THE BILLION BLACK HOLE IN FOREST FINANCE: METHODS

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CONSERVATION STRATEGY FUND

A1. DEFINITION OF HIGHLY FORESTED AREAS

In this section, we present the detailed information for the definition of highly forested areas in Brazil and Indonesia.

Most available datasets on financial flows lack spatially explicit information on the geographic allocation of resources and do not establish a direct linkage with forested areas. To address this limitation, highly forested areas were delineated at the municipal level, providing greater granularity and precision for identifying territories with a higher likelihood of being influenced by such financial flows.

Municipalities were classified as *highly forested* when more than 50% of their territory was covered by native vegetation. Forest cover estimates were derived from the MapBiomas (2020) dataset for both Brazil and Indonesia. For Brazil, two additional spatial criteria were incorporated to better capture forest-relevant areas: (i) the presence of Protected Areas (PAs) and/or (ii) Indigenous Lands (ILs). Data on PAs were obtained from the Ministry of Environment and Climate Change (MMA), while IL boundaries were sourced from the National Foundation of Indigenous Peoples (FUNAI).

Spatial data were used to select municipalities in databases with municipal disaggregation or to scale disaggregated data only available at the national level. In the latter case, spatial data on forest cover from MapBiomas (2020) were used to estimate the percentage of forest within the areas. It was assumed that financial flows to forests are distributed proportionally to the presence of forest cover throughout the territory; therefore, a discount factor equivalent to this proportion was applied. For Brazil, the proportion of highly forested areas represents 81.6%, and for Indonesia, 79.8%.

Table A1.1 below show the categories selected from the Mapbiomas data, while Figures A1.1 and A1.2 below show the municipalities selected for Brazil and Indonesia.

Table A1.1 - MapBiomas forest categories for Brazil and Indonesia

Description	**Source**	
	Brazil	**Indonesia**
Forest cover	MapBiomas (2020). Classes 3, 5, 6, 49, 30.	MapBiomas (2020). Classes 3, 5.

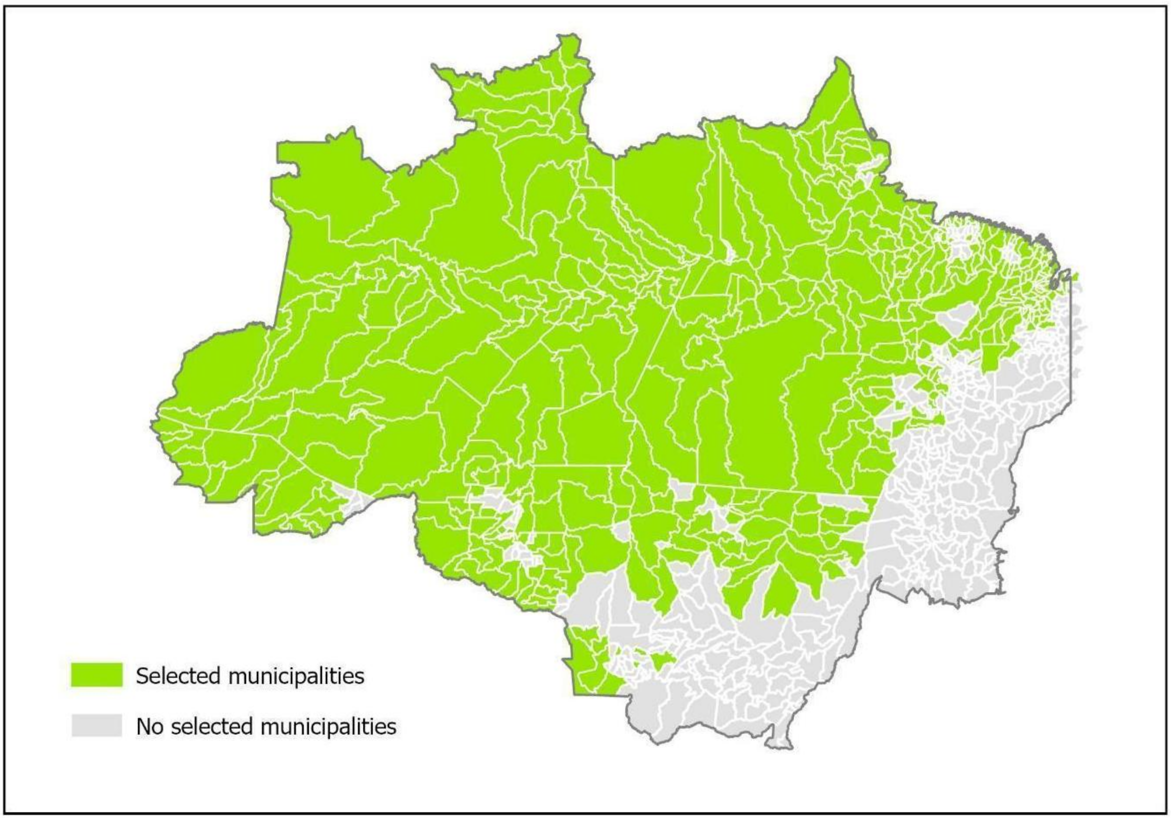

Figure A1.1 - Highly forested areas - selected municipalities for Brazil's Amazon forest.

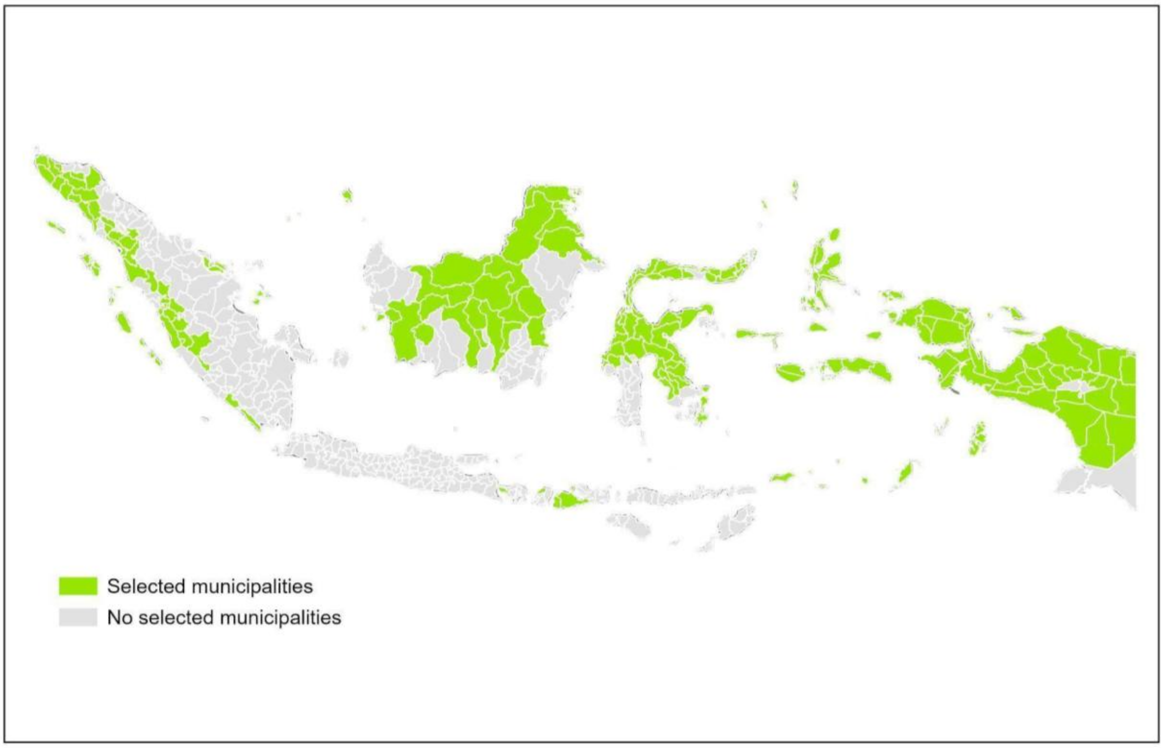

Figure A1.2 - Highly forested areas - selected municipalities for Indonesia.

A2. DEFINITION OF SCALING FACTORS

In this section, we present the detailed information for calculating the estimated scaling factors used to adjust the positive and negative financial flows for highly forested areas in Brazil and Indonesia.

Scaling factors are a methodological approach used in analyzing forest-related financial flows, particularly when data are not sufficiently granular to directly determine whether a specific flow generates a positive or negative impact. This technique estimates the share of resources potentially linked to beneficial actions or deforestation pressures, based on empirical evidence from previous studies. It is applied in contexts where the final allocation of resources is uncertain, but reliable statistical data allows for quantification, providing a structured way to address data gaps and limitations.

Scaling factors was applied to negative forest finance flows. Although sectors and activities that drive deforestation or increase deforestation pressures are well documented in the literature, it is not possible to assert that all such activities directly affect highly forested areas. To address this limitation, land-cover transition data from MapBiomas (2020) were used to estimate the proportion of the expansion of each deforestation category, which is described in Appendix A3. For each category, the expansion of the respective deforestation drivers was calculated, followed by the percentage of that expansion that took place specifically in the highly forested area, as described in Appendix A1. It was assumed that negative financial flows to forests are distributed proportionally to this expansion, and, therefore, a scaling factor equivalent to that proportion was applied.

Table A2.1 below shows the proposed scaling factors for Brazil and Indonesia.

Table A2.1 - Scaling factors for Brazil and Indonesia for positive and negative flows

Description	Scaling factor		Source	
	Brazil	Indonesia	Brazil	Indonesia
Forest cover	0.816	0.798	MapBiomas (2020). Classes 3, 5, 6, 49, 30.	MapBiomas (2020). Classes 3, 5.
Farming expansion	0.376	0.108	MapBiomas (2020). Classes 11, 12, 15, 20,	MapBiomas (2020). Classes 21, 35, 40.

