of the SFN, they were still relevant in the estimation of current NbS employment. The direct employment under PEPs was not modelled within E3ME, so the PEPs figures shared by ILO were added exogenously to the model. The induced impacts of the PEPs expenditure were included within the E3ME modelling, generating further employment in the economy. Where financial data was missing for programmes, the methodology underestimated the induced impacts of PEPs.

From the PEPs dataset provided by ILO, the variables of interest – namely, household transfers, government spending, employment and full-time equivalent (FTE) – were extracted and processed into model inputs. The latter two of these variables were also disaggregated across sectors using NbS supply-chain sector shares data when needed. The PEPs dataset also indicated an NbS archetype for each respective PEPs entry.

NbS supply-chain mapping and shares

For the sake of disaggregating the modelling inputs across the sectoral classification present in E3ME, a mapping matrix to proxy sectoral decomposition of NbS supply chains was constructed. This mapping matrix includes different sectoral shares dependent on region, NbS archetype and whether current expenditure or investment expenditure is being disaggregated.

Concerning regional differentiation of the matrix, there are three main regions for which different data sources are used. For developed non-European countries, the sectoral shares are based on data from US spending data. For the European countries[6] the sectoral shares are based on Eurostat's EGSS dataset[7]. While for developing countries, the sectoral shares are also informed by data on reforestation shared by ILO.

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6 EU27 countries plus Iceland, North Macedonia, Norway, Switzerland, Türkiye and the United Kingdom.

7 Eurostat n.d., "Production, Vale Added and Exports in the Environmental Goods and Services Sector"
The following CEPA and CReMA classifications were used and mapped to the following NbS archetypes:
Management of forest resources -> 0402: Agriculture, forestry, fishing and hunting
Wastewater management -> 0502:
Wastewater management Protection of ambient air and climate -> 0503: Pollution abatement
Protection of biodiversity and landscapes -> 0504: Protection of biodiversity and landscape
Other environmental protection activities -> 0506: Environmental protection n.e.c.

For non-European developed countries and developing countries, the same shares are used across all countries in the respective group, whilst for European countries, each country uses country-specific sectoral shares dependent on data from Eurostat.

Table 4 details the assumption by NbS archetype, region and expenditure type. The table gives the E3ME sector to which expenditure on each NbS archetype is directed, across current and investment expenditure categories. Values in parentheses indicate the share of value. For the European region, the average Europe disaggregation and values are indicated. The value for each specific country varies around these values.

Table 4: NbS supply chain sectoral mapping by broad region based on existing literature

EUROPEAN (SHOWCASING EUROPE AVERAGE SHARES)		
NbS archetype	**Expenditure**	**E3ME sector**
Agriculture, forestry, fishing and hunting	Current	Water supply (0.35) Crop production (0.28) Forestry (0.28) Public admin. and defence (0.07) Fishing (0.01)
	Investment	Electronics (0.47) Machinery, equipment n.e.c. (0.47) Construction (0.07)
Wastewater management	Current	Sewerage and waste (0.54) Construction (0.2) Water supply (0.14) Architect and engineer (0.04)
	Investment	Construction (0.51) Machinery, equipment n.e.c. (0.27) Electronics (0.22)
Pollution abatement	Current	Architect and engineer (0.31) Other professional services (0.23) Public admin. and defence (0.19) R&D activities (0.18) Sewerage and waste (0.09)
	Investment	Electronics (0.91) Computer services (0.07) Construction (0.02)

EUROPEAN (SHOWCASING EUROPE AVERAGE SHARES)		
NbS archetype	**Expenditure**	**E3ME sector**
Protection of biodiversity and landscape	Current	Public admin. and defence (0.72) R&D activities (0.11) Other professional services (0.11) Crop production (0.08) Forestry (0.08)
	Investment	Computer services (0.53) Construction (0.25) Electronics (0.18) Other mining (0.02) Real estate (0.02)
Environnemental protection n.e.c.	Current	Public admin. and defence (0.67) R&D activities (0.32) Sewerage and waste (0.01)
	Investment	Electronics (0.41) Machinery, equipment n.e.c. (0.34) Construction (0.21) Other mining (0.04)
non-European developed		
Agriculture, forestry, fishing and hunting	Current	Agriculture, fishing and hunting (0.4) Forestry (0.4) Professional services (0.2)
	Investment	Electronics (0.5) Construction (0.5)
Wastewater management	Current	Miscellaneous services (0.4) Construction (0.4) Professional services (0.2)
	Investment	Construction (0.84) Mechanical engineering (0.09) Electronics (0.07)
Pollution abatement	Current	Miscellaneous services (0.8) Professional services (0.2)
	Investment	Electronics (0.75) Construction (0.13) Computer services (0.12)

