The Triple Gap in Finance for Agrifood Systems: Annexes

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1. ANNEX I: TAXONOMY

Table 1.1 presents the taxonomy of climate finance needs for agrifood systems resulting from a calibration between CPI and FAO, followed by a list of transition finance activities classified in Table 1.2. Building on the taxonomy used in the Landscape of Climate Finance for Agrifood Systems (CPI, 2023), the improved taxonomy results from a joint effort between CPI and FAO to harmonize their sectoral classification of agrifood systems sectors, solutions, and technologies. Tables 1.3 and 1.4 show which solutions and activities were successfully matched with third-party needs estimations during the data aggregation process, and associated sources.

Table 1.1: Overview of taxonomy for climate finance needs for agrifood systems

Sector	Solution	Activity	Sub-activities (non-exhaustive)
Crop and livestock systems	**Sustainable crops, agroforestry, livestock production**	Crop diversity and resilience	Crop management practices, includes regenerative practices
		Soil health and erosion control	Sowing cover or catch crops, crop rotation
		Soil carbon storage management	Reduced tillage techniques to enhance soil carbon content, agroforestry
		Post-harvest management	Crop residues management (e.g. reduced burning)
		Bioenergy	Biofuels, BECS
		Supply chain	Fertilizer manufacturing and other pre-production
		Energy efficiency and renewable energy	Solar panels, wind turbines, energy efficient practices and facilities
		Reduction of non-CO_2 GHG emissions from agricultural practices and technologies	Rice, nutrient, fertilizer management
		Nutrient and pest control	Integrated (chemical and biological) pest control measures
		Weather forecasting	Forecasting tools and systems
		Supporting infrastructure	Farm facilities, machinery, equipment
		Livestock management for GHG mitigation	Improved feeding/breeding practices, silvopasture, grassland/pasture management
		Resilient livestock breeds	Animal husbandry, adapted breeds
		Manure management	Biodigesters, practices reducing CH_4 and N_2O
		Grassland management	Pasture renovation, grazing optimisation, management of grasslands and savanna
		Waste management	Wastewater and waste management
		Water management	Water-efficient irrigation, water storage
		Urban agriculture	Urban and peri-urban agriculture
	Supply chain management (commercialisation, primary procession, and storage)	Alternative proteins production	On-site facilities for production of alternative meat and dairy products
		Supply chain	Input supply systems for seed production, distribution, and access
		Energy efficiency and renewable energy	Energy efficient primary processing and storage facilities for produce
		Post-harvest management	Minimize post-harvest loss
	Unspecified	Mitigation	N/A
		Adaptation	N/A
		Multiple objectives	N/A

Sector	Solution	Activity	Sub-activities (non-exhaustive)
Forestry	**Afforestation, reforestation, forest conservation, sustainable management of existing forest, including extraction of non-timber products**	Afforestation on non-forested land	Conversion of low productivity land into woodland
		Reforestation on previously forested land	N/A
		Sustainable forest management	Early-warning systems, ecological diversification
		Production of non-timber forest products (NTFP)	Commercial cultivation of goods from forests of biological origin other than wood
		Forest conservation	Non-commercial forestry activities to maintain existing habitat in area and quality
		Forest restoration and rehabilitation	Non-commercial forestry activities to improve and/or increase area and quality of forest
		Projects seeking to reduce emissions from the deforestation or degradation of ecosystems	Payment for ecosystem services, REDD+
		Supporting infrastructure	Infrastructure associated with forestry and initial processing of timber
		Bioenergy	Bioenergy from forest biomass
	Supply chain management (commercialisation, primary procession, and storage)	Supply chain	Management, information systems, and other technologies
	Unspecified	Mitigation	N/A
		Adaptation	N/A
		Multiple objectives	N/A
Fisheries & aquaculture	**Sustainable fish production**	Supporting infrastructure	Machinery, storage facilities, information systems
		Aquaculture	Feed, water, species management and sustainable techniques
		Energy and resource efficiency	Reduction in energy use, resource efficiency
		Water management	Improved water management to sustain fisheries
		Supply chain	Safety at sea from climatic events
	Supply chain management (commercialisation, primary procession, and storage)	Supply chain	N/A
	Unspecified	Mitigation	N/A
		Adaptation	N/A
		Multiple objectives	N/A
Food & diets	**Food loss, waste, and low-carbon diets**	Sustainable consumption patterns	Healthy diets, reducing food loss and waste, local loops and linkages between consumers and farmers
Biodiversity, land & marine ecosystems	**Ecosystems**	Rehabilitation of degraded lands	Peatland, wetlands, coastal wetlands, riparian habitats
		Conservation of non-forested land	Non-commercially productive land (national parks, protected areas)
		Restoration or rehabilitation of non-forested land	Non-commercially productive land
	Unspecified	Mitigation	N/A
		Adaptation	N/A
		Multiple objectives	N/A