			21, 23, 24, 25, 29, 47, 48.	
Mining expansion	0.257	0.174	MapBiomas (2020). Class 35.	MapBiomas (2020). Class 30.
Forestry, pulp and paper expansion	0.010	0.112	MapBiomas (2020). Class 9.	MapBiomas (2020). Class 9.
Infrastructure expansion	0.010	0.010	Araujo et al. (2025)	

A3. DEFINITION OF POSITIVE AND NEGATIVE FOREST FINANCE FLOWS

In this section, we present the detailed methods for calculating the estimated current positive and negative financial flows for highly forested areas in Brazil and Indonesia.

There is no commonly agreed-upon definition of positive and negative forest finance flows. However, some documents consider forest-positive finance as financial flows that support the conservation, restoration, sustainable use, or protection of forest ecosystems (*Forest Declaration Assessment*, 2023) or as investments contributing to halting deforestation, maintaining existing forests, restoring degraded lands, promoting agroforestry, and strengthening sustainable forest value chains (FAO, 2022). In contrast, forest-negative finance generally refers to public subsidies and private investments that directly or indirectly contribute to forest loss or degradation, as typically associated with sectors driving deforestation, such as farming and commodities, extractive industries, and infrastructure expansion (FAO, 2022; Global Canopy, 2024).

This study is closely aligned with the literature on tropical forest conservation and deforestation (Balboni *et al*., 2023), which consistently highlights the effectiveness of public policies in safeguarding forests. Empirical evidence shows that instruments such as protected areas play a central role both in conserving critical forest regions and in curbing deforestation (Assunção, Gandour, 2018; Amin *et al*., 2019; Fuller *et al*., 2019). Indigenous territories, and other forms of collective lands, including territories inhabited by local communities and afro-descendant populations in the Brazilian context, are also relevant as community-based governance has contributed significantly to stewarding these landscapes (Baragwanath, Bayi, 2020; Sze *et al*., 2021). Command-and-control instruments are fundamental for forests by establishing rules that restrict harmful activities affecting native vegetation, as well as by enabling monitoring, enforcement, investigation, and the sanctioning of environmental infractions and crimes (Assunção, Gandour, Rocha, 2019). At the same time, there is growing interest in approaches that reconcile forest conservation with sustainable development, which includes the strengthening of bioeconomy, sociobiodiversity value chains, and the transition to more sustainable agricultural and livestock practices (*Uma Concertação pela Amazônia, 2021, 2023;* Aguiar *et al.,* 2023*).*

Moreover, deforestation and forest degradation result from the interaction of multiple direct and indirect drivers, which often operate simultaneously and reinforce one another. Empirical evidence consistently shows that forest loss is primarily driven by the expansion of agriculture and commodity supply chains (Lapola *et al.,* 2023; Haddad *et al.,* 2024). Other direct drivers identify infrastructure development (Araujo *et al.,* 2025), which might include the construction of roads, hydroelectric dams, mining and oil extraction activities, and urban development. Other forest degradation drivers are associated with various anthropogenic pressures and illegal activities such as understory fires, edge effects, selective logging, hunting, and the impacts of climate change (Berenguer *et al.,* 2024; Cabral *et al., 2024)*. Due to data availability and the analytical scope of this study, the focus was restricted to legal activities contributing to deforestation and forest degradation.

Table A3.1 below shows the proposed forest categories for Brazil and Indonesia.

Table A3.1 - Forest categories for positive and negative financial flows.

Categories	Direction	Examples
Forest conservation	Positive	Conservation and Environmental Protection of public and private areas Conservation and Recovery of Watersheds Formulation of Policies and Programs for Environmental Protection, Conservation, Restoration, and Sustainable Use Formulation of Policies for Biodiversity and Ecosystems

		Initiatives for Nationally Determined Contributions
		Initiatives for National Biodiversity Strategies and Action Plans
		Environmental Control
		Prevention and Control of Forest and Peat Fires
		Prevention, Inspection, Combating, and Control of Illegal Deforestation and Other Environmental Crimes
Forest enforcement	Positive	Creation, expansion, and maintenance of Protected Areas
		Research, Evaluation, and Use of Satellites for Deforestation Monitoring
		Environmental Monitoring and Management of Environmental Information
		Implementation of Environmental Education Actions
		Public awareness and media coverage expenses
Forest restoration	Positive	Recovery of Degraded Areas
		Productive Structuring, Promotion, and Strengthening of Agroecology and Agroforestry
Forest sustainable management	Positive	Management of Sustainable Use of Biodiversity and Ecosystems
		Mangrove and Peat Restoration
		Improvements in agriculture and livestock sustainable practices

		Financing, support, and public budget for socio-biodiversity chains and products Support programs for the sociobioeconomy and non-timber forest products Community-based Agroforestry
Indigenous Peoples' and local communities forest governance and rights	Positive	Support and Fulfillment of Multi-Ethnic, Cultural, and Social Rights of Indigenous Peoples Land Regularization, Protection, and Management of Indigenous Territories Regularization, Demarcation, and Inspection of Indigenous Lands and Protection of Isolated Indigenous Peoples Support for the Implementation of Policies for Afro-descendants, Local and Traditional Communities Socio-environmental Management of Natural Resources in Territories of Traditional Peoples and Communities and Family Farmers Identification, Recognition, and Titling of Territories of Local, Traditional, and Afro-descendant Communities Social Forestry Programs Indigenous Land Registrations
Deforestation driver - farming	Negative	Support for Farming Production Development Technical Assistance and Rural Extension Subsidies for Agriculture and Livestock Technology Transfer for Innovation in Agriculture and Livestock
Deforestation driver - mining	Negative	Assessment of Mineral Resources Mining Development

		Geological Mapping of Brazil Mining Concessions, Inspection, and Regulation
Deforestation driver - another type of land conversion	Negative	Agrarian Reform and Land Regularization Support for the Pulp and Paper Sectors
Infrastructure	Negative	Development and Construction of Road and Railway Sections Expansion of Hydroelectric Power Generation and Dams Urban Expansion

A4. FOREST FINANCE FLOWS DATA ANALYSIS

In this section, we present the detailed methods for calculating the estimated current positive and negative financial flows for highly forested areas in Brazil and Indonesia.

All financial values in the dataset were standardized to constant 2024 US dollars to ensure comparability across sources and countries. For international databases originally reported in US dollars, values were adjusted for inflation using the GDP deflator series provided by the International Monetary Fund (IMF) World Economic Outlook. For national datasets reported in local currency, a two-step procedure was adopted. First, values were adjusted for domestic inflation: for Brazil, the official inflation indices from the Brazilian Institute of Geography and Statistics (IBGE) were used; for Indonesia, inflation data from Badan Pusat Statistik (BPS) were applied. Second, the inflation-adjusted values were converted into US dollars using the average annual nominal exchange rate for each corresponding year, sourced from the Central Bank of Brazil and Bank of Indonesia.

The database could be analyzed using three complementary approaches: institutional, functional, and programmatic. The institutional approach refers to the identification of institutions and implementing entities responsible for fund disbursement. The functional approach classifies expenditures according to thematic areas or policy sectors. The programmatic approach, in turn, focuses on specific activities, projects, or financial instruments. While institutional and functional classifications are widely used in studies of conservation finance, they can overestimate forest-related flows by including environmental expenditures not directly linked to forests. To ensure greater precision, we prioritized as much as possible a programmatic approach, selecting interventions with clear positive or negative impacts on forests, as previously described in Appendix A3. The institutional and functional classifications were subsequently applied to the subset of data filtered through this programmatic approach or when the databases did not provide disaggregated data at the programmatic level.

Figure A4.1, below, presents an overall representation of the process. The subsequent sections of this Appendix offer a detailed description of each stage of the methods.

Figure A4.1 - Stages of the forest finance flow analysis.

A4.1. International public forest finance flows

Table A4.1 - International public forest finance flows.

International public	Direction	Brazil	Indonesia
		Mean estimate – 2024 US$ million/yr	**Mean estimate – 2024 US$ million/yr**
Bilateral	Positive	63	68
Multilateral	Positive	12	15
Other Official Flows	Positive	5	61

A4.1.1. Organisation for Economic Co-operation and Development (OECD) Creditor Reporting System (CRS) – Brazil and Indonesia

The international public forest finance flows estimate uses the Organisation for Economic Co-operation and Development (OECD) Creditor Reporting System (CRS), which is monitored and analysed by the Development Assistance Committee (DAC) and contains detailed information on the official development assistance (ODA) budget execution. It includes data on donors, recipient countries, sectors, subsectors, title, short description, long description of projects, as well as the committed and paid amounts.

The OECD CRS database presents disaggregated data at the national level, and scaling factors were applied where needed, as previously described in Appendix A2.

ODA is the term used by DAC members to refer to what most people would call *aid*, including activities carried out with the economic development and welfare of developing countries as their main objective. It is a measure of donor effort, including grants and concessional loans. Bilateral aid represents flows from official government sources directly to the recipient country, even if the donor contracts a multilateral agency to deliver a programme or project on its behalf in a recipient country. Multilateral aid represents core contributions from official government sources to multilateral agencies, which use them to fund their own development programmes.

In addition to ODA, the DAC collects and publishes data on *other official flows* (OOF), reflecting financial flows that are not primarily aimed at development, or do not classify as grant or concessional loans. OOF was included in the general estimate of international public forest finance flows, but disaggregated as other than grants or concessional loans.

To identify international public forest finance flows, only observations that met all the following criteria were considered. First, projects whose title, short, or long descriptions contained one or more relevant keywords detailed in Appendix B were considered. Second, projects in the scope of the selected sectors and subsectors detailed in Appendix C were considered. The sectors and subsectors identified by the keywords underwent a manual review process and removal of inappropriate or duplicate observations. Third, projects tagged under at least one of the four Rio Markers or associated with SDG 15 were considered. For expenditures marked as principal in most Rio Markers, 100% of the financial value was accounted for, while for those marked as significant in the majority of the markers, 40% of the financial value was considered for. Flows between 2020-2023 were considered.

