Technical report: Indicator recommendation for assessing adaptation progress in food and agriculture (Target 9b) of the UAE framework for Global Climate Resilience

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Summary

This document presents a set of 13 headline indicators and 53 sub-indicators recommended and shortlisted by the expert group working on Target 9b under the UAE-Belém Framework for Climate Resilience, as part of the broader UAE Framework for adaptation indicators. These indicators are intended to support the measurement of climate adaptation progress in food and agriculture. The summary of headline indicators, which are further elaborated in this document under section 3, are outlined below:

1. Agricultural land under climate-resilient practices and technologies
2. Adoption rate of climate-resilient agricultural practices and technologies
3. Climate resilience of food and agricultural supply and distribution systems
4. Diversification of livelihoods and rural economies
5. Access to climate-responsive social protection, credit, and insurance for populations dependent on agrifood systems
6. Financing allocated for climate-resilient agriculture
7. Availability and access to climate information services, including early warning systems and agrometeorological data
8. Institutional and organizational capacity for climate change adaptation in food and agriculture
9. Capacity building and knowledge transfer for climate adaptation in the agrifood sector
10. Changes in agricultural productivity and biophysical impact drivers linked to climate variability and change
11. Impacts of climate change on agricultural incomes
12. Losses and damage in the food and agriculture sectors
13. Impacts of climate change on food security and nutrition

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1. Introduction

The UAE Framework for Global Climate Resilience's (UAE FGCR) target on food and agriculture articulates an ambition of "**attaining climate-resilient food and agricultural production and supply and distribution of food, as well as increasing sustainable and regenerative production and equitable access to adequate food and nutrition for all" (**UNFCCC, 2023, 2/CMA.5, para. 9b). The target emphasizes not only the need to track the uptake of adaptive practices, particularly those promoting sustainable and regenerative production but also the impact of adaptation actions in enhancing resilience across the agricultural value chain, including production, supply, distribution, access and nutrition.

Beyond these target-specific components, the overall assessment of adaptation progress is also guided by the broader framework of the Global Goal on Adaptation (GGA), which aims to reduce vulnerabilities, improve resilience and enhance adaptive capacities, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the temperature goal (UNFCCC, 2015, Article 7, paragraph 1). These overarching elements highlight critical aspects that must inform the development of indicators.

Furthermore, at SB60 and COP29, Parties agreed upon criteria to guide the selection of indicators.

Considering these foundations, a structured framework and systematic process guided the selection of Target 9b indicators to ensure alignment with the objectives of assessing adaptation under the Paris Agreement while ensuring that the final indicator set corresponds with adaptation priorities and actions across scales. This approach is broken down into a series of well-defined steps that integrate essential conceptual elements, ensuring that the indicators identified are robust, policy-relevant, and reflective of adaptation efforts and contexts. The steps are sufficiently flexible and aligned with approaches applied by other expert groups, thereby contributing to the establishment of a harmonized approach across expert groups.

2. Description Of Methodology and Guiding Principles for Identifying and Developing Indicators

To systematically identify and develop indicators for assessing progress toward the UAE FGCR target 9b on food and agriculture, a structured, multi-step approach has been adopted. Each step builds on key conceptual foundations, beginning with the identification of key elements within the target components, followed by the mapping of existing indicators, identification of gaps, and the development of new indicators as needed. Indicators are then evaluated and refined based on the criteria agreed by Parties at SB60 and CMA6 (Decision 3/CMA.6), as described in the steps below (Fig. 1). While the figure may suggest a linear process, the mapping, review, and development of indicators was in fact an iterative exercise. Experts engaged in continuous dialogue—framing and reframing relevant categories and indicators, mapping and remapping indicators—to arrive at the current list.