Sector	Solution	Activity	Sub-activities (non-exhaustive)
Policy, national budget support & capacity building	**Policy instruments**	Economic incentives and market-based instruments	N/A
		Regulatory approaches	N/A
		Voluntary actions and agreements	N/A
		Inventories and monitoring strategies	N/A
		Climate change planning and institutional capacities	N/A
		Financing and investments	N/A
		Climate and disaster risk planning and institutional capacities	N/A
		Emergency response and recovery	N/A
	Financial services for sustainable production, commercialisation, storage, and processing	Climate services	Risk-based insurance, financial services targeting climate-vulnerable beneficiaries
	R&D	R&D	Climate-focused R&D in crops and livestock, testing of climate-friendly practices, research of climatic trends
	Training and monitoring	Extension services	Improvement of agronomic practices, access to technology and infrastructure, farm advisory services
		Capacity-building	Training for locally appropriate climate-smart practices
	Unspecified	Mitigation	N/A
		Adaptation	N/A
		Multiple objectives	N/A

Table 1.2: Overview of taxonomy for transition finance needs for agrifood systems

Sector	Solution
Livelihoods & poverty	On and off-farm livelihood diversification
	Payments for ecosystem services
	Subsidies
	Social networks and member organizations
	Land and water tenure
	Social protection
	Food security
	Rural infrastructure

Table 1.3: Agrifood finance needs taxonomy solutions matched with third-party data

Sector	Solution	Activity	Sub-activities included in third-party data
Crop and livestock systems	**Sustainable crops, agro-forestry, livestock production**	Livestock management of GHG mitigation	Silvopastoralism Improved feeding practices
		Soil carbon storage management	Biochar application to soils Increase in above-ground biomass
		Grassland management	Pasture renovation and grazing optimization Avoided grassland and savannah degradation
		Soil health and erosion control	Sowing cover crops Soil water retention
		Crop diversity and resilience	Crop management practices (includes regenerative practices)
		Water management	Water-efficient irrigation technologies
		Supply chain	Production of organic and biofertilizers
		Nutrient and pest control	Pest control measures
		Supporting infrastructure	Managing machinery and equipment for breeding and farming
		Manure management	Manure management with biodigesters Manure management practices to reduce GHG emissions
		Reduction non-CO_2 GHG emissions from agricultural practices and technologies	Improved fertilizer use to reduce impact Paddy rice management
	Supply chain management of agricultural products	Post harvest management	Minimize post-harvest loss
		Supply chain	Improvement in energy and resource efficiency aiming for a reduction of GHG emissions
		Urban agriculture	Urban farming
Forestry	**Afforestration, reforestation, forest conservation, sustainable management of existing forest**	Forest restoration and rehabilitation	Non-commercial forestry activities designed to increase the area or improve the quality of existing forest habitat or to establish new forest stands.
		Forest conservation	Non-commercial forestry activities designed to maintain the existing forest habitat in both area and quality.
		Sustainable forest management	Sustainable forest management activities that increase carbon stocks or reduce the impact of forestry activities on soil quality, soil carbon and biodiversity
		Project seeking to reduce emissions from the deforestation or degradation of ecosystems	Payments for ecosystem services, including REDD+
Fisheries & aquaculture	**Sustainable fish production**	Aquaculture	Adaptation to changes in fish stocks
	Unspecified/Multiple objectives	Unspecified/Multiple objectives	Sustainable fisheries

Sector	Solution	Activity	Sub-activities included in third-party data
Food & diets	**Food loss, waste, and low-carbon diets**	Sustainable consumption patterns	Reducing food loss and waste Healthy diets (diversified sources of protein, plant-based diets) Local loops and linkages between urban consumers and farmers
Biodiversity, land, & marine ecosystems	**Ecosystems**	Rehabilitation of degraded lands	Wetlands and coastal wetlands restoration Peatland restoration Reduce degradation and conversion of wetlands and coastal wetlands Reduce degradation and conversion of peatlands
		Restoration or rehabilitation of non-forested land	Restoration or rehabilitation of non-commercially productive land to improve the quality or to increase the area of existing habitats or to establish new habitats
		Conservation of non-forested land	Protected areas
Policy, national budget support & capacity building	**Policy instruments**	Climate change planning and institutional capacities	N/A
		Economic incentives and market-based instruments	N/A
		Financing and investments	N/A
	R&D	R&D	Testing climate-friendly practices, inputs, adaptive crop varieties, or technologies, including research relating to climatic trends Climate-focused R&D in crops & livestock
	Training and monitoring	Extension services	Advisory services on transitioning a farm to climate-friendly practices, including the provision of information on crop diversification options to farmers