The National Bank for Economic and Social Development (BNDES) database was also considered for public international flows, as it acts as the operating agency for the Amazon Fund. More information on the BNDES analysis is presented below, and further details on double counting can be found in Appendix D.

A4.2. Domestic public forest finance flows

Table A4.2 - Domestic public forest finance flows.

Domestic public	**Direction**	**Brazil**	**Indonesia**
		Mean estimate – 2024 US$ million/yr	**Mean estimate – 2024 US$ million/yr**
Governments	Positive	170	80
	Negative	741	231
BNDES	Positive	16	-
	Negative	156	-

A4.2.1. Integrated Planning and Budget System (SIOP) – Brazil

The domestic public forest finance flows estimate uses the Integrated Planning and Budget System (SIOP) database, managed by the Ministry of Planning and Budget, which contains detailed information on the federal government's budget execution. It includes data on budgetary bodies, budgetary units, functions, sub-functions, programs, and actions, as well as the committed and paid amounts.

The SIOP database presents disaggregated data at the national and municipal levels. Observations were initially cleaned based on the selected priority areas, and scaling factors were applied where needed, as previously described in Appendix A1 and A2.

The SIOP database observations were also initially cleaned using two processes: (i) removal of double counts and (ii) removal of inactive resources. To avoid double-counting, the variable Application Modality "91 - Direct Application Resulting from Operations between Agencies, Funds, and Entities within the Budgets" was excluded. These transfers are classified as intra-budgetary operations, carried out between bodies and units that are part of the same government entity. Intra-budgetary operations do not represent new public revenue flows but merely internal reallocations between agencies. To account only for the mobilization of active resources, all observations containing keywords related to pensions and retirement were excluded.

To identify domestic public forest finance flows, only observations that met all the following criteria were considered. First, projects whose program and action descriptions contained one or more relevant keywords detailed in Appendix B were considered. Second, projects in the scope of the selected programs and actions detailed in Appendix C were considered. The programs and actions identified by the keywords underwent a manual review process and removal of inappropriate or duplicate observations. Flows between 2020-2024 were considered.

To proceed with the functional approach, based on previously filtered observations, budgetary functions and sub-functions possibly related to forests were identified. To this end, the function of Environmental Management and its sub-functions of Environmental Preservation and Conservation, Water Resources and Environmental Control, as well as other sub-functions of Assistance to Indigenous Peoples, Regulatory and Enforcement, Land Use Planning, and Agrarian Reform, were considered.

To proceed with the functional approach, based on previously filtered observations, budgetary agencies and units potentially related to forests were identified. The analysis focused on environmental agencies under the Ministry of the Environment and Climate Change (MMA) and its affiliated units, namely the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA), the Chico Mendes Institute for Biodiversity Conservation (ICMBio), the Brazilian Forest Service (SFB), and the Rio de Janeiro Botanical Garden Research Institute (JBRJ), as well as two administered funds, the National Environmental Fund (FNMA) and the National Climate Change Fund (FNMC). The National Water and Sanitation Agency (ANA) was also included due to its historical linkage to the MMA and its ongoing relevance to forest-related water resources and springs management. In addition, the National Institute for Colonization and Agrarian Reform (INCRA) was included, given its impact on forest dynamics through the creation and regularization of rural settlements, land tenure regularization, and land-grabbing control. The Ministry of Indigenous Peoples (MPI) and the National Foundation for Indigenous Peoples (FUNAI) were also considered, due to the fundamental role of Indigenous territories in forest conservation.

SIOP provides information on subsidies from the public budget allocated to rural credit programs. The subsidies were considered in their entirety, but they may also appear in whole or in part in other databases that measure the total volume of rural credit, such as the National Bank for Economic and Social Development (BNDES) and Rural Credit Operations System (SICOR). More information on the BNDES and SICOR analysis is presented below, and further details on double counting can be found in Appendix D.

4.2.2. National Bank for Economic and Social Development (BNDES) – Brazil

The domestic public forest finance flows estimate also uses the National Bank for Economic and Social Development (BNDES) database, which contains detailed information on disbursements made with its own resources or with third-party resources when acting as an operational agency for donations or credits. It includes data on the type of support, program, subprogram, sector, and subsector, as well as the committed and paid amounts.

The BNDES database presents disaggregated data at the municipal level. Observations were initially cleaned based on the selected priority areas, and scaling factors were applied where needed, as previously described in Appendix A1 and A2.

To identify domestic public forest finance flows, programs, and subprograms were selected manually based on a review of the literature on possibly positive or negative contributions to forests, as detailed in Appendix C. Only programs and subprograms that use BNDES's own resources were considered at this moment, such as BNDES FINEM and BNDES non-reimbursable programs. Flows between 2020-2024 were considered.

BNDES rural credit lines have been covered by the Rural Credit Operations System (SICOR) database and not considered from the BNDES database to avoid double-counting. Specifically for financial flows from the Climate Fund, information from technical reports was considered due to the greater detail and disaggregation of information.

A4.2.3. Federal Public Debt – Brazil

The domestic public forest finance flows estimate further uses the Federal Public Debate portal, which contains detailed information about Brazil’s Sovereign Sustainable Bonds through its Allocation and Impact Report. It includes data on eligible actions, selection processes for budgetary actions and eligible projects, and the committed and paid amounts.

The Sovereign Sustainable Bond Allocation and Impact Report presents disaggregated data at the national level, and scaling factors were applied where needed, as previously described in Appendix A2.

To identify domestic public forest finance flows, budgetary actions were manually selected according to previously established criteria for identifying actions in the SIOP database. Flows between 2020-2024 were considered.

A4.2.4. Public Domestic Budget at National and Province Level (APBN and ABPD) – Indonesia

Estimates of domestic public forest finance flows in Indonesia draw on two main sources: (i) the Central Government Financial Report (LKPP) for the national budget (APBN), managed by the Ministry of Finance and audited by BPK, and (ii) Regional Government Work Plans (RKPD) that corresponds provincial budget reports (APBD).

These sources provide data on programs, activities, and realized expenditures for 2020–2024. For data cleaning and double-counting prevention, two filters were applied: (i) Intra-government transfers (e.g., between central agencies or from APBN to APBD) were removed to avoid double-counting. Only expenditures executed at the point of delivery were recorded; (ii) Inactive resources such as pension or retirement-related and procurement of goods spending were excluded to focus on active financial mobilization.

Budget lines were screened using forest-related keywords (Appendix B) such as forestry, conservation, protected area, law enforcement, restoration, peatland, mangrove, watershed, social forestry, land tenure, indigenous peoples, spatial planning, forest fire prevention, MRV, and others. Matching programs and activities were then manually reviewed against a positive list of forest-related programs (Appendix C) to ensure relevance and remove duplicates.

Selected expenditures were classified under forest-relevant functions and sub-functions, including Environmental Management, Forestry, Land Use Planning, Enforcement, and Indigenous Peoples Affairs, and attributed to key agencies such as the Ministry of Environment and Forestry (KLHK), Peat and Mangrove Restoration Agency (BRGM), Environmental Fund (BPDLH), ATR/BPN, BNPB (for forest fire management), and provincial Forestry and Environmental Offices (DLH, Dinas Kehutanan).

Each item was categorized as either positive (e.g., forest protection, restoration, social forestry, IPLC support) or negative (e.g., subsidies or infrastructure spending driving land conversion. When national programs covered multiple provinces, expenditures were allocated proportionally using indicators such as forest area or program output locations. Multi-purpose activities were disaggregated, and only forest-relevant components were retained.

Provincial analysis focused on provinces with significant forest cover. In cases where realized APBD data were unavailable, revised budget allocations were used as proxies, adjusted using sectoral realization ratios. Documentation of keyword lists, program mapping, and classification criteria ensures transparency and comparability with the Brazil study.

A4.3. International private forest finance flows

Table A4.3 - International private forest finance flows.

Domestic public	**Flow**	**Brazil**	**Indonesia**
		Mean estimate – 2024 US$ million/yr	**Mean estimate – 2024 US$ million/yr**
Financial institutions	Negative	124	1.987
Philanthropy	Positive	16	12
Business and markets	Positive	39	2

A4.3.1. Organisation for Economic Co-operation and Development (OECD) Creditor Reporting System (CRS) – Brazil and Indonesia

The international private forest finance flows estimate uses information from the OECD CRS database. The same analysis method described above was followed. In this case, we used the CRS Private Finance for Development and CRS Private Philanthropy for Development databases. Private Philanthropy provides project-level information for over 40 of the largest private philanthropic foundations working on financing for development, while Private Finance covers all private finance mobilised by official development finance interventions. Flows between 2020-2023 were considered.

A4.3.2. Forests and Finance (F&F) – Brazil and Indonesia

Forests and Finance is a coalition that aims to highlight the role that finance plays in enabling tropical deforestation. The project assesses the financial services received by over 300 companies directly involved in the beef, palm oil, pulp & paper, rubber, soy, and tropical timber supply chains, whose operations impact natural tropical forests, including Brazil and Southeast Asia. Their methods include the company selection and financial institution financing contributions, segment adjusters, and geographical adjusters. For more information, please visit https://forestsandfinance.org/.

The F&F database presents disaggregated data at the national level. As the F&F database already has its own adjusters, we restrict ourselves to geographical adjustment to filter Legal Amazon data, without applying scaling factors.

The F&F database observations were also initially cleaned to remove double counts. For Brazil, a comparison was made between banks and financial institutions previously covered by the SICOR database, and all those previously identified in SICOR were removed from F&F. Flows between 2020-2024 were considered.

A4.3.3. Carbon Markets – Brazil and Indonesia

The international private forest finance flows estimate also uses data from Verra. The database provides information on the issuer, issuer type, sector, certification type, and estimated annual emission reductions. To identify cash flow values, the estimated annual emission reductions were multiplied by the average price of carbon credits presented by Ecosystem Marketplace. Flows between 2020-2024 were considered.