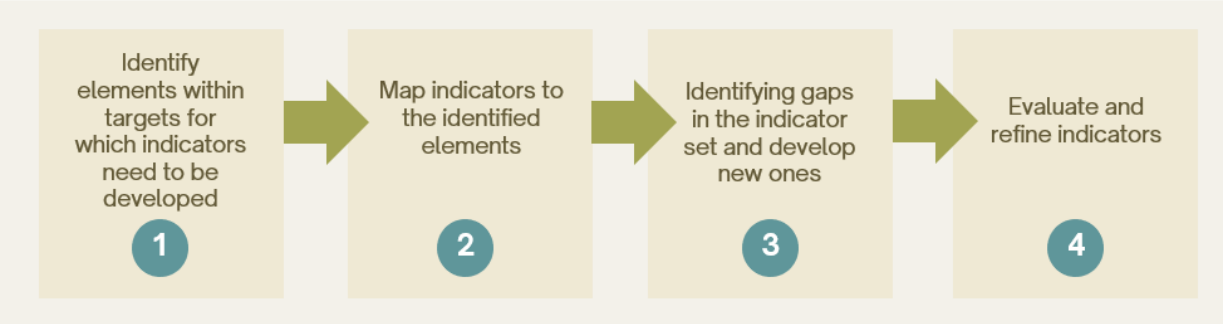


Figure 1: Steps for indicator review, selection and development

STEP 1: IDENTIFY CATEGORIES FOR WHICH INDICATORS WERE DEVELOPED

As highlighted above, each target of the UAE FGCR outlines key components that the global adaptation community is striving to achieve. These components provide foundational entry points for reviewing, refining, and developing indicators for tracking the targets. The first step involved unpacking what these components represent, considering different geographical contexts and sub-sectoral. For example, in the case of Target 9b, it considered climate risks, drivers, actions and results related to various aspects of food and agricultural systems such as production, supply, distribution, access, and nutrition while paying attention to diverse geographic locations such as mountain regions and arid and semi-arid lands (Fig 2).

Figure 2: Components of target 9b

Additionally, the various subsectors of food and agriculture were considered based on IPCC 6th Assessment Report (AR6) -- crops, livestock, fisheries and forestry – while also paying attention to cross-cutting aspects along agricultural value chains (IPCC, 2022). Forestry in the context of food and agriculture indicator selection only covers managed forests, such as agroforestry and agro-silvo pastoralism, distinguishing it from forest ecosystems that would otherwise be covered under Target 9d on ecosystems and biodiversity. Key guiding questions for this step included:

- **How does resilience for food and agriculture look like?**
  To answer this question, experts identified key climate impact drivers, impacts relevant for food and agriculture and outlined anticipated adaptation results that would show the effective reduction of those impacts and climate vulnerability.
- **What adaptation actions could lead to climate resilience and reduced climate vulnerability?**
  This question guided the identification of various adaptation measures across food and agriculture sub-sectors, scales (local, subnational, national, and global) and contexts. Consideration of these measures in the selection of indicators is fundamental for assessing implementation progress of adaptation actions, including the development and uptake of adaptive technologies and adoption of regenerative and sustainable production practices. Based on this question, a wide range of adaptation action categories were defined, including the development and adoption of technologies and practices across contexts and scales, enhancement of knowledge and information systems, and investments to strengthen institutional and organizational capacities for adaptation.
- **What factors are fundamental to enabling adaptation and resilience in food and agriculture sectors?**
  This involves identifying aspects related to adaptive capacity, capturing both material and immaterial elements that facilitate or hinder adaptation, including finance, institutions, infrastructure, and knowledge and information networks.