Table 1.4: Transition finance needs taxonomy solutions matched with third-party data

Solution	Activities	Sub-activities	Sources
Livelihoods & poverty	Social protection	N/A	Thornton et al. (2023), FOLU (2019)
	Food security	Multi-sectoral approaches for food security and nutrition	Ruggeri Laderchi (2024), FOLU (2019)
	Rural infrastructure	N/A	FOLU (2019), Ruggeri Laderchi (2024)
	On an off-farm livelihood diversification	N/A	Thornton et al. (2023)
	Social networks and member organizations	N/A	Thornton et al. (2023)

2. ANNEX II: TOP-DOWN APPROACH

The top-down approach aggregates and summarises climate finance needs estimated by third-party publications. Through a comprehensive literature review, CPI collected needs estimates for agrifood systems at the sectoral level. The aim is to present a comprehensive overview of available needs estimates to date and provide a collective understanding of the magnitude of finance required to align agrifood systems to a 1.5°C pathway.

2.1 DATA SOURCES AND PRIMARY DATA COLLECTION

Our research identified 46 recent reports and publications mentioning climate finance needs for agrifood systems. Out of the 46 sources, seven reports included a quantified assessment of future investment needed to meet climate and development goals. Table 2.1 includes the list of data sources reviewed vs. the reports used for the needs estimates. The final list of reports used in CPI's needs estimations matched the following criteria:

1. **Recency:** Reports published over the last five years (2019-24) were prioritized to reflect the most recent methodological advancements in the field and the increased adoption of the systemic framing, i.e. the widening of activities falling under the scope of agrifood systems.
2. **Comprehensiveness:** Reports that covered climate finance to agrifood systems comprehensively were prioritized, especially if their objectives were geared towards the 2030 and 2050 deadlines to reach the Paris Agreement goals.
3. **Primary data:** Reports developing their own needs scenarios and estimates were prioritized. If a data source referred to a scenario developed by a different institution, the data from the original scenario was used, unless more granular or additional information could be gathered from the secondary source.
4. **Granularity:** Reports providing data in disaggregated formats (e.g., sector and solutions) were prioritized.

Table 2.1: Data sources reviewed vs. used in calculations to estimate top-down climate finance needs

Sources reviewed	Sources used in top-down needs estimations
• ACFS (2022) • AlphaBeta (2017) • Bene (2019) • Bhattacharya (2022) • CBI (2022) • CBI (2024) • CCAFS (2020) • CompensACTION (2022) • Costa (2022) • Deforestation Free Finance (2021) • FAO (2020) • FAO (2023) • FOLU (2019) • FOLU (2023) • FOLU (2024) • Global Alliance for the Future of Food (2024) • Harmsen (2019) • IFPRI (2021) • IFPRI (2022) • IFPRI (2024) • IHLEG (2022) • Laborde (2022) • Laderchi (2024) • Loboguerrero (2020) • LSE (2021) • McKinsey (2022) • Mercy Corps (2023) • Millan (2019) • ODI (2024) • Paulson Institute (2020) • Planet (2023) • Root Capital (2024) • Steiner (2020) • Thornton (2023) • UN Environment (2019) • UNCTAD (2023) • UNEP (2022) • UNEP (2023) • UNEP (2023) • UNEP FI (2023) • UNFCCC (2023) • UNFSS (2021) • WBCSD (2023) • World Bank (2024) • WRI (2019) • WWF (2022)	• FOLU (2019) • FOLU (2024) • Global Alliance for the Future of Food (2024) • Laderchi (2024) • Thorton et al. (2023) • UNEP (2023) • World Bank (2024)

2.2 DATA STANDARDIZATION AND ANALYSIS

All data was extracted directly from the reports reviewed, except for UNEP (2023), for which the dataset was accessed. The original data extracted from different sources was highly heterogeneous in terms of sectoral classification and timeframes. To make needs estimates comparable, the data was standardized as detailed below.

SECTORAL CLASSIFICATION

Data in the reports were matched to the taxonomy defined in Annex I. Compared with the sectoral AFOLU taxonomy historically used for CPI's Global Landscape of Climate Finance report (CPI, 2023), the agrifood systems taxonomy used in this report includes a wider range of sectors. For example, the inclusion of sectors such as "biodiversity, land, and marine ecosystems" reflects an intention to promote the need for systemic change across social and environmental contingencies. For this reason, the total values reported throughout this report are higher as compared to reports focusing on a smaller range of aspects of agrifood systems. Furthermore, the scenarios modeled differed in scope, sector coverage, and even classification. As such, this report is the first of its kind to provide a comprehensive overview of climate finance needs for agrifood systems.