The Gold Standard, the ART-TREE, and the Ecosystem Marketplace were not included due to data and access limitations.

A4.4. Domestic private forest finance flows

Table A4.4 - Domestic private forest finance flows.

Domestic public	**Direction**	**Brazil**	**Indonesia**
		Mean estimate – 2024 US$ million/yr	**Mean estimate – 2024 US$ million/yr**
Financial institutions	Positive	44	-
	Negative	2.132	1.207
Business and markets	Positive	26	2

A4.4.1. National Bank for Economic and Social Development (BNDES) – Brazil

The domestic private forest finance flows estimate uses information from the BNDES database. The same analysis method described above was followed. In this case, only programs and subprograms that use BNDES's third-party resources were considered, such as most of the rural credit programs. Flows between 2020-2024 were considered.

A4.4.2. Rural Credit Operations System – SICOR

The domestic private forest finance flows estimate uses the Rural Credit Operations System (SICOR) database, maintained by the Central Bank of Brazil, which contains detailed information on rural credit operations. It includes data on the program, subprogram, type of disbursement, type of activity, as well as the paid amounts.

The SICOR database presents disaggregated data at the municipal level. Observations were initially cleaned based on the selected priority areas, and scaling factors were applied where needed, as previously described in Appendix A1 and A2.

The SICOR database observations were also initially cleaned to remove double counts. To avoid double-counting, all observations related to external funding and government resources were removed.

To identify domestic private forest finance flows, programs, and subprograms were selected manually based on a review of the literature on possibly positive or negative contributions to forests, as detailed in Appendix C. Flows between 2020-2024 were considered. BNDES rural credit lines have also been covered by the Rural Credit Operations System (SICOR), but were classified as Public Domestic.

The rural credits were considered in their entirety, but they may also appear in whole or in part in other databases that measure subsidies allocated to rural credit programs, such as the Integrated Planning and Budget System (SIOP). More information on the SIOP is presented above, and further details on double counting can be found in Appendix D.

A4.4.3. Forests and Finance (F&F) – Brazil and Indonesia

The domestic private forest finance flows estimate also uses information from the Forests and Finance (F&F) database. The same analysis method described above was followed. Flows between 2020-2024 were considered.

A4.4.4. Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio) – Brazil

The domestic private forest finance flows estimate uses data from the Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio) regarding mandatory biodiversity offsets. The database provides information on the protected area benefiting from the offset, the type of action undertaken, the modality, the sector responsible for the disbursement, and the amounts paid.

Mandatory biodiversity offsets are recognized as an important instrument to strengthen Brazil's National System of Protected Areas (SNUC), established under Article 36 of Law No. 9.985 of July 18, 2000, and regulated by Articles 31 to 34 of Decree No. 4.340 of August 22, 2002. The mechanism does not aim to compensate for the direct environmental impacts of the enterprise that triggered it, but rather to provide broader compensation to society and the environment for the authorized use of natural resources by projects with significant environmental impacts (ICMBio, 2000). This instrument requires developers to support the creation or maintenance of protected areas, preferably strict protection areas. The financial amount to be paid by the enterprise and the selection of the beneficiary conservation units are determined by the licensing authority, based on the scale of the project's environmental impact and specific technical criteria used to identify eligible protected areas.

The ICMBio database presents disaggregated data at the regional level. Observations were initially cleaned based on the selected priority areas, and scaling factors were applied where needed, as previously described in Appendix A1 and A2. Flows between 2020-2024 were considered.

A4.4.5. Impact Investing – Brazil and Indonesia

The domestic private forest finance flows estimate uses data from the Climate Bonds Initiative, Green Bond Transparency, and ICMA Group. For Brazil, it also included data from ERM-NINT. The database provides information on the issuer, issuer type, sector, and amounts paid.

The databases present disaggregated data at the national level, and scaling factors were applied where needed, as previously described in Appendix A2.

Most of the green bonds issued are not directly related to forests, as they cover other sectors related to energy or infrastructure. Only observations from the Agriculture and Forests sector were included. Flows between 2020-2024 were considered.

A4.4.6. Certified Sustainable Forestry and Palm Oil – Brazil and Indonesia

The domestic private forest finance flows estimate uses data from the Forest Stewardship Council (FSC), the Programme for the Endorsement of Forest Certification

(PEFC), and the Roundtable on Sustainable Palm Oil (RSPO). The database provides information on the total hectares certified according to the type of production.

The databases present disaggregated data at the state level, and scaling factors were applied where needed, as previously described in Appendix A2.

FSC and PEFC was considered for both Brazil and Indonesia. Only the natural forest category was selected. This estimate uses Breukink's (2015) costs for certified forests, adjusted for inflation. It is assumed that the cost of forest certification has kept pace with inflation since 2015, with no structural changes over time. This cost is applied to the certified forest area, resulting in the financial flow value. Flows between 2020-2024 were considered.

RSPO was considered for Indonesia. This estimate uses WWF (2022) costs for certified palm oil, adjusted for inflation. It is assumed that the cost of forest certification has kept pace with inflation since 2022, with no structural changes over time. This cost is applied to the certified forest area, resulting in the cash flow value. Flows between 2020-2024 were considered.

A4.4.7. Private Green Bonds and Sustainability Bonds – Indonesia

Indonesia's green bond data were compiled from the annual reports, sustainability reports, and allocation reports of issuing financial institutions, including commercial banks and state-owned enterprises such as PT Sarana Multi Infrastruktur (PT SMI), as well as from disclosures on the Indonesia Stock Exchange (IDX) and OJK's Sustainable Finance Roadmap. Green bonds are instruments whose proceeds are earmarked exclusively for environmentally beneficial projects—such as renewable energy, sustainable transport, energy efficiency, or forest and landscape restoration. Reported allocations were filtered to identify activities directly or indirectly contributing to forest protection, rehabilitation, or land-use emissions reduction.

Sustainability bonds combine the objectives of green bonds and social bonds, financing projects that deliver both environmental and social benefits. Data were collected from public disclosures, investor reports, and sustainability allocation reports issued by commercial banks (e.g., BNI, BRI, Mandiri) and development finance institutions (e.g., PT SMI, PT Penjaminan Infrastruktur Indonesia). Each issuance was screened based on its use-of-proceeds categories and alignment with the ASEAN Sustainability Bond Standards and ICMA Principles. Only the portion of proceeds supporting forest-positive outcomes was retained for this study.

A5. FOREST FINANCE NEEDS DATA ANALYSIS

In this section, we present the detailed methods for calculating the estimated forest finance needs for highly forested areas in Brazil and Indonesia. All financial values in the dataset were standardized to constant 2024 US dollars to ensure comparability across sources and countries, as previously described in Appendix A4.

To analysis of forest finance needs was structured around key categories of forest-related expenditures: forest restoration, forest conservation, forest enforcement, forest sustainable use, Indigenous Peoples' lands and other collective lands, and the forest bioeconomy.

These categories were aligned with Brazil's and Indonesia's national policy targets and international commitments. For Brazil, the analysis drew on the National Native Vegetation Recovery Plan (Planaveg), the Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm), the Native Vegetation Protection Law (Law 12.651 /12, known as the Forest Code), and the National Bioeconomy Development Plan (PNDBio). For Indonesia, the analysis aligned with key national policy frameworks, including the *Enhanced Nationally Determined Contribution (NDC)* and the *Forestry and Other Land Use (FOLU) Net Sink 2030*.

When national plans for the current period included costed implementation targets, these figures were used directly. In cases where no such plans or cost estimates were available, complementary studies and technical assessments were reviewed to derive proxy cost estimates.

A5.1. Forest restoration - Brazil

Table A5.1 - Forest restoration finance needs.

Forest restoration - Brazil	**Mean estimate by 2030 (US$ million/yr)**
Restoration in protected areas	640
Productive restoration	660

Forest restoration efforts in Brazil are anchored in the National Native Vegetation Recovery Plan (Planaveg), which establishes a national target of restoring 12 million hectares of native vegetation by 2030. Of this total, 11 million hectares are to be restored within public and private protected areas, while 1 million hectares are designated for productive restoration models that integrate economic use with ecological recovery. Accordingly, the analysis considered both protected and productive restoration areas.

To identify the share of this target specific to the Amazon biome, the Strategic Plan for Sustainable Development Based on the Effective Implementation of the Forest Code (Planaflor) (Sant'Anna & Costa, 2022) was used. Planaflor provides detailed estimates of environmental liabilities by state, indicating that the Amazon biome accounts for 39.25% of Brazil's total restoration liability. This proportional share was applied for both restoration categories, accounting for approximately 4.71 million hectares of the 11 million public and private protected areas targeted nationally, and to 0,39 million hectares out of the 1 million productive restoration projected nationally.

For restoration in protected areas, whether located on private lands, public lands, or collective territories, three recovery cost scenarios were considered: (i) fencing costs, based on *Young et al.* (2016); (ii) weighted average costs of reforestation techniques under both favorable and unfavorable conditions, following *Ribeiro et al.* (2022). From these, an average unit cost of US$760 per hectare was adopted, resulting in a total restoration cost of approximately US$3.2 billion until 2030.

For productive restoration, cost estimates were drawn from *Gasparinetti et al.* (2022), who modeled agroforestry systems in Brazil and identified an average investment cost of US$3,300 per hectare and operational costs of US$934 per hectare. In addition, opportunity costs were estimated as US$122 per hectare, based on average cattle ranching revenues across municipalities in Pará (SEMAS, 2023). The combination of these three components results in an average total cost of US$8.6 million per hectare, equivalent to approximately US$3.4 billion until 2030.

The total restoration cost for Brazil, combining protected-area restoration on private, public, or collective lands and productive restoration, is therefore estimated at US$6.6 billion by 2030.

A5.2. Forest conservation - Brazil

Table A5.2 - Forest conservation finance needs.