EUROPEAN (SHOWCASING EUROPE AVERAGE SHARES)		
NbS archetype	**Expenditure**	**E3ME sector**
Protection of biodiversity and landscape	Current	Agriculture, fishing and hunting (0.4) Forestry (0.4) Professional services (0.2)
	Investment	Electronics (0.5) Construction (0.3) Computer services (0.2)
Environnemental protection n.e.c.	Current	Construction (0.5) Professional services (0.5)
	Investment	Construction (0.8) Electronics (0.11) Mechanical engineering (0.09)
non-European developing		
Agriculture, forestry, fishing and hunting	Current	Professional services for private expenditure or public admin. and defence (0.41) Chemicals (0.24) Forestry (0.22) Wood and paper (0.13)
	Investment	Chemicals (0.5) Forestry (0.25) Wood and paper (0.17) Metal products (0.04) Professional services or Public admin. and defence (0.04)
Wastewater management	Current	Miscellaneous services (0.4) Construction (0.4) Professional services (0.2)
	Investment	Construction (0.84) Mechanical engineering (0.09) Electronics (0.07)
Pollution abatement	Current	Miscellaneous services (0.8) Professional services (0.2)
	Investment	Electronics (0.75) Construction (0.13) Computer services (0.12)

EUROPEAN (SHOWCASING EUROPE AVERAGE SHARES)		
NbS archetype	**Expenditure**	**E3ME sector**
Protection of biodiversity and landscape	Current	Professional services for private expenditure or public admin. and defence (0.41) Chemicals (0.24) Forestry (0.22) Wood and paper (0.13)
	Investment	Chemicals (0.55) Forestry (0.25) Wood and paper (0.17) Metal products (0.04) Professional services or Public admin. and defence (0.04)
Environnemental protection n.e.c.	Current	Construction (0.5) Professional services (0.5)
	Investment	Construction (0.8) Electronics (0.11) Mechanical engineering (0.09)

SOURCE: Cambridge Econometrics

Modelling future NbS expenditure

The methodology employed in estimating future employment impacts of the increased NbS expenditure uses the same methodology as the one outlined above for current employment, in the sense that the future expenditure requirements are mapped to different economic sectors in the E3ME model and differentiated between CAPEX and OPEX modelling inputs.

The SFN 2023 dataset accounts for future NbS expenditure across 13 NbS activities for 18 distinct regions. Table 6 lists these NbS activities and regions as well as indicating the distribution of total future NbS expenditures across region–activity combinations in 2030.

The 18 regions for which future NbS expenditure is available have been further disaggregated to align with E3ME model regions by using current expenditure regional patterns. This means that, for example, the disaggregation of the Oceania region to the relevant E3ME regions (e.g., Australia, New Zealand, etc.) is made by using the proportion of current expenditure of each individual region in relation to the broader one (i.e., the expenditure share of Australia

in Oceania). This gives rise to a limitation of the modelling exercise, as the current NbS expenditure patterns do not always reflect future expenditure needs and/or abilities.

The mapping of the 13 NbS activities to the different sectors, as well as a brief explanation of the selected mapping, can be found below (Table 7). In relation to this mapping, the allocation between CAPEX and OPEX is based on the current expenditure split by region and the public–private split is based on data available in the MAgPIE (Model of Agricultural Production and its Impact on the Environment) modelling results.

It is also worth highlighting that the results of the modelling exercise are subject to the similar limitations discussed in Section 2.2.1 of the main report.

Similar to current NbS expenditure, future NbS expenditure model inputs are also processed in two distinct variants: one in which future NbS expenditure is aggregated across all NbS categories, and another in which it is disaggregated by the three NbS categories. The justification behind this approach is the same as in the case of the current expenditure approach: it allows for the assessment of the impact of future NbS expenditure overall as well as giving the impacts of each specific NbS category. The mapping between the 13 future NbS activities and NbS categories is presented in the Table 5.

Table 5: Mapping of NbS activities to NbS categories

NBS CATEGORY	NBS ACTIVITY
Protected areas/avoided conversion	Protected areas Avoided deforestation Avoided peatland conversion Avoided mangrove conversion Avoided grassland conversion Avoided seagrass conversion
Restoration	Reforestation Reforestation of peatland Reforestation of mangrove Reforestation of saltmarshes Reforestation of seagrass
Sustainable land management	Agroforestry – silvoarable Agroforestry – silvopasture Cover crops Grazing – optimal intensity

SOURCES: SFN 2023

Table 6: Allocation of future NbS expenditure by region and activity in 2030, per cent of total expenditure

	Oceania	Brazil	Canada	China	Japan and Korea	EU	India
PROTECTED AREAS	1.3	1.2	1.2	1.3	0.1	0.7	0.3
SEAGRASS – AVOID	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AVOIDED MANGROVE IMPACT	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RESTORATION OF MANGROVES	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AVOIDED GRASSLAND CONVERSION	0.1	0.0	0.0	0.0	0.0	0.3	0.0
AVOIDED PEATLAND IMPACT	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GRAZING - OPTIMAL INTENSITY	0.1	0.0	0.0	0.3	0.0	0.0	0.0
COVER CROPS	0.1	0.1	0.0	0.1	0.0	0.2	0.6
RESTORATION OF PEATLANDS	0.0	0.0	0.1	0.6	0.0	1.9	0.0
AVOIDED DEFORESTATION	0.0	0.9	0.0	0.0	0.0	0.0	0.0
AGROFORESTRY – SILVOARABLE	0.3	0.7	0.1	1.8	0.0	0.8	2.3
AGROFORESTRY - SILVOPASTURE	1.7	0.7	0.0	2.2	0.0	0.6	0.3
REFORESTATION	0.0	2.2	0.0	18.8	0.2	0.0	5.5