TIMEFRAME CONSIDERED

The report presents needs estimates compiled from literature for the period 2024-30. This period was chosen to reflect short- to medium-term estimations, starting to date. As a comparison, Table 2.2 provides the original timeframe, and the scenario used in the seven reports that were used. When yearly estimates were not available, the given figures were annualized.

Table 2.2: Data of sources used for needs estimates, original timeframe, and scenario

List of sources	Original timeframe	Scenario
FOLU (2019)	2018-30	Growing Better
FOLU (2024)	2025-30	Agricultural Emissions Mitigation
Global Alliance for the Future of Food (2024)	2024-34	Annual global cost of transition to regenerative and agroecological approaches
Laderchi (2024)	2020-50	Cost of transforming food systems
Thorton et al. (2023)	2018-30	Thornton et al.
UNEP (2023)	2023-50	NbS needs to reach Rio Targets
World Bank (2024)	2024-30	Cost of transforming food systems

FOLU (2024) provided estimates from 2025, creating a data gap for the year 2024. To ensure compatibility between the figures, the missing values for the year 2024 were set equal to the 2025 values.

CURRENCY YEAR

Most needs estimates found in third-party literature were expressed in nominal (current) USD, with different scenarios being published in different years. Where not stated in the original source, the currency year was assumed to be the year of publication. To improve the consistency and comparability of data, all investment needs estimates were standardized to 2022 USD, considering inflation rates shown in Table 2.3.

Table 2.3: Inflation rates for currency conversion

Original currency year	Conversion rate to 2022 USD
2005	1.5
2010	1.34
2012	1.27
2015	1.23
2018	1.16
2019	1.14
2020	1.13
2021	1.08
2023	0.95
2024	0.93

Source: US Inflation Calculator, available here.

2.3 OMISSION OF POST-2030 DATA

Need estimates from the literature review were initially collected and standardized to cover two timeframes: 2024-30 and 2031-50. Needs estimates were prepared for the short-, medium-, and long-terms. Due to data limitations in the post-2030 period, this report only presents needs estimations to 2030.

There is limited information on agrifood finance needs over longer timeframes in the current literature. Data gaps were too significant to allow for direct comparisons between the 2024-30 and 2031-50 periods. Table 2.4 showcases the lack of data for the 2031-50 period. Only two out of seven reports provided estimates over this period.

Table 2.4: List of sources used for estimations and covered timeframes

List of sources	2024-30	2031-50
FOLU (2019)	2023-34	N/A
FOLU (2024)	2025-30	N/A
Global Alliance for the Future of Food (2024)	2024-30	Partial (2031-34)
Laderchi (2024)	2024-30	2031-50
Thorton et al. (2023)	2024-30	N/A
UNEP (2023)	2024-30	2031-50
World Bank (2024)	2024-30	N/A

To understand which sectors were most impacted by the data gaps related to the reports' timeframes, a gap analysis was conducted at the sector and sub-activity levels. Table 2.5 compares the number of sources and the percentage of sub-activities covered between the two timeframes, for each of the six sectors. Table 2.6 lists the sources that provided data at the activity level, for each timeframe.

Table 2.5: Data coverage per sector, number of sources, and percentage of sub-activities

Sectors (40 sub-activities)	Coverage for 2024-30		Coverage for 2031-50	
	Number of sources	Percentage of sub-activities	Number of sources	Percentage of sub-activities
Agriculture (20)	6	60% (100% from 2025)	3	25% (35% until 2034)
Forestry (4)	3	100%	2	75%
Fisheries & aquaculture (1)	1	100%	0	0%
Food & diets (3)	5	100%	1	67%
Biodiversity, land & marine ecosystems (6)	3	100%	1	83% (100% until 2034)
Policy, national budget support & capacity building (6)	3	100%	1	17%

Table 2.6: List of sources by sector, solution, activity, and timeframe

Sectors (6), solutions (10), and activities (29)	Sources for 2023-30	Sources for 2031-50
Agriculture	FOLU_2024, UNEP_2023, Laderchi_2024, Global Alliance for the Future of Food_2024, World Bank_2024, FOLU_Growing Together_2019	UNEP_2023, Laderchi_2024, Global Alliance for the Future of Food_2024
Sustainable crops, agroforestry, livestock production	FOLU_2024, UNEP_2023, Laderchi_2024, Global Alliance for the Future of Food_2024, World Bank_2024, FOLU_Growing Together_2019	UNEP_2023, Laderchi_2024, Global Alliance for the Future of Food_2024
Livestock management for GHG mitigation	FOLU_2024, UNEP_2023	UNEP_2023
Soil carbon storage management	FOLU_2024, Laderchi_2024, UNEP_2023	Laderchi_2024, UNEP_2023
Grassland management	UNEP_2023	UNEP_2023
Soil health and erosion control	Global Alliance for the Future of Food_2024, UNEP_2023	Global Alliance for the Future of Food_2024, UNEP_2023
Crop diversity and resilience	FOLU_Growing Together_2019, World Bank_2024, FOLU_2024, Global Alliance for the Future of Food_2024	Global Alliance for the Future of Food_2024
Water management	FOLU_Growing Together_2019	N.A.
Supply chain	FOLU_Growing Together_2019	N.A.
Nutrient and pest control	FOLU_Growing Together_2019	N.A.
Supporting infrastructure	FOLU_Growing Together_2019	N.A.
Manure management	FOLU_2024	N.A.