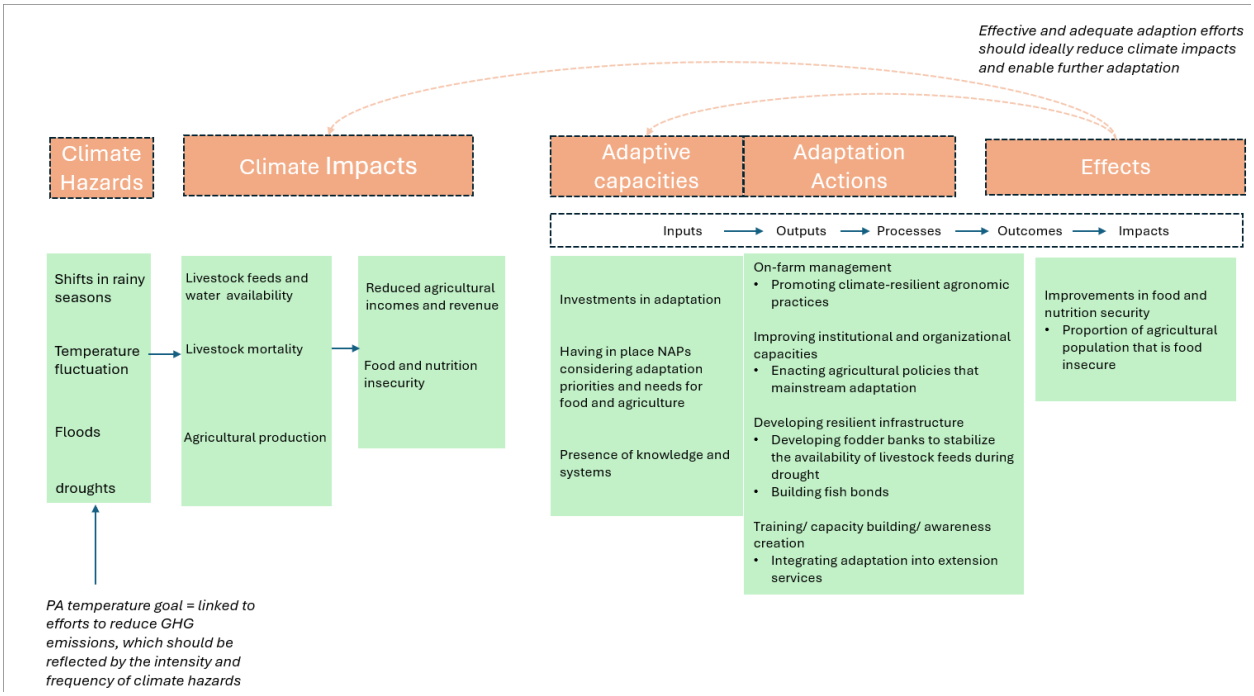


Figure 3. Example of a theory of change or pathways to arrive at results categories developed in Step 1.

This approach resulted in the construction of theories of change or pathways for the target, offering a structured method for linking vulnerability contexts, adaptation actions, measurable outcomes, and long-term results (Fig. 3). These pathways describe how interventions such as adopting climate-resilient production practices, strengthening supply chains, and improving food access can contribute to improved adaptive capacity, reduced vulnerability, and enhanced resilience, particularly in relation to food and nutrition security. In further unpacking this into a matrix (Table 1) this approach ensured that the categories used to operationalize the components of Target 9b—and subsequent steps in indicator mapping and development—were comprehensive and systematic.

Table 1. Examples of result categories corresponding with components of target 9b and GGA domains, for which indicators were identified (definitions corresponding to the table are provided in Annex 1.2 and 1.3)

Adaptation context (Impacts/ Resilience/ Vulnerability)			
Climate impact drivers and impacts on agriculture	Changes in crop/livestock/fisheries' yields and productivity Changes in pests, diseases vectors and weeds Changes in availability and quality of soil and water resources for agriculture	Impacts on productive infrastructure Impacts on aggregation & processing Impacts on storage & distribution	Impact on food security Impact on health and well-being Impact on income and livelihoods Impact on nutritional status Losses and damage in agrifood systems
Adaptive capacity (Enablers)			
Institutions, policies, capacities, finance, R&D and	Climate (and disaster risk planning) and institutional capacities Financing and investments Economic incentives and market-based instruments		