Forest conservation - Brazil	**Mean estimate by 2030 (US$ million/yr)**
Maintenance of Private lands	7.221
Maintenance of existing and newly established Protected Areas	759
Fire prevention	119
Avoid deforestation in risk areas	77
Allocation of undesignated federal public forests	62
Forest concessions	20
Creation of new Protected Areas	6

Forest conservation efforts were anchored in the Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm), which constitutes the cornerstone of Brazil's strategy to ensure long-term forest conservation and biodiversity protection within the Amazon biome. Although no comprehensive study estimating the total cost of PPCDAm was identified, several of its action lines include quantifiable, area-based targets that can be directly associated with available unit cost estimates, allowing for partial cost assessments within this study.

Under PPCDAm, the main quantitative targets include: the creation of 3 million hectares of new Protected Areas (PAs); the allocation of 29.5 million hectares of undesignated federal public forests; the granting of public forest concessions covering 5 million hectares; and the implementation of restoration concessions in an additional 100 million hectares.

To estimate the costs associated with the creation of new Protected Areas (PAs), an average unit cost of USD 9.1 million per hectare (*da Silva et al.*, 2022) was applied. This value encompasses all activities required for the establishment of new conservation units, including biological inventories, social assessments, stakeholder consultations, boundary demarcation, management planning, and infrastructure development. The resulting total cost amounts to approximately USD 0.03 billion by 2030.

For the allocation of undesignated federal public forests, an average cost of USD 9.89 per hectare (*da Silva et al.*, 2022) was used, yielding an estimated total of USD 0.3 billion by 2030.

For forest and restoration concessions, an average cost of USD 20 per hectare (*CSF*, 2020) was applied. This estimate draws on data from carbon-related forest concession projects implemented in Extractive Reserves (RESEX) and National Parks (PARNA) within the Amazon biome, assuming comparable concession costs across the forest sector. The total estimated cost for this category is USD 0.1 billion by 2030.

For the maintenance of both existing and newly established Protected Areas, average costs from *da Silva et al.* (2022) were applied. The baseline for existing PAs was derived from ICMBio's 2025 database, which identifies 392 Conservation Units across different administrative levels within the Amazon biome, covering a total of 122.1 million hectares. For new PAs, the values previously estimated under PPCDAm were incorporated. The combined total for PA maintenance is estimated at USD 3.8 billion by 2030.

Additionally, the forest conservation category also includes expenditures related to fire prevention, avoided deforestation, and opportunity costs. For fire prevention, average costs from *da Silva et al.* (2022) were applied, resulting in an estimated total of USD 0.6 billion by 2030. For avoided deforestation, the analysis relied on PrevisIA's deforestation risk data, which identifies approximately 649 million hectares under imminent risk within the Amazon biome. Applying an average cost of USD 462 per hectare (*Cunha et al.*, 2016) yielded an estimated total of USD 0.4 billion by 2030.

Finally, conservation costs on private lands were also considered, corresponding to the sum of native vegetation remnants within Legal Reserves (RLs) and Permanent Preservation Areas (APPs), as well as surplus native vegetation, as reported by the Forest Code Observatory, totaling approximately 56.2 million hectares. The total conservation cost for these areas was estimated through two main components: (i) management costs, based on the average management cost of Protected Areas within the national conservation system (*da Silva et al.*, 2022); and (ii) opportunity costs, derived from the reference land-use opportunity cost in the State of Pará (*SEMAS*, 2023). The combined total conservation cost for private lands was estimated at USD 36.1 billion by 2030.

A5.3. Indigenous Peoples' lands and other collective lands - Brazil

Table A5.3 - Indigenous Peoples' lands and other collective lands finance needs.

Indigenous Peoples' lands and other collective lands - Brazil	Mean estimate by 2030 (US$ million/yr)
Maintenance of existing Indigenous Lands	687
Allocation of undesignated federal public forests	69
Development of Territorial and Environmental Management Plans (PGTAs)	5

The estimation of financial needs for Indigenous Peoples' lands and other collective territories was structured around three main components: (i) the maintenance of existing Indigenous Lands (ILs); (ii) the allocation of a portion of undesignated public forests (as established under the PPCDAm target) into collective territories; and (iii) the development of Territorial and Environmental Management Plans (PGTAs) for Indigenous Lands, as defined in the PPCDAm.

For the maintenance of existing Indigenous Lands, an average annual cost of USD 600 per hectare (*da Silva et al.*, 2022) was applied. The total estimated cost for this component amounts to USD 3.4 billion by 2030.

For the allocation of undesignated public forests, it was assumed that the 29.5 million hectares of undesignated public forests would be distributed following the proportional pattern currently observed in the National Registry of Public Forests (CNFP). For Indigenous Lands, it was assumed that the remaining area not allocated to conservation units would be designated as collective territories, corresponding to approximately 19.2 million hectares. This assumption reflects the historical trend of allocating significant portions of public forests to Indigenous and traditional peoples. Based on *da Silva et al.* (2022), annual management costs for the newly incorporated territories were estimated to range from USD 23.1 million in 2026 to USD 115.6 million in 2030, resulting in a cumulative cost of approximately USD 346.9 million by 2030.

For the development of PGTAs, the PPCDAm set a target of preparing eight plans. According to *INESC* (2021), the cost of developing five PGTAs was BRL 65.8 million, equivalent to USD 12.7 million. By extrapolation, the cost of eight plans was estimated at BRL 105.3 million, or approximately USD 20.3 million (USD 0.02 billion).

Altogether, these three components form the cost framework for traditional and collective territories under the PPCDAm, resulting in an estimated total of USD 3.8 billion by 2030.

A5.4. Forest enforcement - Brazil

Table A5.4 - Forest enforcement finance needs.

Forest enforcement - Brazil	**Mean estimate by 2030 (US$ billion/yr)**
Forest enforcement	300

Enforcement was defined as the system-wide costs required to maintain and strengthen the overall forest conservation and governance framework in the Amazon biome. This category encompasses national and regional coordination, strategic planning and budgeting, the selection and designation of new conservation areas, and other cross-cutting functions that extend beyond the direct management of individual Protected Areas (PAs) or Indigenous Lands.

Following *da Silva et al.* (2022), these system-wide enforcement costs were estimated as 15–20% of the annual recurrent management costs, applied exclusively to management (excluding establishment costs). For this analysis, an average coefficient of 17.5% was applied to the combined management costs of two major categories: (i) the management of existing Conservation Units (UCs), the 3 million hectares of new UCs under the PPCDAm target, and the 10.3 million hectares of undesignated forests allocated to UCs; and (ii) the management of existing Indigenous Lands, plus the 19.2 million hectares of public forests assumed to be allocated to Indigenous territories.

Based on these parameters, the total estimated enforcement cost amounts to approximately USD 1.3 billion by 2030.

A5.5. Forest sustainable use and the bioeconomy - Brazil

Table A5.5 - Forest bioeconomy finance needs.

Forest bioeconomy - Brazil	**Mean estimate by 2030 (US$ million/yr)**

Establishment of sociobiodiversity development centers, and the promotion of territorial arrangements	70
Opportunity costs	2.176

Sustainable forest use essentially considered the opportunity cost to be addressed through payments for environmental services to rural landowners and residents of sustainable use protection areas, in addition to the implementation of the Brazil's National Bioeconomy Development Plan (PNDBio).

In the case of opportunity costs, a proxy was established based on Payments for Environmental Services (PES) schemes for sustainable-use protected areas, reflecting the opportunity cost of land. The value was calculated at USD 122 per hectare, derived from average cattle ranching revenues across municipalities in Pará (*Government of Pará*, 2024). This corresponds to an annual opportunity cost proxy of approximately USD 10.8 billion.

The Brazil's National Bioeconomy Development Plan (PNDBio) defines key strategic actions such as: (i) the establishment of sociobiodiversity development centers, and (ii) the promotion of territorial arrangements aimed at strengthening biodiversity-based value chains. Although the PNDBio has not yet established detailed implementation indicators or costed targets, this analysis relied on specialist consultations and existing project references to estimate the potential scale of financial needs.

According to expert assessments, the estimated cost to establish six sociobiodiversity development centers ranges from USD 16–21 million, based on projections derived from ongoing project design processes rather than from dedicated cost studies. This range was adopted as a preliminary benchmark to reflect the indicative financial magnitude of implementing sociobiodiversity centers under the PNDBio.

To estimate the resources required for territorial sociobiodiversity arrangements, this study used the KfW Project as a reference, which allocated approximately USD 13.5 million to implement six territorial arrangements, corresponding to an average of USD 2.3 million per microregion. Applying the territorial prioritization methodology developed by CSF and the Ministry of the Environment (MMA), a total of 24 priority microregions were identified within the Amazon biome. Extrapolating the KfW unit cost across these 24 territories yields an estimated total requirement of approximately USD 55 million for the Amazon, under the assumption that the same average cost per microregion applies across all priority areas.

Based on these parameters, the total estimated for sustainable use and the bioeconomy cost amounts to approximately USD 10.9 billion by 2030.

A5.6. Forest restoration - Indonesia

Indonesia's FOLU roadmap targets the restoration of 13 million hectares of degraded land by 2030—equivalent to 19 billion trees and an estimated carbon sequestration potential of 1.6 billion tons CO_2. Restoration supports multiple ecosystem functions, including biodiversity recovery, watershed rehabilitation, and climate mitigation.

A spatial overlay of WWF's 18 study provinces indicates that 7.27 million hectares (55.7% of the national target) fall within these areas. Restoration costs were differentiated into two categories:

1. Protected areas restoration, estimated at an average of USD 110/ha, based on Gasparinetti (2023).
2. Productive restoration through agroforestry systems, at USD 9,549/ha, including investment (USD 1,045/ha), operational (USD 1,037/ha/year for 5 years), and opportunity costs derived from palm oil land returns.

The combined restoration cost for the WWF study provinces is USD 19.26 billion, consisting of USD 0.14 billion for protected area restoration and USD 16.2 billion for productive restoration.