Sectors (6), solutions (10), and activities (29)	Sources for 2023-30	Sources for 2031-50
Reduction of non-CO_2 GHG emissions	FOLU_2024	N.A.
Urban agriculture	FOLU_Growing Together_2019	N.A.
Supply chain management of agricultural products	FOLU_2024	N.A.
Post-harvest management	FOLU_2024	N.A.
Supply chain	FOLU_2024	N.A.
Forestry	UNEP_2023, Laderchi_2024, FOLU_Growing Together_2019	UNEP_2023, Laderchi_2024
Afforestation, reforestation, forest conservation, sustainable management of existing forest, including extraction of non-timber products	UNEP_2023, Laderchi_2024, FOLU_Growing Together_2019	UNEP_2023, Laderchi_2024
Forest restoration and rehabilitation	FOLU_Growing Together_2019, UNEP_2023	UNEP_2023
Forest conservation	UNEP_2023, FOLU_2024	UNEP_2023
Sustainable forest management	FOLU_Growing Together_2019, Laderchi_2024	Laderchi_2024
Projects seeking to reduce emissions from the deforestation or degradation of ecosystems	FOLU_Growing Together_2019	N.A.
Fisheries & aquaculture	FOLU_Growing Together_2019	N.A.
Sustainable fish production	FOLU_Growing Together_2019	N.A.
Aquaculture	FOLU_Growing Together_2019	N.A.
Unspecified - Multiple objectives	FOLU_Growing Together_2019	N.A.
Food & diets	FOLU_Growing Together_2019, World Bank_2024, FOLU_2024, Thornton_Thornton et al. _2023, Laderchi_2024	Laderchi_2024
Food loss, waste, and low-carbon diets	FOLU_Growing Together_2019, World Bank_2024, FOLU_2024, Thornton_Thornton et al. _2023, Laderchi_2024	Laderchi_2024
Sustainable consumption patterns	FOLU_Growing Together_2019, World Bank_2024, FOLU_2024, Thornton_Thornton et al. _2023, Laderchi_2024	Laderchi_2024
Biodiversity, land & marine ecosystems	FOLU_Growing Together_2019, UNEP_2023, Global Alliance for the Future of Food_2024	UNEP_2023
Ecosystems	FOLU_Growing Together_2019, UNEP_2023, Global Alliance for the Future of Food_2024	UNEP_2023
Rehabilitation of degraded lands	FOLU_Growing Together_2019, UNEP_2023	UNEP_2023
Restoration or rehabilitation of non-forested land	Global Alliance for the Future of Food_2024	N.A.
Conservation of non-forested land	UNEP_2023	UNEP_2023
Policy, national budget support & capacity building	Thornton_Thornton et al. _2023, Laderchi_2024, FOLU_Growing Together_2019	Laderchi_2024
Policy instruments	Thornton_Thornton et al. _2023, Laderchi_2024, FOLU_Growing Together_2019	Laderchi_2024
Climate change planning and institutional capacities	Thornton_Thornton et al. _2023	N.A.
Economic incentives and market-based instruments	Thornton_Thornton et al. _2023, Laderchi_2024	Laderchi_2024
Financing and investments	Thornton_Thornton et al. _2023, FOLU_Growing Together_2019	N.A.

Sectors (6), solutions (10), and activities (29)	Sources for 2023-30	Sources for 2031-50
R&D	FOLU_Growing Together_2019, Thornton_Thornton et al. _2023	N.A.
Training and monitoring	Thornton_Thornton et al. _2023	N.A.
Extension services	Thornton_Thornton et al. _2023	N.A.