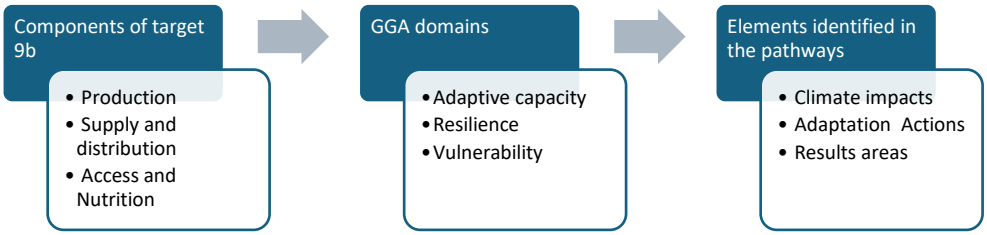
climate information			
Adaptation in relation to production (actions/ outputs and outcomes)			
Adaptation in crop-based systems	Sustainable/climate-resilient agriculture Climate tolerant crops and varieties Crop calendar optimization and rotation Agroforestry and tree crops	Urban, protected and controlled environment agriculture Pest and disease management On-farm soil and water moisture conservation	Drainage and irrigation Water harvesting Water management in agriculture, forestry and fisheries
Adaptation in livestock and grassland-based systems	Sustainable/climate-resilient livestock and/or grassland system Water infrastructure for livestock production	Adapted animal breeds and species diversification Grazing and grassland management and restoration	Feed and forage management Animal husbandry Agro-silvo-pastoralism
Farm-forest-based adaptation	Sustainable forest management Reducing deforestation and promoting forest conservation Adapted forest species and genetic diversification	Afforestation, reforestation and forest and/or landscape restoration Pest and disease management in forest-based systems	Wild-fire prevention and integrated management Payment for ecosystem services
Adaptation in ocean-based and inland fisheries and aquaculture systems	Sustainable fisheries practices Adaptive capture fishing practices and technologies Improved water management to sustain fishery services	Aquaculture feed management Aquaculture species selection and selective breeding	
Adaptation in relation to supply and distribution (actions/outputs and outcomes)			
Adaptation in post-harvest food systems and supply chains	Improved post-harvest practices Agricultural waste management	Food loss and waste Adaptive infrastructure and equipment	
Adaptation in relation to access and nutrition (actions/ outputs and outcomes)			
Social protection	Social assistance and insurance Cash transfers Food subsidies	Access to finance, savings, credit and livelihood**s** Livelihood diversification	Agricultural insurance Subsidies
Adaptation related to food security and nutrition	Changing dietary patterns Nutritional diversity and multi-sectoral approaches for food security and nutrition		

STEP 2: MAPPING INDICATORS TO COMPONENTS OF TARGET 9B, GGA DOMAINS AND RESULT CATEGORIES IDENTIFIED IN STEP 1

In this step, experts mapped indicators from the UNFCCC database of compiled indicators to high-level categories—such as target components, GGA domains, and result categories identified in Step 1 (see Figure 4 and Table 1). The

aim was to filter and group indicators according to their alignment with the elements identified earlier. **This process focused only on the 1,134 indicators previously tagged as "yes" or "maybe" in terms of relevance during the initial tagging exercise[1], out of a total of 1,801 indicators linked to Target 9b**.

Figure 4 Mapping indicators to facilitate filtering and gap analysis



This process offered several advantages. First, it enabled us to leverage the extensive pool of existing indicators while ensuring alignment with context-specific adaptation elements observed on the ground. To demonstrate this, **where applicable, Column I[2] of the Excel sheet accompanying this technical report includes information on indicators that were merged or modified during the development of each proposed indicator – more than 95% of recommended specific indicators for Target 9b cover elements highlighted in existing indicators.** Second, by mapping indicators to related elements, we were able to identify overlaps and redundancies, allowing for the consolidation and reduction of the total number of indicators under consideration. Third, as further elaborated in Step 3, this approach revealed elements that are not currently addressed by existing indicators, thereby highlighting areas where new indicators would need to be developed.