SOURCES: MAgPIE and State of Finance for Nature 2023

Middle East and North Africa	Other Europe, excluding EU and UK	Reforming countries	Russia	Southern Africa	South Asia	Latin America's Southern Cone	Southeast Asia	Tropical Africa	Tropical Latin America	US
1.1	0.3	0.7	1.7	0.4	0.2	0.4	0.6	2.6	1.2	1.1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
0.2	0.0	0.4	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.1
0.1	0.0	0.0	0.2	0.0	0.0	0.1	0.2	0.2	0.0	0.3
0.0	0.3	0.0	0.1	0.0	0.0	0.0	11.0	0.1	0.1	0.3
0.1	0.0	0.0	0.0	0.0	0.0	1.1	1.7	0.1	0.3	0.0
1.0	0.4	0.2	0.3	0.1	0.4	0.2	0.3	0.4	0.2	0.4
4.3	0.2	4.9	1.0	0.3	0.2	0.6	0.1	0.2	0.6	0.7
0.0	0.0	0.0	0.0	0.1	0.4	0.8	0.9	1.6	0.8	0.0

Table 7: Proposed mapping of future NbS activity to sector

NBS ACTIVITY	DEVELOPED: CAPEX	DEVELOPED: OPEX	DEVELOPING: CAPEX	DEVELOPING: OPEX
Reforestation	46% Electronics; 47% Machinery equipment; 7% Construction	61% Forestry; 33% Water supply; 6% Public admin.	50% Chemicals; 25% Forestry; 5% Public admin.; 17% Wood and paper; 4% Metal goods	35% Forestry; 41% Public admin.; 24% Chemicals
Agroforestry – silvopasture	46% Electronics; 47% Machinery equipment; 7% Construction	31% Agriculture; 30% Forestry; 33% Water supply; 6% Public admin.	29% Forestry; 35% Metal products;16% Wood and paper; 14% Chemicals; 6% Public admin.	25% Forestry; 22% Chemicals; 53% Public admin.
Agroforestry – silvoarable	46% Electronics; 47% Machinery equipment; 7% Construction	31% Agriculture; 30% Forestry; 33% Water supply; 6% Public admin.		
Avoided deforestation	46% Electronics; 47% Machinery equipment; 7% Construction	61% Forestry; 33% Water supply, 6% Public admin.	50% Chemicals; 25% Forestry; 5% Public admin.; 17% Wood and paper; 4% Metal goods	35% forestry; 41% Public admin.; 24% Chemicals
Restoration of peatlands	10% Real estate; 5% Public admin.; 15% Computer science; 10% Construction; 30% Machinery and equipment; 30% Electronics	10% Public admin.; 15% Computer Science; 15% Electronics; 15% Machinery and equipment; 10% Construction; 10% Agriculture; 15% R&D; 10% Arts, entertainment and recreation	10% Real estate; 5% Public admin.; 15% Computer science; 10% Construction; 30% Machinery and equipment; 30% Electronics	10% Public admin.; 15% Computer science; 15% Electronics; 15% Machinery and equipment; 10% Construction; 10% Agriculture; 15% R&D; 10% Arts, entertainment and recreation
Cover crops	46% Electronics; 47% Machinery equipment; 7% Construction	61% Agriculture; 33% Water supply, 6% Public admin.	50% Chemicals; 42% Agriculture; 5% Public admin.;; 3% Metal goods	35% Forestry; 41% Public admin.; 24% Chemicals
Grazing -– optimal intensity	46% Electronics; 47% Machinery equipment; 7% Construction	61% Agriculture; 33% water supply, 6% Public admin	46% Electronics; 47% Machinery equipment; 7% Construction	61% Agriculture; 33% water Supply, 6% Public admin.