2.4 DATA AGGREGATION AND COMPILATION OF RESULTS

The overall figures extracted from third-party literature were split across the sectors and solutions listed in Annex I to the most granular level possible. For each sector, the figures extracted for each solution were aggregated to ensure the widest coverage possible. For each sector and solution, we calculated annual maximum, minimum, and average values for the 2024-30 period, as follows:

- **Maximum and minimum needs values:** For each sector and solution, these are the highest needs estimates across all scenarios included in the calculations. For example, if sources A, B, and C estimated the annual climate finance needs for aquaculture to be USD 150 billion, USD 350 billion, and USD 300-450 billion, respectively, we obtain the annual finance needs for aquaculture as the range with the minimum USD 150 billion and maximum USD 450 billion.
- **Average needs values:** For each sector and solution, these were calculated as the average of needs estimates in each scenario included in the calculations. In the example above, we would present the annual average finance need for aquaculture as USD 291.7 billion (i.e., the average between USD 150 billion, USD 350 billion, and USD 375 billion which is the average of the USD 300-450 figures above).

2.5 ADVANTAGES AND LIMITATIONS

2.5.1 ADVANTAGES

Aggregating estimates from various reports efficiently leverage existing data to assess the investment needs for a net zero trajectory by 2050. This approach reduces variability in methodologies across institutions and produces a more consistent and comprehensive overview of required investments. Solutions and activities benefit from broad coverage, as multiple reports often highlight similar practices central to the agrifood climate transition. For example, sustainable consumption patterns are included in five distinct reports, and the estimates are averaged to smooth methodological differences and avoid reliance on outlier figures.

However, some activities, such as grassland management and biodiversity protection, are only covered by a single report. In this analysis, 14 out of 29 activities have estimates from just a single source, with the most referenced source, FOLU (2019), covering half of the activities. As such, aggregating estimates across reports enables a more comprehensive view of the solutions presented in the literature and provides a robust estimate of the investments required to deploy these initiatives effectively.

2.5.2. LIMITATIONS

The primary limitation of this approach lies in the interpretation of the results. While aggregating estimates from multiple sources provides a comprehensive overview of solutions and their investment needs, the complementarity of these solutions is not guaranteed. Many scenarios focus on specific activities as part of their transition strategies, resulting in investment figures driven by targeted priorities. Since no single scenario is exhaustive, overlapping investments by incorporating initiatives from various scenarios remains relevant. However, it is important to recognize that these estimates are not derived from a unified model, and there may be inconsistencies in the suggested levels of effort and investment.

Averaging estimates helps smooth variability and avoid extremes, as noted in Section 2.5.1. However, the diversity of solutions is not solely due to challenges in assessing needs but also reflects deliberate choices in transition strategies, which influence the associated investment estimates. Smoothing this variability inevitably also smooths the impact of these strategic differences on investment levels for each activity. For this reason, the average value is supplemented with maximum and minimum estimates to capture the range of possible outcomes more accurately.

The average should not be seen as a definitive benchmark that guarantees the achievement of net zero targets. Instead, it should be viewed as an indicative estimate of the scale of investment required, along with the financial and political efforts necessary to support the transition.

3. ANNEX III: BOTTOM-UP APPROACH

3.1 DATA SOURCE AND PRIMARY DATA COLLECTION

Nationally Determined Contributions (NDCs) contain qualitative information on the financial needs[1] of developing and developed economy parties to the UNFCCC to implement the Paris Agreement.[2] FAO reviewed the latest versions of NDCs (n=167) submitted by all developing and developed economy parties to the UNFCCC NDC Registry as of January 2024.[3]

NDCs are countries' self-defined national climate pledges under the Paris Agreement, detailing what they will do to help meet a global temperature increase of at most 1.5°C, adapt to climate impacts, and ensure sufficient finance to support these efforts. NDCs represent short- to medium-term goals and need updating every five years. There are currently 168 available NDCs, representing 195 parties to the Paris Agreement. As of September 2023, according to UNFCCC, NDCs covered 94.9% of the total global emissions in 2019. A NDC update round will begin in 2025.

Data was manually extracted from each NDC based on FAO's protocol for data extraction and analysis of agrifood systems in NDCs (forthcoming) and systematically organized in a structured data collection template in Microsoft Excel. The extracted data included reported total and agrifood system climate finance needs, which was extracted at the most granular level, when possible, and coded based on the finance taxonomies used by the UNFCCC Standing Committee on Finance and agrifood sectoral taxonomies, FAO, and CPI. Four main datatypes were extracted:

- **Thematic:** Includes adaptation, mitigation, cross-cutting, and other areas of climate action.
- **Sources of finance:** Categorized as domestic, international, or unspecified funding.
- **Sectoral and sub-sectoral coverages:** Detailed in Annex I (refer to FAO 2024 for further details).
- **Cost aggregation:** Encompasses total costs, sectoral costs, sub-sectoral costs, and action-level costs.

Other extracted data include NDC submission date, investment timeframe, gender and social inclusion (GSI), and climate and sustainable development co-benefit finance markers.