STEP 3: IDENTIFYING GAPS AND DEVELOPING NEW INDICATORS

Building on the elements identified in Step 1 and the mapping and tagging exercise conducted in Step 2, in Step 3, experts systematically examined the coverage of existing indicators. Through this analysis, they identified gaps—specific adaptation elements for which no suitable indicators currently exist in the UNFCCC database. These gaps highlighted areas where new or additional indicators were needed.

To address these gaps, experts developed new indicators designed to capture the missing elements. In some cases, experts checked if there were indicators in other global frameworks relevant to fill the gap, which entails reviewing global indicators such as those tracked under SDGs and Sendai framework or by custodian UN agencies such as FAO. In cases where no relevant indicator was found, experts formulated new indicators to capture particular elements. **The newly developed indicators were then reviewed, tagged to their corresponding adaptation element, and clearly marked as "new" indicators within the database (see column I[3] of the Excel sheet accompanying this technical report).** This step not only expanded the indicator set but also ensured comprehensive coverage of the adaptation elements identified as relevant, supporting a more complete and context-sensitive GGA tracking framework.

In Step 3, experts also reviewed the proposed indicators to identify important aspects that remained unaddressed, even when general topics had been included in Step 1. This required a careful examination of how each indicator was framed, leading to recommendations for adjustments or the development of additional indicators where needed. For instance, while the initial list included an indicator on agricultural insurance, it primarily focused on access. As a result, experts proposed supplementary indicators to capture other critical dimensions such as the availability and

[1] https://unfccc.int/documents/644540
[2] In the report shared by the expert group, "E" was in place of "I". The Secretariat changed it to "I" to align with the consolidated compilation from all expert groups.
[3] Same as footnote 2

diversity of insurance products, as well as their effectiveness. This expanded perspective was informed by our approach, which emphasizes the importance of tracking a sequence of adaptation actions or processes that ultimately contribute to desired outcomes, such as enhanced resilience. At the same time, given the goal of supporting global assessments of adaptation progress, experts sought to strike a balance between capturing detailed, context-specific indicators and ensuring that core adaptation steps were represented in a streamlined and globally relevant framework. **This resulted in a long list of 83 indicators.**

Following further review of this longlist of 83 indicators, it became evident that many indicators converged around common thematic areas. Based on this observation, indicators measuring similar or related aspects were grouped together, resulting in the formulation of headline indicators, each supported by a set of specific, corresponding indicators. This step resulted in **13 headline indicators** and **53 sub-indicators.** The headline indicators are broad and universally applicable, making them suitable for global aggregation. In contrast, the specific indicators offer flexibility, allowing Parties to report on elements that are most relevant to their national adaptation contexts.

STEP 4: EVALUATING AND REFINING INDICATORS BASED ON CRITERIA ESTABLISHED AT SB60 AND CMA6 DECISION

This step primarily draws on the indicator selection criteria agreed by Parties at SB60 and COP29 (3/CMA.6). In addition to tagging indicators according to the criteria categories, experts applied filters to assess and select indicators measuring related aspects and synthesized context-specific indicators into globally relevant formulations. Once each expert group prioritized a set of indicators, a cross-group review was conducted to further refine the indicator set, reduce redundancy, and identify indicators relevant to multiple targets. While this step was useful in helping to characterize the shortlisted indicators, further work is needed to refine them and to ensure a more balanced distribution across the selection criteria, where applicable.