Avoided peatland impact	10% Real estate; 5% Public admin.; 15% Computer science; 10% Construction; 30% Machinery and equipment; 30% Electronics	10% Public admin.; 15% Computer science; 15% Electronics; 15% Machinery and equipment; 10% Construction; 10% Agriculture; 15% R&D; 10% Arts, entertainment and recreation	10% Real estate; 5% Public admin.; 15% Computer science; 10% Construction; 30% Machinery and equipment; 30% Electronics	10% Public admin.; 15% Computer science; 15% Electronics; 15% Machinery and equipment; 10% Construction; 10% Agriculture; 15% R&D; 10% Arts, entertainment and recreation
Avoided grassland conversion	40% Construction (hydrology); 3% Chemicals; 11% Agriculture; 17% Forestry (cutting of wood mass); 18% Machinery and equipment; 11% Electronics	17% Chemicals; 40% Agriculture (seeds and mowing/ burning); 10% Public admin.; 13% Computer science; 10% Electronics; 10% R&D	40% Construction (hydrology); 3% Chemicals; 11% Agriculture; 17% Forestry (cutting of wood mass); 18% Machinery and equipment; 11% Electronics	17% Chemicals; 40% Agriculture (seeds and mowing/ burning); 10% Public admin.; 13% Computer science; 10% Electronics; 10% R&D
Restoration of mangroves	33% Forestry, 46% Construction; 13% Architecture; 8% Machinery and equipment	40% Forestry; 25% Construction; 25% Public admin.; 10: Machinery and equipment	67% Public admin.; 25% Forestry; 1% Construction; 5% Machinery and equipment; 2% Water transport	40% Forestry; 25% Construction; 25% Public admin.; 10: Machinery and equipment
Avoided mangrove impact	33% Forestry, 46% Construction; 13% Architecture; 8% Machinery and equipment	40% Forestry; 25% Construction; 25% Public admin.; 10% Machinery and equipment	67% Public admin.; 25% Forestry; 1% Construction; 5% Machinery and equipment; 2% Water transport	40% Forestry; 25% Construction; 25% Public admin.; 10: Machinery and equipment
seagrass-avoid	35% Agriculture (seagrass seeds/ seedlings?), 20% Construction; 15% R&D; 15% Machinery and equipment; 10% Electronics; 5% Water transport	35% Public admin.; 15% Electronics; 20% Machinery and equipment; 15% R&D; 15% Water transport	35% Agriculture (seagrass seeds/ seedlings?), 20% Construction; 15% R&D; 15% Machinery and equipment; 10% Electronics; 5% Water transport	35% Public admin.; 15% Electronics; 20% Machinery and equipment; 15% R&D; 15% Water transport
Protected areas	2% Mining; 18% Electronics; 27% Construction; 50% Computer services; 3% Real estate	5% Forestry; 5% Agriculture; 9% R&D; 1% Other professional services; 80% Public admin.	50% Chemicals; 25% Forestry; 4% Public admin.; 17% Wood and paper; 4% Metal goods	35% Forestry; 41% Public admin.; 24% Chemicals

SOURCE: Cambridge Econometrics

NOTES: Percentages may not add up to 100, due to rounding.

Modelling employment

The direct employment in NbS presented in Section 2.2.2 of the main report is a result of:

1. Direct employment exogenously added from PEPs.
2. Government employees in NbS work or administering NbS work.
3. E3ME estimation from government and private current and investment expenditure on NbS.

The indirect employment effects result from the private and public expenditure on NbS. Induced effects accrue through income effects from direct and indirect employment.

Comparison to employment estimates reported in Decent Work in NbS 2022

There are various differences in NbS employment results between the results presented in this report and those reported in Decent Work in NbS 2022 (ILO, UNEP and IUCN 2022).

The SFN reports highlighted that expenditure increased substantially in 2021–2023, from US$154 billion to US$200 billion. This increase led to higher non-PEPs NbS employment estimates in the current iteration. In the 'standard' scenario – which is comparable in its design to the modelling exercise in the 2022 report – non-PEPs-related NbS employment increased from around 3.5 million to around 6 million people.

Considering total NbS employment, including the NbS employment from PEPs, there has been a substantial drop in employment since the previous release. This is due to a substantial reduction in the number of people working on NbS through a reduction in the overall number of people working in the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) in India. This scheme, which is structured as an employment guarantee, reached a peak in 2021–22, employing a total of 106 million people in the aftermath of COVID-19, when many people who lost their jobs took up the opportunity to work in this scheme. Since then, many people have returned to other jobs and the total number of people working in 2023–24 was reduced to 83 million (Government of India 2024). The total number of those involved in natural resource management (NRM) work has also decreased. Furthermore, since 2023, while there has been no change in the works permissible under the scheme, a new categorization of these works was introduced and many activities previously categorized as NRM, are now classified as supporting agriculture, although their nature has not changed. This new categorization makes an exact comparison with the data from 2021–2022 more difficult. However, the norm that the overall share of expenditure on NRM-related activities should be above 60 per cent has remained in effect.

Improvements in the future employment modelling approach compared to the 2022 edition of Decent Work in NbS

While the broad methodological approach remains the same as in the 2022 version of this report – i.e., future investment needs are mapped to regions and economic sectors and then inputted into the E3ME model to generate estimates of economic growth and employment – some improvements to the modelling approach were possible for this 2024 edition because of better input data:

- Better disaggregation to regions

  Under the previous modelling exercise future expenditure requirements were available mainly at global level (only reforestation had a regional dimension). Under the current modelling exercise, input data was available for 18 regions for all NbS activities allowing for a better regional allocation of future investment needs.

- Better mapping of NbS activities to economic sectors

  Under the current modelling exercise, future NbS expenditure is estimated for 13 different NbS activities – a significant improvement to the four activities available under the previous exercise. This more detailed differentiation, coupled with findings from a literature review, led to a more distinct and varied sectoral mapping.