Several factors limit the representativeness of these NDC-based results. The lack of a standardized approach to developing and submitting NDCs creates inconsistencies across countries. Delays in submissions further hinder timely analysis and comparisons. Additionally, many submissions lack disaggregated financial figures at the sectoral level, making it difficult to assess specific funding needs. Analysing current data reveals variations in the number of countries that have submitted their NDCs, with different submission dates and deadlines for updates. Only a limited number of countries provide financial figures disaggregated by sector, and their geographic distribution is uneven, often concentrated in specific regions.

1 Costed needs refer to the financial resources required to implement specific climate actions or measures, as outlined in the NDCs.
2 Parties refers to the countries or regional organizations that have formally agreed to and ratified the UNFCCC.
3 The European Union's NDC is treated as representative of all EU member states, and as such we exclude the individual NDCs of each member, and the Holy See, from the analysis.

3.2 DATA STANDARDIZATION AND ANALYSIS

Due to the heterogenous nature of NDCs, climate finance needs by parties are not directly comparable. To facilitate aggregation and comparability, the data was harmonized in the following way to minimize misalignment between information and data according to regions, sectors, objectives, and timeframes:

- **Normalization to average annual climate finance needs:** The climate finance needs were normalized to average annual values, when reported as cumulative values for a specified investment time frame. Some countries already reported climate finance needs as an average annual value. Inflation was not accounted for in the analysis.
- **Normalization to cumulative climate finance needs over 2021-2030 investment time frame:** The average annual climate finance needs were normalized to cumulative values for a standardized investment time frame in line with NDC implementation under the Paris Agreement (2021-30). Some countries already reported cumulative climate finance needs for the 2021-30 investment timeframe.
- **Normalization to per capita annual climate finance needs and annual climate finance needs as an equivalent percentage of GDP:** To enable comparisons between countries, annual average climate finance needs were normalized to per capita annual climate finance needs by country income level, with annual climate finance needs normalized as an equivalent percentage of GDP. This method controls for population size and the size of the economy, which are major factors that influence total finance needs (UNEP, 2023). Population and GDP data were downloaded from the World Bank's World Development Indicators database.
- **Geographic region, income level, and other special country groupings:** Geographic regions are based on the World Bank's regional classification and income groups are based on the World Bank's list of economies.[4] Three income groups were used: low-income countries, middle-income countries, and high- income countries. The lower-and middle-income country categories were combined into a single cluster.
- **Data quality control:** The data was reviewed by three separate FAO experts and corrected for outliers, gaps and inconsistencies with CPI dataset.

3.3 DATA EXTRAPOLATION FOR A GLOBAL ESTIMATE

Data from the 108 NDCs that cost needs – both agrifood systems and other sectors – is extrapolated to create a global figure. The extrapolation methodology is as follows and is based on the method used in UNEP's 2023 Adaptation Gap Report (UNEP, 2023). Two extrapolation factors were employed to estimate total, and agrifood system-specific, climate finance needs globally and by region:

1. Extrapolation factor 1 (Ef1): Average annual total climate finance needs per capita (USD/person), by WB country income level
2. Extrapolation factor 2 (Ef2): Annual AFS climate finance needs (as a percent of GDP), by WB country income level

4 For this analysis, Palestine is coded as Middle East & North Africa; Cooks Island and Niue coded as East Asia & Pacific; EU's NDC coded as Europe & Central Asia. All individual EU country NDCs are excluded.

For Ef1, the median of average annual climate finance needs per capita by income group was used as an extrapolation factor. The factor was based on NDC submissions with finance needs estimated (n=108). Per capita climate finance needs is considered a commonly used and straightforward method for global extrapolation (UNEP 2023). Results can be seen in Figure 3.1.

For Ef2, average annual agrifood system climate finance needs as a percentage of GDP by income group was used as an extrapolation factor. This factor was based on NDC submissions with agrifood system finance needs estimated (n=67). Needs expressed as an equivalent percentage of GDP is an alternative method for global extrapolation (UNEP 2023) to complement the per capita extrapolation factor used. Both per capita and GDP factors were tested for sensitivity, and we adopted the most conservative approach. Results can be seen in Figure 3.2.