A5.7. Forest conservation - Indonesia

The forest conservation category follows Indonesia's Forestry and Other Land Use (FOLU) Net Sink 2030 Operational Plan, which aims to achieve a net emission balance of -140 $MtCO_2$ by 2030. This target is pursued through a comprehensive set of measures: reducing deforestation and degradation, increasing carbon sequestration in natural and production forests, restoring peat and mangroves, conserving biodiversity, and strengthening forest law enforcement.

Baseline emissions from the FOLU sector are projected to reach 714 $MtCO_2e$ by 2030, with the sector contributing roughly 17-25% of the national mitigation effort depending on international support. Conservation measures thus require substantial and sustained financing to maintain ecosystem services, ensure compliance, and promote sustainable land use.

Investment needs for conservation were estimated using national cost models aligned with the FOLU roadmap. These include capital expenditure (CAPEX) and operational expenditure (OPEX) for forest protection, management, and ecosystem service development across 64.4 million hectares of conservation areas. The estimated range is USD 2.4-6.8 billion (USD 37-106/ha) for 2025-2030, covering both rehabilitation and maintenance costs.

In addition, the analysis accounts for the opportunity costs associated with halting the conversion of Convertible Production Forests (HPK), areas typically cleared for oil palm, mining, or settlement expansion. Over the past decade, approximately 150,000 hectares of HPK have been converted annually, primarily to oil palm plantations. Using the average net revenue of oil palm as a proxy for forgone income, the opportunity cost of avoided conversion is estimated at USD 2.5 billion for the 2025-2030 period.

Including this opportunity cost, the total conservation financing needed across the highly forested provinces rises to approximately USD 7.1 billion. This figure reflects not only the direct management and operational costs of conservation areas but also the economic trade-offs necessary to preserve remaining forest landscapes. Addressing this cost through incentive-based mechanisms, such as carbon payments, jurisdictional REDD+ programs, and ecological fiscal transfers, will be critical to sustaining Indonesia’s long-term forest protection efforts.

A5.8. Indigenous Peoples' lands and other collective lands - Indonesia

Indonesia’s recognized Indigenous territories cover approximately 5.7 million hectares (BRWA). Annual management costs were estimated at USD 625-938 million, with an average of USD 782 million per year (USD 146/ha/year) after adjustment to 2024 values. The total management cost for 2025-2030 is approximately USD 0.83 billion, reflecting expenditures needed for governance, monitoring, and sustainable livelihood support within Indigenous and community-managed forests.

A5.9. Forest enforcement - Indonesia

Forest enforcement costs capture system-wide expenditures to maintain the conservation network across the 18 WWF provinces, including coordination, monitoring, fire prevention, and compliance. Following the da Silva et al. (2022) framework, enforcement was assumed to account for 15–20% of annual management costs. Using Indonesian benchmarks (Hakim, 2009), annual operational expenses, including patrols, administration, and management, amount to approximately IDR 835,000/ha/year, equivalent to USD 2.19 billion for 2025-2030. The total forest enforcement cost for 2025-2030 is approximately USD 2.3 billion.

A6. FOREST FINANCE CHANGING FLOWS DATA ANALYSIS

In this section, we present the detailed methods for calculating the forest finance changing flows for highly forested areas in Brazil and Indonesia. All financial values in the dataset were standardized to constant 2024 US dollars to ensure comparability across sources and countries, as previously described in Appendix A4.

The analysis of changing financial flows considered two distinct scenarios. The first, an optimistic scenario, was based on the historical trends and maximum values identified through the financial flow analysis. The second, a full potential scenario, represents an ideal condition in which existing and emerging financial mechanisms are fully implemented and operate at their maximum efficiency and effectiveness.

Table A6.1 below presents both optimistic and potential scenarios for each of the instruments considered.

Table A6.1 - Forest finance changing flows.

Mechanism	Enhanced mobilization approach	Full potential mobilization approach	Mean estimate by 2030 (US$ billion/yr)
TFFF	Late implementation allowing for one disbursement until 2030.	Immediate implementation allowing for four disbursements until 2030.	407-813
EcoInvest	Two new tenders focused on forests by 2030. Amounts mobilized similar to the average allocation for forests in the initial tenders.	Four new tenders focused on forests by 2030. Amounts mobilized similar to the average allocation for forests in the initial tenders.	244-488

Sustainable sovereign bonds	Two new tenders focused on forests by 2030. Amounts mobilized similar to the average allocation for forests in the initial tenders.	Four new tenders focused on forests by 2030. Amounts mobilized similar to the average allocation for forests in the initial tenders.	21-42
J-REDD+	Credit trading based on historical averages and carbon prices at USD 15/CO2 ton.	Credit trading based on theoretical potential and carbon prices at USD 15/CO2 ton.	59-1049
RBP	Credit trading based on historical averages and carbon prices at USD 5,13/CO2 ton.	Credit trading based on theoretical potential and carbon prices at USD 5,13/CO2 ton.	119-1237
Domestic budget	Annual growth based on the maximum for the period 2020-2024.	Annual growth based on double the maximum for the period 2020-2024.	379-758
ODA	Kept maximum constant for the period 2020-2024.	Double the maximum for the period 2020-2024.	149-299
Rural subsidies	20% reduction in harmful subsidies by 2030.	100% reduction in harmful subsidies by 2030.	285-1424
Rural credit	20% reduction in perverse credit	100% reduction in perverse credit	854-4269

	lines by 2030.	lines by 2030.	
Domestic grants	Annual growth based on the maximum for the period 2020-2024.	Annual growth based on double the maximum for the period 2020-2024.	168-284
Carbon markets	Kept maximum constant for the period 2020-2024.	Double the maximum for the period 2020-2024.	18-36
Biodiversity offsets	Kept maximum constant for the period 2020-2024.	Double the maximum for the period 2020-2024.	409-1022
Forest private instruments	Kept maximum constant for the period 2020-2024.	Double the maximum for the period 2020-2024.	11-23

APPENDICES B. KEYWORDS

In this section, we present the keywords used to filter positive and negative forest finance flows. The keywords were selected based on a literature review and on the definition of positive and negative flows previously described in Appendix A3.

Positive forest finance flows	
Category	**Keywords**
Forest conservation	"amazon"*, "biodiversity", "carbon", "climate", "conservation", "ecosystem service", "ecosystem services", "ecoturism", "environmental regularization", "forest", "forests", "PROKLIM"*, "REDD", "REDD+", "regeneration", "wildlife corridors", "forest policies", "forest policy",

Forest enforcement	"deforestation", "environmental control", "environmental crime", "environmental crimes", "environmental enforcement", "environmental monitoring", "environmental protection", "fire", "illegal activities", "logging", "logger", "wildfire", "wildfires", "wood", "forest research", "forest studies", "forest mapping", "geoprocessing", "geospatial analysis", "GIS", "remote sensing", "satellite", "satellites", "education for rural communities", "environmental education", "public awareness", "rural education",
Forest protected areas	"conservation unit", "conservation units", "extractive reserve", "extractive reserves", "national park", "protected area", "protected areas", "protected forest",
Forest restoration	"degraded area", "degraded areas", "forestry", "reforestation", "rehabilitation", "restoration", "revegetation", "watershed",
Forest sustainable management	"agroecology", "agroforestry", "FSC", "KPH"*, "natural resource management", "RIL-C"*, "sustainable agriculture", "SVLK"*, "tree", "trees", "bioeconomy", "sociobiodiversity"*, "sociobioeconomy"*,
Indigenous Peoples' and local communities forest governance and rights	"customary lands", "customary forest", "Indigenous", "Indigenous land", "Indigenous lands", "Indigenous Peoples", "Indigenous Peoples' rights", "Indigenous territory", "Indigenous territories", "pluricultural rights", "pluriethnic rights", "rights of Indigenous Peoples", "traditional peoples", "village forest", "Afro-descendant communities"*, "Afro-descendant peoples"*, "collective rights", "local communities", "quilombola"*, "quilombolas"*, "quilombo"*, "quilombos"*, "social rights", "traditional communities",
Negative forest finance flows	
Category	**Key words**
Deforestation driver - agriculture	"agribusiness", "agricultural", "agriculture", "agro-industry", "agro-industries", "agro-livestock"*, "biofuel", "crop", "cattle"*, "fertilizer", "guarantee", "oil palm"*, "palm oil"*, "pasture"*, "pastures"*, "rural credit", "seedlings", "subsidies", "subsidy", "plantation",
Deforestation driver - mining	"dam", "gold", "mineral resource", "mineral resources", "mining", "nickel", "tin", "metal", "coal", "cooper", "bauxite"

Deforestation driver - another type of land conversion	"agrarian reform", "land regularization", "silviculture",
Infrastructure	"bridge", "bridges", "dam", "ferries"*, "ferry"*, "hydroelectric plant", "logistics", "railroad", "railroads", "railway", "road", "roads", "roadway",
*Keywords considered only for Brazil. Keywords considered only for Indonesia.	

APPENDICES C. VARIABLES AND SUB-VARIABLES SELECTED

In this section, we present the variables and sub-variables selected to filter positive and negative forest finance flows. The selection was based on an analysis of regular expressions (regex), which are patterns used to identify, extract, or classify specific parts of text based on defined rules. We used the keywords previously described in Appendix B.