There are also some interesting differences with future employment estimates compared to the estimates reported in Decent Work in NbS 2022 (ILO, UNEP and IUCN 2022). For this 2024 edition of the report, the future NbS investment requirements were estimated to be higher in 2030 compared to levels reported in the 2022 report. Despite this, employment effects for the lower scenario are on a similar scale in both reports.

While the level of investment is important in determining the level of economic activity and thus employment, the sectors benefitting from the investment are also important. The limited information about the NbS activities where future investment took place in the 2022 report (only four), resulted in a narrower distribution of investment among economic sectors, with most of the investment activity concentrated in agriculture and forestry and its supply chain. In the current exercise, the availability of future NbS activities (13 in total) has led to a more diversified allocation of investment. This diversification has led to the creation of jobs in sectors that are higher value-added on average compared to agriculture and forestry and have a higher earning potential. The changes to the sectoral mapping of future NbS investment, while in the lower bound scenario, not leading to a significantly higher number of jobs overall, despite the increased investment compared to the 2022 version, have resulted in an increased number of jobs with higher earning potential. This is illustrated in Table 8, with just under a half of the new jobs created being in agriculture and forestry (compared to 70 per cent in the 2022 report), with more jobs generated in manufacturing, public services and business services, which, on average, would have higher earning potential.

Table 8: Employment effect distribution by sector in 2030, per cent of total

	WORLD TOTAL, 2022 VERSION	WORLD TOTAL, 2024 VERSION
Agriculture and forestry	70	44
Extractive industries	0	0
Manufacture	12	18
Energy and utilities	0	3
Construction	2	5
Distribution, retail, hotels and catering	3	6
Transport and storage	1	1
Business services	4	6
Public services	8	16

SOURCES: Cambridge Econometrics E3ME model

Regional classification of countries included in the modelling results

Modelling results are presented at a macro-regional level, resulting from the sum of various E3ME modelling regions. The mapping of E3ME modelling regions to macro-regions can be found in Table 9.

There are two types of macro-regional classification. The first one is based on geographic location, while the second is based on income level. Income groups are defined according to the World Bank's income group classifications[8]. It should also be noted that E3ME regions that contain more than a country are not present in this mapping, having instead been recorded separately as 'Rest of the world'.

8 World Bank Blogs, "World Bank Country Classifications by Income Level for 2024–2025"

Table 9: Regional classification of countries included in the modelling results

GEOGRAPHIC BASED MACRO-REGIONS (AS PRESENTED IN MODELLING RESULTS)	COUNTRIES PRESENT IN E3ME MODELLING
Africa	Democratic Republic of Congo Egypt Kenya Nigeria South Africa
North America	Canada United States of America
Latin America and Caribbean	Argentina Brazil Colombia Mexico
Arab States	Saudi Arabia United Arab Emirates
Asia and the Pacific	Australia China India Indonesia Japan Republic of Korea Malaysia New Zealand
EU27	Austria Belgium Bulgaria Croatia Cyprus Czechia Denmark Estonia Finland France Germany Greece Hungary Ireland

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GEOGRAPHIC BASED MACRO-REGIONS (AS PRESENTED IN MODELLING RESULTS)	COUNTRIES PRESENT IN E3ME MODELLING
EU27	Italy Latvia Lithuania Luxembourg Malta Netherlands Poland Portugal Romania Slovakia Slovenia Spain Sweden
Rest of Europe and Central Asia	Belarus Iceland Kazakhstan North Macedonia Norway Russian Federation Switzerland Türkiye Ukraine United Kingdom of Great Britain and Northern Ireland
Income group based macro-regions (as presented in modelling results)	**Countries present in E3ME modelling**
High income	Australia Austria Belgium Bulgaria Canada Cyprus Czechia Denmark Estonia Finland France Germany Greece Hungary Iceland Ireland Italy »

GEOGRAPHIC BASED MACRO-REGIONS (AS PRESENTED IN MODELLING RESULTS)	COUNTRIES PRESENT IN E3ME MODELLING
High income	Japan Republic of Korea Latvia Lithuania Luxembourg Malta Netherlands New Zealand Norway Poland Portugal Russian Federation Saudi Arabia Slovakia Slovenia Spain Sweden Switzerland United Arab Emirates United Kingdom of Great Britain and Northern Ireland United States of America
Upper-middle income	Argentina Belarus Brazil China Colombia Croatia Kazakhstan Malaysia Mexico North Macedonia Romania South Africa Türkiye Ukraine
Lower-middle income	Egypt India Indonesia Kenya Nigeria
Low income	Democratic Republic of Congo

SOURCE: Cambridge Econometrics

References

Classification of Environmental Protection Activities and Expenditure (CEPA) and Classification of Resource Management Activities (CReMA). 2020. Explanatory notes. https://ec.europa.eu/eurostat/documents/1798247/12177560/CEPA+and+CReMA+explanatory+notes+-+technical+note.pdf/b3517fb9-1cb3-7cd9-85bd-4e3a3807e28a?t=1609863934103