Figure 3.1: Ef1 values across income group

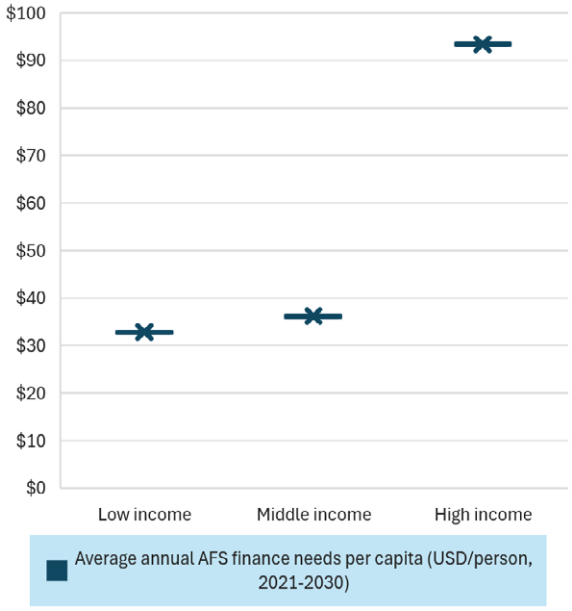
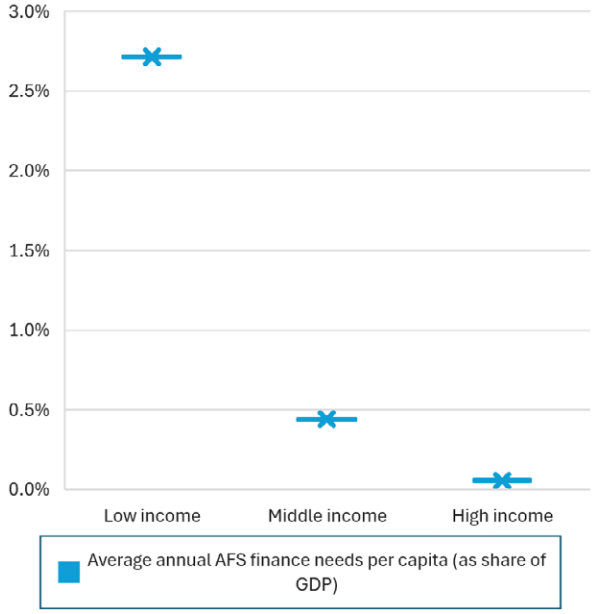


Figure 3.2: Ef2 values across income groups



The income group includes low-income countries, lower-middle-income countries, upper-middle-income countries, and high-income countries. The upper-middle-income country and high-income country categories were combined into a single group due to the limited reporting of climate finance needs by non-Annex I high-income countries. Normalized climate finance needs were also obtained for LDCs and SIDS.

The per capita emission factors used correspond to similar trends observed in other studies (UNFCCC 2021; UNEP 2023), which suggest that wealthier countries have higher-valued assets and infrastructure that are at risk of climate change and, therefore, estimate higher adaptation needs in absolute values because they have assets. It also suggests that wealthier countries have greater historical responsibility for GHG emissions and can afford to invest more in mitigation solutions, resulting in higher needs estimated amongst higher-income countries. However, it is also critical to acknowledge that agrifood system climate finance needs for low-income countries represent a larger relative proportion of their economy. When finance needs are expressed as an equivalent percentage of GDP, a different trend is observed. The average agrifood system climate finance

needs in LICS constitute 2.7% of GDP, while needs equate to 0.4% of GDP in MICs and 0.1% of GDP in HICs on average.

3.4 ADVANTAGES AND LIMITATIONS

3.4.1 ADVANTAGES

NDCs provide an importance source of bottom-up information for estimating climate finance needs for agrifood systems. They also provide valuable insights on the scale and relative prominence of agrifood systems in the global climate finance needed for achieving the goals of the Paris Agreement, across different regions and country income groups; the relative priority of adaptation and mitigation finance needs for agrifood systems, across different regions and country income groups; the expected sources of climate finance for agrifood systems and the extent to which climate action in agrifood systems depend upon the flow of international finance; and the sub-sectoral climate investment needed for agrifood systems in the transition towards a Paris-aligned future. They also provide evidence on capacity and knowledge gaps for estimating climate finance needs and the rationale for strengthened capacity building and improved methodologies in this area.

3.4.2 LIMITATIONS

Due to the heterogenous nature of NDCs in their varying level of detail; scope; and methodologies employed, these documents present numerous challenges for data aggregation and comparability. Therefore, the findings presented in the report must be interpreted within the context of the limitations of data gaps and inconsistencies.

Data gaps in the coverage of information provided challenges the representativeness of data. Not all NDCs contain costed climate finance needs at the sectoral and sub-sectoral level (or by climate adaptation/mitigation objective) and therefore, there is a likely underrepresentation of the true cost of climate action in agrifood systems. This stems from methodological challenges and limited knowledge and capacity to climate finance needs in agrifood systems (UNFCCC 2021; UNEP 2023). Additionally, due to the lack of rigorous and transparent methods, costed needs may also be overestimated in some NDCs.

Inconsistent data provided presents the following challenges: inconsistent sub-totals with respect to total; varying timelines; risk of double counting; lack of clarity between finance needed vs already allocated; varying definition of climate finance needs (investments, needs, costs, etc.).

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