OECD CRS positive forest finance flows	
Purpose name	"Agrarian reform", "Agricultural alternative development", "Agricultural co-operatives", "Agricultural development", "Agricultural education/training", "Agricultural extension", "Agricultural inputs", "Agricultural land resources", "Agricultural policy and administrative management", "Agricultural research", "Agricultural services", "Agricultural water resources", "Food crop production", "Industrial crops/export crops", "Livestock", "Formal sector financial intermediaries", "Basic life skills for youth", "School feeding", "Business development services", "Responsible business conduct", "Information and communication technology (ICT)", "Education facilities and training", "Teacher training", "Material relief assistance and services", "Forestry development", "Forestry education/training", "Forestry policy and administrative management", "Forestry research", "Biodiversity", "Biosphere protection", "Environmental education/training", "Environmental policy and administrative management", "Environmental research", "Site preservation", "Decentralisation and support to subnational government",

	"Democratic participation and civil society", "Ending violence against women and girls", "Human rights", "Legal and judicial development", "Media and free flow of information", "Public sector policy and administrative management", "Women's rights organisations and movements, and government institutions", "Forest industries", "Industrial development", "Technological research and development", "Food safety and quality", "Multisector aid", "Multisector education/training", "Research/scientific institutions", "Rural development", "Culture and cultural diversity", "Labour rights", "Social Protection", "Population policy and administrative management", "Higher education", "Immediate post-emergency reconstruction and rehabilitation", "Vocational training"
SIOP positive forest finance flows	
Action	"Promoção e Fortalecimento da Comercialização, do Abastecimento, e do Acesso aos Mercados para a Agricultura Familiar e Povos e Comunidades Tradicionais", "Apoio à Organização Econômica e Promoção da Cidadania e o Bem Viver de Mulheres Rurais", "Apoio e Fortalecimento ao Etnodesenvolvimento e Acesso à Terra e ao Território dos Povos e Comunidades Tradicionais e Quilombolas", "Estruturação Produtiva, Promoção e Fortalecimento da Agricultura Familiar e da Agroecologia", "Desenvolvimento Sustentável da Bioeconomia", "Promoção da Educação do Campo", "Apoio à Conservação Ambiental e à Erradicação da Extrema Pobreza", "Desenvolvimento da Bioeconomia", "Fomento a Projetos de Desenvolvimento Sustentável e Conservação do Meio Ambiente", "Gestão Socioambiental dos Recursos Naturais em Territórios de Povos e Comunidades Tradicionais e Agricultores Familiares", "Ampliação e Modernização da Infraestrutura para o Estudo da Biodiversidade, Inovação Tecnológica e Sustentabilidade dos Ecossistemas Amazônicos frente às Mudanças Globais", "Apoio à Criação, Gestão e Implementação das Unidades de Conservação Federais", "Apoio à Formulação e Implementação de Políticas e Programas para Proteção e Defesa Animal", "Cadastro, Recomposição e Produção Florestal", "Execução de Pesquisa e Conservação de Espécies e do Patrimônio Espeleológico", "Execução de Pesquisa, Monitoramento e Conservação de Espécies e do Patrimônio Espeleológico", "Formulação e Implementação de Estratégias para Promover a Conservação, a Recuperação e o Uso Sustentável da Biodiversidade, da Vegetação Nativa e do Patrimônio Genético", "Formulação e Implementação de Estratégias para Promover a Proteção, a Conservação e o Uso Sustentável da

	Biodiversidade, da Vegetação Nativa e do Patrimônio Genético", "Gestão do Uso Sustentável da Biodiversidade e Recuperação Ambiental", "Gestão Socioambiental em Territórios de Povos e Comunidades Tradicionais e Agricultores Familiares", "Implementação de Ações de Cidadania e Educação Ambiental", "Licenciamento Ambiental Federal", "Monitoramento Ambiental e Gestão da Informação sobre o Meio Ambiente e Educação Ambiental", "Monitoramento Ambiental e Gestão da Informação Sobre o Meio Ambiente e Educação Ambiental", "Monitoramento, Avaliação e Controle de Substâncias, Produtos Químicos e Biológicos e de Atividades Potencialmente Poluidoras e Utilizadoras de Recursos Ambientais", "Pesquisa e Informações Florestais", "Pesquisa, Avaliação e Monitoramento da Flora Brasileira", "Publicidade de Utilidade Pública", "Ciência, Tecnologia e Inovação no Instituto Nacional da Mata Atlântica", "Manutenção do Sistema de Proteção da Amazônia", "Manutenção e aprimoramento do Centro Gestor e Operacional do Sistema de Proteção da Amazônia – CENSIPAM", "Proteção, Fiscalização e Combate a Ilícitos na Amazônia Legal e sua Região Fronteiriça", "Regularização Fundiária, Proteção e Gestão dos Territórios Indígenas", "Fomento à Pesquisa, Tecnologia e Inovação para o Desenvolvimento Sustentável da Biodiversidade Amazônica", "Direitos Pluriétnico-Culturais e Sociais dos Povos Indígenas", "Gestão de Políticas para Povos Indígenas", "Apoio a Estudos e Projetos de Pesquisas e Desenvolvimento Relacionados à Mudança do Clima", "Fomento a Estudos e Projetos para Mitigação e Adaptação à Mudança do Clima", "Implementação e Monitoramento da Política Nacional sobre Mudança do Clima", "Pesquisa e Desenvolvimento para Estudos de Tempo, Clima, Observação e Modelagem do Sistema Terrestre", "Gestão e Operacionalização do Terra Brasil", "Governança Fundiária e Gerenciamento do Cadastro Rural", "Monitoramento de Conflitos Agrários e Pacificação no Campo", "Reconhecimento e Indenização de Territórios Quilombolas", "Apoio ao Desenvolvimento Territorial Sustentável à Inclusão Produtiva e à Infraestrutura Rural", "Desenvolvimento e Gestão Ambiental para o Público da Reforma Agrária", "Identificação, Reconhecimento e Titulação de Territórios Quilombolas", "Promoção da Educação e Cultura do Campo", "Enfrentamento dos Processos de Desertificação, Mitigação e Adaptação aos Efeitos da Seca", "Implementação e Monitoramento de Políticas de Mudanças Climáticas, Mitigação e Adaptação", "Iniciativas para Implementação e Monitoramento da Política Nacional sobre Mudança do Clima e da Contribuição Nacionalmente Determinada", "Pesquisa,

	Desenvolvimento e Supercomputação para Previsão de Tempo e Clima", "Redução da Vulnerabilidade aos Efeitos da Desertificação", "Descomissionamento de Unidades Mínero-Industriais de Material Radioativo com Recuperação de Áreas Degradadas", "Apoio à Implementação de Políticas para Quilombolas, Comunidades Tradicionais de Matriz Africana, Povos de Terreiro e Ciganos", "Controle e Fiscalização Ambiental", "Fiscalização Ambiental e Prevenção e Combate a Incêndios Florestais", "Prevenção e Controle de Incêndios Florestais nas Áreas Federais Prioritárias", "Prevenção, Fiscalização, Combate e Controle ao Desmatamento Ilegal, aos Incêndios Florestais e aos Demais Ilícitos Ambientais na Amazônia Legal e sua Região Fronteiriça", "Construção da Sede do Centro Nacional de Prevenção e Combate aos Incêndios Florestais", "Aprimoramento da Infraestrutura da Fundação Nacional do Índio", "Proteção e Promoção dos Direitos dos Povos Indígenas", "Regularização, Demarcação e Fiscalização de Terras Indígenas e Proteção dos Povos Indígenas Isolados", "Formulação e Implementação de Políticas, Estratégias e Iniciativas para o Controle do Desmatamento, Incêndios Florestais e o Ordenamento Ambiental Territorial", "Gestão de Florestas", "Implementação da Agenda Nacional de Proteção, Defesa, Bem-Estar e Direitos Animais", "Implementação de Políticas para Biodiversidade, Vegetação Nativa e Áreas Protegidas", "Avaliação e Gestão de Substâncias, Produtos Químicos e Biológicos para Proteção da Biodiversidade", "Controle Ambiental de Produtos, Substâncias, Resíduos e Atividades Potencialmente Poluidoras", "Conservação e Recuperação de Bacias Hidrográficas", "Implantação do Plano de Recuperação de Áreas Degradadas em São Félix/BA", "Recuperação de Áreas Degradadas".
SIOP negative forest finance flows	
Action	"Fiscalização dos Estoques e das Operações de Garantia e Sustentação de Preços na Comercialização de Produtos Agropecuários", "Promoção do Cooperativismo, Associativismo e Agroindústria para o Desenvolvimento Agropecuário e da Agricultura Familiar", "Assistência Técnica e Extensão Rural", "Contribuição ao Fundo Garantia-Safra (Lei nº 10.420, de 2002)", "Fortalecimento da Agricultura Familiar Brasileira no Cenário Internacional", "Agropecuária Conservacionista", "Apoio ao Desenvolvimento da Produção Agropecuária Sustentável", "Apoio ao Desenvolvimento de Agricultura de Baixa Emissão de Carbono", "Concessão de Subvenção Econômica ao Prêmio do Seguro Rural (Lei nº 10.823, de 2003)", "Desenvolvimento das Cadeias Produtivas da Agropecuária",