Deltares. 2021. Economic Rationale of NBS in Freshwater Ecosystems. Deltares: Ethiopia. https://wwfint.awsassets.panda.org/downloads/economic_rationale_of_nbs_in_freshwater_ecosystems_1.pdf

Edwards, Peter E.T, Ariana Sutton-Grier, and G.E. Coyle. 2013. "Investing in Nature: Restoring Coastal Habitat Blue Infrastructure and Green Job Creation. Marine Policy. 38. 65–71. https://doi.org/10.1016/j.marpol.2012.05.020

Eurostat. 2016. Practical Guide: Environmental Goods and Services Sector Accounts — 2016 Edition. Eurostat: Luxembourg. https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-GQ-16-011

———. n.d., "Production, Vale Added and Exports in the Environmental Goods and Services Sector" https://ec.europa.eu/eurostat/databrowser/view/env_ac_egss2__custom_12257657/default/table?lang=en

Government of India. 2024. Mahatma Gandhi National Rural Employment Guarantee Act, 2025: Annual Master Circular 2024–25. https://nregaplus.nic.in/netnrega/writereaddata/Circulars/AMC_2024-25-English.pdf

International Labour Organization. 2018. The Employment Impact of Climate Change Adaptation. ILO: Geneva. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/@ed_emp/documents/publication/wcms_645572.pdf

ILO, UNEP and IUCN. 2022. Decent Work in Nature-based-Solutions 2022. https://www.ilo.org/publications/decent-work-nature-based-solutions-2022

Merry, Frank, Paola B. Pulido, and Manuelita Montaño. 2023. The Employment Effect of ASL Forest Restoration Projects. Climate Focus North America: Washington DC. https://documents1.worldbank.org/curated/en/099092923113017994/pdf/P17360208cff16014099aa0d929924a38f1.pdf

Metreau, Eric, Kathryn Elizabeth Young, and Shwetha Grace Eapen. 2024. "World Bank Country Classifications by Income Level for 2024–2025". World Bank Blogs. 1 July 2024. https://blogs.worldbank.org/en/opendata/world-bank-country-classifications-by-income-level-for-2024-2025

New Zealand Government. 2020. "Press Release on the $1.1 billion investment to create 11,000 environment jobs in our regions", 14 May 2020. https://www.beehive.govt.nz/release/11-billion-investment-create-11000-environment-jobs-our-regions

Organisation for Economic Co-operation and Development. 2023. Government at a Glance 2023: Classification of the Functions of Government (COFOG). OECD: Paris. https://www.oecd-ilibrary.org/governance/government-at-a-glance-2023_0ffb2b04-en

Raes, Leander, Damien Mittempergher, Matías Piaggio, and Juha Siikamäki. 2021. Nature-based Recovery Can Create Jobs, Deliver Growth and Provide Value for Nature, Technical Paper No. 3. IUCN: Gland. https://iucn.org/sites/default/files/2022-06/iucn-nbr-tp-3-compressed.pdf

Spanish Ministry for Ecological Transition and the Demographic Challenge, Biodiversity Foundation, and Spanish Climate Change Office. 2023. Empleo y Transición Ecológica. Yacimientos de Empleo, Transformación Laboral y Retos Formativos En Los Sectores Relacionados Con El Cambio Climático y La Biodiversidad En España. Ministry for Ecological Transition and the Demographic Challenge: Madrid. https://www.miteco.gob.es/es/ceneam/recursos/pag-web/estudio-empleo-transicion-ecologica.html

USASPENDING.gov. n.d. "The official source of government spending data". https://www.usaspending.gov/

WWF and ILO. 2020. Nature Hires: How Nature-Based Solutions Can Power a Green Jobs Recovery. WWF: Geneva. https://wwf.panda.org/wwf_news/?943816/Nature-based-solutions-jobs-report

ANNEX B
NbS main occupations and key skills according to skills assessment and anticipation from Canada, Scotland and Spain

AREAS WHERE NBS CAN BE APPLIED	MAIN SKILLS ACROSS COUNTRIES	SPECIFIC SKILLS BY COUNTRY			OCCUPATIONS
		CANADA	SCOTLAND	SPAIN	
Restoration	Data analysis Implementation Restoration techniques Environmental/ ecological monitoring Communication	Terrain stability Vegetation installation Management and maintenance (tree planting) Waste management Operations safety Contaminants clean-up	Project management (administration, reporting) Communication	Modelling Cost–benefit analysis Carbon and water footprint calculation Water management: wastewater treatment Integrated water management Scientific writing Software in hydrology Pedagogical skills Organizational skills (conflict management, decision-making)	Project manager Environmental scientist Biologist Forester Ecologist (specialist in ecological restoration) Field operative Landscaping and grounds maintenance labourers Specialist in hydrology Civil engineer Consultant in NBS
Agriculture and forestry	Sustainable forestry and agricultural techniques Digital skills Data analysis Remote sensing	Risk identification and assessment Sample handling and sorting Firefighting Site assessment Heavy machinery operation	Forest management Carbon accounting	Sustainable supply-chain management Carbon footprint calculation Environmental monitoring and control of invasive species Integrated water management Circular economy techniques Administration and financial skills Organizational skills (decision-making, communication, cooperation) Critical analysis Communication Group work	Agricultural workers (Agronomists specializing in agroecology and biodiversity) Sustainable and/or ecological farmer Livestock farmer (specializing in sustainable and/or ecological exploitation) Wildlife managers Forestry professionals and contractors (including tree planting and protecting, fencing, felling, harvesting)

ANNEX B NBS MAIN OCCUPATIONS AND KEY SKILLS ACCORDING TO SAA FROM CANADA, SCOTLAND AND SPAIN

AREAS WHERE NBS CAN BE APPLIED	MAIN SKILLS ACROSS COUNTRIES	SPECIFIC SKILLS BY COUNTRY			OCCUPATIONS
		CANADA	SCOTLAND	SPAIN	
Flood risk management	Remote sensing Sustainable construction/ engineering design	Environmental monitoring (environmental/ plant/wildlife research and surveys) Data analysis and management Mapping Root-cause analysis Vegetation management, installation and maintenance Engineering design	Land management Natural flood management Sustainable construction Natural capital accounting Climate adaptation strategies Stewardship skills Communication Planning and coordination	N/a	Hydrologist (flood risk managers) Ecologist Biologist Civil engineer Mechanical engineer Biologist Constructor (heavy equipment operator)
Urban greening/NbS in urban areas	Ecological engineering Sustainable construction Parks/gardens/ trees planning, installation and maintenance	Public health expertise Path design, creation and maintenance	Landscape design	Restoration of landscapes Sustainable waste management Implementation of smart irrigation Participatory management	Urban planners Ecological engineers Landscape architects Technician in arboriculture and gardening Technician in participation and governance Machinery operators Sustainable transport planners Eco-builders

SOURCE: Own analysis based on NatureScot (2020, 2024), ECO Canada (2024), MITECO (2023).

AREAS WHERE NBS CAN BE APPLIED	MAIN SKILLS ACROSS COUNTRIES	SPECIFIC SKILLS BY COUNTRY			OCCUPATIONS
		CANADA	SCOTLAND	SPAIN	
Fisheries	Sustainable fishing Remote sensing Environmental monitoring	-	Marine conservation (monitoring, restoration) Policy development	Rehabilitation and restoration of ecosystems Data collection and analysis Compliance with environmental laws Scientific writing Organizational capacities (decision-making) Participatory approaches	Ecologist Marine biologist (specialist in research into natural resources and aquatic ecosystems) Coastal engineer Environmental manager (specialist in sustainability and marine biodiversity) Fisheries managers Environmental policy advisors
Tourism	Wildlife guiding Marketing Digital skills		Knowledge of basic ecology and geology Project management and business development Nature-focused marketing Photography and filmmaking Interpretation skills	Event and communications management Graphic design Organizational capacities Communication and negotiation skills Pedagogical skills Participatory management	Technician in tourism or nature tourism promotion Environmental educator or Environmental education monitor Technician in marketing and communication Countryside ranger Biologist

AREAS WHERE NBS CAN BE APPLIED	MAIN SKILLS ACROSS COUNTRIES	SPECIFIC SKILLS BY COUNTRY			OCCUPATIONS
		CANADA	SCOTLAND	SPAIN	
Other	Natural capital accounting Carbon accounting		Sustainability reporting Knowledge of environmental regulations Risk assessment	Species protection	Green finance Green finance analysts Environmental economists Sustainability consultants Protected areas management: Specialist in research into natural resources and ecosystems Technician specializing in management and conservation of wild flora and fauna and/or natural spaces Specialist in sustainable and environmental communication (Facilitator)

ANNEX C
Survey methodology

An online survey targeting NbS practitioners was conducted on 15 July to 25 August to assess trends, patterns and attitudes related to skills needs for NbS. Prior to the main survey, a pilot study was carried out in June, which provided valuable insights for refining the questionnaire. The final survey was distributed through a variety of channels, including networks such as the Ecosystem-based Adaptation (EbA) Fund, the Friends of EbA (FEBA) partnership and PANORAMA among others. This broad dissemination sought to engage a diverse range of practitioners and organizations involved in NbS projects. The survey was available in English, French and Spanish, and took approximately 30 minutes to complete. Administered via the LimeSurvey platform – a custom-designed data collection tool – an online questionnaire was used for the survey, which consisted of three main sections:

Section 1: General information

- This section collected information on the respondent´s organization, including number of years it has been involved in implementing NbS, its type and sector.

Section 2: Information on the NbS project

- In this section, details about the NbS project were gathered, such as its location, scale, status, primary action, type and the societal challenges it addresses.

Section 3: Skills demand and gaps for the NbS project

- This section focused on identifying key occupations within the NbS project, the technical and core skills required for these roles, access to training, and the most-in-demand skills anticipated for the future. Additionally, respondents were asked to evaluate their satisfaction with the availability of training programmes in their regions as well as to identify primary barriers that hinder the development of skills for NbS projects.