"Desenvolvimento do Abastecimento Agroalimentar", "Desenvolvimento e Difusão de Tecnologias, Estudos e Pesquisas afins em Agricultura Irrigada", "Estruturação e Inclusão Produtiva dos Agricultores Familiares e dos Pequenos e Médios Produtores Rurais", "Fomento à Tecnologia Agropecuária e aos Recursos Genéticos", "Fomento ao Setor Agropecuário", "Promoção do Agronegócio Brasileiro no Mercado Internacional", "Promoção do Cooperativismo e Associativismo para o Desenvolvimento Agropecuário", "Promoção e Fortalecimento da Comercialização e Acesso aos Mercados", "Promoção e Fortalecimento da Estruturação Produtiva da Agricultura Familiar, Pequenos e Médios Produtores Rurais", "Redução de Riscos na Atividade Agropecuária", "Remissão de Dívidas Decorrentes de Operações de Crédito Rural (Lei nº 12.249, de 2010)", "Subvenção Econômica em Operações de Comercialização de Produtos Agropecuários (Lei nº 8.427, de 1992)", "Subvenção Econômica em Operações de Investimento Rural e Agroindustrial (Lei nº 8.427, de 1992)", "Subvenção Econômica em Operações de Investimento Rural e Agroindustrial destinadas a Empresas Cerealistas (Lei nº 13.986, de 2020)", "Subvenção Econômica em Operações de Investimento Rural e Agroindustrial destinadas a Empresas Cerealistas (Medida Provisória nº 897, de 2019)", "Subvenção Econômica nas Aquisições do Governo Federal e na Formação de Estoques Reguladores e Estratégicos", "Subvenção Econômica nas Operações de Custeio Agropecuário (Lei nº 8.427, de 1992)", "Subvenção Econômica nas Operações de Financiamento para a Estocagem de Álcool Combustível e para Renovação e Implantação de Canaviais (Lei nº 12.666, de 2012)", "Subvenção Econômica para Garantia e Sustentação de Preços na Comercialização de Produtos Agropecuários (Lei nº 8.427, de 1992)", "Subvenção Econômica para Garantia e Sustentação de Preços na Comercialização de Produtos da Agricultura Familiar (Lei nº 8.427, de 1992)", "Subvenção Econômica para Operações decorrentes do Alongamento de Dívidas Originárias de Crédito Rural (Leis nº 9.138, de 1995 e nº 10.437, de 2002)", "Subvenção Econômica para Operações decorrentes do Alongamento de Dívidas Originárias de Crédito Rural (Leis nº 9.138, de 1995, nº 9.866, de 1999, nº 10.437, de 2002, e nº 11.775, de 2008)", "Fomento a Projetos Institucionais para Pesquisa no Setor de Agronegócio (CT-Agronegócio)", "Apoio ao Desenvolvimento e Controle da Agricultura Orgânica", "Fortalecimento do Sistema Unificado de Atenção à Sanidade Agropecuária", "Modernização e Fortalecimento da Defesa Agropecuária", "Vigilância e Inspeção das Operações de Comércio

	Exterior de Mercadorias, Bens e Materiais de Interesse Agropecuário", "Apoio aos Polos de Agricultura Irrigada", "Polos de Agricultura Irrigada", "Estudos de Inventário e Viabilidade para Expansão da Geração Hidrelétrica", "Avaliação dos Recursos Minerais do Brasil", "Desenvolvimento Sustentável e Tecnológico da Mineração", "Estudos para o Planejamento dos Setores de Geologia, Mineração e Transformação Mineral", "Gestão das Políticas de Geologia, Mineração e Transformação Mineral", "Gestão e Disseminação da Informação Geológica", "Levantamentos da Geodiversidade", "Levantamentos Geológico-Ambientais aplicados ao Ordenamento Territorial", "Levantamentos Geológicos e Integração Geológica Regional", "Outorga, Fiscalização e Regulação da Mineração", "Pesquisa, Desenvolvimento e Inovação nas Geociências e Setor Mineral", "Produção Laboratorial de Análises Minerais", "Regulação, Outorga e Fiscalização da Mineração", "Revisão e Automação dos Processos de Outorga e Fiscalização de Pesquisa e Lavra Mineral da ANM", "Reforma Agrária e Regularização Fundiária", "Regularização Fundiária e Assistência Técnica e Extensão Rural na Amazônia Legal e sua Região Fronteiriça", "Mapeamento Geológico do Brasil", "Indenizações e Restituições relativas ao Programa de Garantia da Atividade Agropecuária", "Subvenção Econômica nas Operações de Crédito Rural para empreendimentos localizados em áreas de abrangência da SUDENE ou da SUDAM ou para atendimento de Decisão Judicial (Leis nº 12.844/2013 e nº 13.340/2016)", "Pesquisa e Desenvolvimento de Tecnologias para a Agropecuária", "Pesquisa, Desenvolvimento e Transferência de Tecnologias para a Agropecuária", "Promoção da Inovação tecnológica na Agropecuária", "Transferência de Tecnologias para a Inovação para a Agropecuária", "Fiscalização dos Serviços de Transporte Rodoviário".
SICOR positive forest finance flows	
Subprogram	“Programa Nacional De Fortalecimento Da Agricultura Familiar (Pronaf)”, “Programa Para Reducao Da Emissao De Gases De Efeito Estufa Na Agropecuaria (Abc), “Programa de Financiamento a Sistemas de Produção Agropecuária Sustentáveis (RenovAgro)”.
SICOR negative forest finance flows	
Subprogram	“Programa Nacional De Apoio Ao Medio Produtor Rural (Pronamp)”, “Programa De Modernizacao Da Agricultura E Conservacao De Recursos Naturais (Moderagro)”, “Programa De Modernizacao Da

	Frota De Tratores Agricolas E Colheitadeiras (Moderfrota)”, “Programa de Desenvolvimento Cooperativo para a Agregação de valor à produção agropecuária (ProdeCoop)”, “Programa de Incentivo à Inovação Tecnológica na Produção Agropecuária (Inovagro)”, “Programa Nacional De Credito Fundiario (Pncf)”, “Programa não especificado”.
BNDES positive forest finance flows	
Financial instrument	“Programa Nacional De Fortalecimento Da Agricultura Familiar (Pronaf)”, “Programa Para Reducao Da Emissao De Gases De Efeito Estufa Na Agropecuaria (Abc)”, “BNDES FINEM” – “Saneamento Ambiental e Recursos Hídricos”, “Meio Ambiente”, “BNDES Fundo Socioambiental”, “Fundo Amazônia”.
BNDES negative forest finance flows	
Financial instrument	“Programa Nacional De Apoio Ao Medio Produtor Rural (Pronamp)”, “Programa De Modernizacao Da Agricultura E Conservacao De Recursos Naturais (Moderagro)”, “Programa De Modernizacao Da Frota De Tratores Agricolas E Colheitadeiras (Moderfrota)”, “Programa de Incentivo à Inovação Tecnológica na Produção Agropecuária (Inovagro)”, “BNDES FINEM” – “Geração de Energia Hidrelétrica e Termoelétrica a gás natural”, “Transmissão de Energia Elétrica”, “Logística”, “BNDES Crédito Rural”.
Brazil’s Sovereign Sustainable Bonds	
Action	“Monitoramento da Cobertura da Terra e do Risco de Queimadas e Incêndios Florestais (INPE)”, “Apoio a Estudos e Projetos de Pesquisa e Desenvolvimento Relacionados à Mudança do Clima”, "Regularização Fundiária, Proteção e Gestão dos Territórios Indígenas", "Redução de Riscos na Atividade Agropecuária", "Estruturação Produtiva, Promoção e Fortalecimento da Agricultura Familiar e da Agroecologia", "Apoio a organização econômica e promoção da cidadania e o bem viver de mulheres rurais", "Desenvolvimento sustentável da bioeconomia", "Direitos pluriétnico-culturais e sociais dos povos indígenas", "Recuperação hidroambiental nas bacias hidrográficas na área de atuação da CODEVASF", "Gestão de políticas para povos indígenas", "Apoio ao desenvolvimento da produção agropecuária sustentável”, "Monitoramento e Risco de Queimadas e Incêndios Florestais", "Apoio a conservação ambiental e a erradicação da extrema pobreza", "Apoio à Criação, Gestão e Implementação das Unidades

	de Conservação Federais", "Prevenção e Controle de Incêndios Florestais nas Áreas Federais Prioritárias", "Controle e fiscalização ambiental", "Fiscalização ambiental e prevenção e combate a incêndios florestais", "Fomento à pesquisa e ao desenvolvimento científico e tecnológico", Ampliação e modernização da infraestrutura para o estudo da biodiversidade, inovação tecnológica e sustentabilidade dos ecossistemas amazônicos frente às mudanças globais", "Monitoramento e alerta de desastres naturais - CEMADEN", "Ciência, tecnologia e inovação no instituto nacional de pesquisas da Amazônia - INPA", "Apoio a Estudos e Projetos de Pesquisa e Desenvolvimento Relacionados à Mudança do Clima", "Apoio a Obras Emergenciais de Mitigação para Redução de Desastres"

APPENDICES D. DOUBLE-COUNTING

In this section, we present detailed information on possible double counting during the analyses and ways to avoid its inclusion in the final results of the calculation of positive and negative financial flows currently estimated for highly forested areas in Brazil and Indonesia. In general, processes to evaluate and remove double counts were conducted throughout all database analysis processes and previously mentioned on a case-by-case basis in Appendix A4.

Resources from the Amazon Fund were identified in two different databases: the OECD CRS and BNDES databases. The OECD CRS captures the financial contributions made by developed countries to Brazil, while the BNDES reflects the actual disbursements of these resources to approved projects under the Amazon Fund. Although both datasets refer to the same financial instrument, the amounts reported correspond to different stages of the financial cycle and are therefore not directly comparable. To address this, data related to the Amazon Fund are presented separately in analyses based on each respective source. However, to avoid double-counting, to calculate the overall average financial flow, only the difference between the amounts reported in the two databases was considered.

Climate Fund resources were also identified in two different databases: the SIOP database and the BNDES technical reports. SIOP indicates public budget contributions to the Climate Fund, while BNDES records actual disbursements for approved projects to all Climate Fund sources of funding. As these data sets represent different sources of financing, the reported values are not directly comparable. For this reason, the analyses present the data from each source separately and, to avoid double-counting, only the difference between the two was considered in calculating the overall average of financial flows.

Another relevant case of potential double-counting was identified in the analysis of subsidies and rural credit. Subsidy data were obtained from the SIOP database, while rural credit resources were drawn from the SICOR database. The SICOR database has a high potential to include, either partially or fully, the subsidies granted to rural credit, as it reports the total value of credit disbursements. To avoid this potential double-counting, all observations from the SICOR database related to external funding and government resources were removed. Future studies require further attention to explore this issue.

APPENDICES E. EXPERTS CONSULTED

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Carlos Eduardo Frickmann Young – Federal University of Rio de Janeiro (UFRJ)

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FURTHER INFORMATION

Results for Indonesia and Brazil are available at https://www.wwf.org.uk/articles/forest-finance

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