ANNEX D
Description of the main occupations identified in the online survey

Environmental specialists: These are professionals who apply interdisciplinary knowledge to assess, plan and implement strategies that enhance ecosystem services while addressing environmental challenges such as climate change, biodiversity loss and habitat degradation. These specialists may come from various scientific backgrounds, including biology, botany, ecology and environmental science. Their responsibilities often involve monitoring ecological health and developing nature-based interventions that restore, protect or sustainably manage natural systems. By leveraging their expertise in natural sciences, they ensure that NbS projects are ecologically sound, contribute to biodiversity conservation and align with both local and global sustainability goals. Think of them as nature's doctors, prescribing remedies for ecological health.

Community liaison / Coordinator: This role involves acting as a bridge between project teams and local communities. Community liaisons ensure that local people are informed, involved and consulted in NbS projects. They listen to concerns, explain project goals and help build trust between communities and project leaders. Local communities often have deep knowledge of their environment and their involvement is critical for the long-term success of NbS. Think of them as nature's politicians, making sure that everyone's on the same page.

Conservation worker: This group of workers perform physical labour to improve the quality of natural areas such as forests, rangelands and wetlands (Bureau of Labor Statistics, U.S. Department of Labor 2024). Often, they work outdoors; sometimes in remote locations; and always in all types of weather. Most are employed full-time, although part-time or seasonal work is common (often on a voluntary basis). Conservation workers help to protect and restore natural environments: they might plant trees, restore wetlands or remove invasive species. Think of them as nature's gardeners, making sure that ecosystems stay healthy and diverse.

Ecological restoration technicians: These technicians help to repair and restore damaged ecosystems, like forests, wetlands or grasslands. They might plant native species, remove

invasive ones or restore waterways to their natural state. Restoring ecosystems is crucial for biodiversity, water quality and climate resilience. Think of them as nature's repair team, making sure everything is done scientifically and effectively.

Environmental educator: These educators are teachers, coordinators, facilitators, communicators, mentors and community leaders (ECO Canada 2024a). They operate in diverse settings and engage with different groups: some teach in schools and universities, others educate adults through seminars and events, and some work in environments like zoos and parks. Their focus is on educating people about topics such as conservation, preservation and sustainability, playing an essential role in fostering environmental awareness. Think of them as nature's teachers, inspiring people with their knowledge.

Environmental engineers: These engineers devise effective solutions to issues involving pollution, public health and sustainability. At the same time, they research how human decisions can impact different environments, leading to issues like drinking water contamination and acid rain (ECO Canada 2024a). Their goal is to apply principles from engineering, soil science, biology and chemistry to create solutions for environmental challenges that enhance the quality of our surroundings. Think of them as nature's problem-solvers, keeping the environment clean and accessible.

Field facilitators: This group of workers are the on-the-ground coordinators who help make sure nature-based projects run smoothly. They engage with local communities, manage activities in the field and ensure that tasks like planting trees or restoring ecosystems are carried out efficiently. They are crucial for ensuring that NbS projects are executed properly, and that local communities are supported and informed. Think of them as nature's managers, ensuring everything goes according to plan.

Park Ranger: These professionals are involved in the protection and management of national parks, natural areas, wildlife and cultural sites (WWF 2024a). They patrol protected areas, monitor wildlife, prevent poaching, engage local communities in conservation, help communities resolve human–wildlife conflicts, and assist with tourism. They help preserve the beauty and biodiversity of natural areas, ensuring that they remain pristine. Think of them as nature's police force, ensuring that environments remain intact for future generations to enjoy.

Project managers: These managers and organizers keep NbS projects on track. They plan, execute and oversee projects from start to finish. This might include coordinating teams, managing budgets and ensuring that all goals are met on time. Project managers make sure everything runs smoothly. Think of them as nature's protectors, helping projects to achieve their environmental goals.

Specialist in participatory approaches: These specialists ensure that NbS projects involve people in decision-making processes. They design strategies to include community members, stakeholders and local experts in the planning and implementation of projects. The idea is to make sure projects gain local support by reflecting local needs and knowledge – when projects are tailored to the specific social, cultural and ecological context, it increases their chances of success. Think of them as nature's spokespeople, making sure that everyone's voice is heard.

References

ECO Canada. 2024a. Environmental Educator. ECO Canada: Calgary. https://eco.ca/career-profiles/environmental-educator/

ECO Canada. 2024b. Environmental Engineer. ECO Canada: Calgary. https://eco.ca/career-profiles/environmental-engineer/

U.S. Bureau of Labor Statistics, U.S. Department of Labor. 2023. Occupational Outlook Handbook: Forest and Conservation Workers. U.S. Bureau of Labour Statistics: Washington DC. https://www.bls.gov/ooh/farming-fishing-and-forestry/forest-and-conservation-workers.htm

WWF. n.d. "What do rangers do and how does WWF support them?". WWF: Gland. https://www.worldwildlife.org/pages/what-do-rangers-do-and-how-does-wwf-support-them