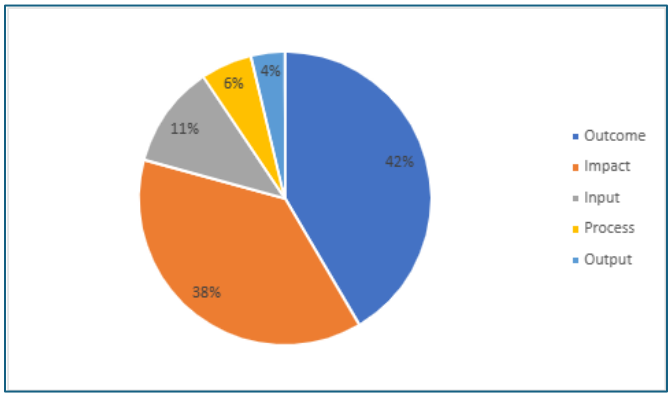


Figure 5. Distribution of indicators based on their function

An assessment of the function of proposed sub-indicators (whether they are outcome, impact, input, process or output indicators as defined in Annex 1.3) shows that the majority are outcome (42%) and impact (38%) indicators (Fig. 5). This reflects the experts' deliberate focus on indicators that can support the assessment of adaptation implementation and effectiveness, particularly by capturing the adoption of adaptive practices and technologies, including through investments, as well as the intermediate and long-term effects of those efforts on building resilience and reducing vulnerability.

All the proposed sub-indicators are quantitative, demonstrating their aggregability across contexts. Moreover, 30% of the sub-indicators allow for disaggregation by socioeconomic and other demographic characteristics, enhancing the potential for equity-sensitive analysis. In addition, many sub-indicators can be disaggregated by subsector, location, and other relevant variables, offering further flexibility for national reporting.

Five of the 13 shortlisted indicators focus on enablers of adaptation, which include means of implementation, along with 16 sub-indicators. These cover various areas such as finance, capacity building, technology development and transfer, as well as institutional and governance capacities.

3. Shortlisted indicators

HEADLINE INDICATOR 1: AGRICULTURAL LAND UNDER CLIMATE-RESILIENT AGRICULTURE PRACTICES AND TECHNOLOGIES

Description of the indicator: This indicator measures the extent to which agricultural land is managed using climate-resilient practices—such as agroforestry, soil and water conservation, sustainable irrigation, and crop and livestock diversity. It tracks the implementation of adaptation actions in response to key climate hazards including drought, flooding, heat stress, soil degradation, and shifting rainfall patterns. This indicator provides essential insights into whether adaptation measures related to land-based production and cultivation are being adopted across scales.

Rationale for choice of indicators: This indicator is essential for tracking adaptation progress in agrifood systems as it measures the extent of agricultural land managed under practices that build resilience to contextual climate-related risks. These include agroforestry, soil and water conservation, and crop and livestock diversity—all of which are widely recognized in scientific literature and policy frameworks. Agroforestry and agrosilvopastoral systems improve soil moisture, reduce erosion, and create microclimates that buffer heat and drought stress (IPCC, 2022). Soil and water conservation practices, such as mulching, sustainable irrigation and rainwater harvesting, have been shown to improve yields by 20–40% in drylands (WOCAT, 2020) and reduce land degradation (IPCC, 2019). Crop and livestock diversity at the farm level enhances adaptive capacity and buffers against climate shocks (FAO, 2019; Bezner Kerr et al., 2021). Additionally, climate-smart practices—such as improved irrigation, conservation agriculture, and use of stress-tolerant varieties—are central to adaptation strategies (FAO, 2013; FAO, 2021). Including this indicator helps countries assess whether their agricultural landscapes are transitioning toward more climate-resilient and risk-informed systems.

Sub-indicator 1.1: Proportion of agricultural land under productive, sustainable, and climate-resilient practices and technologies.
Sub-indicator 1.2: Proportion of agricultural land under agroforestry and agrosilvopastoralism.
Sub-indicator 1.3: Proportion of agricultural land under soil and water conservation and restoration measures, including flood protection and sustainable irrigation.
Sub-indicator 1.4: Proportion of agricultural land with crops and livestock diversity at the farm and landscape level.

HEADLINE INDICATOR 2: ADOPTION RATE OF CLIMATE-RESILIENT AGRICULTURE PRACTICES AND TECHNOLOGIES

Description of the indicator: This indicator measures the rate at which agricultural actors—such as producers, processors, and distributors—are adopting climate-resilient practices and technologies. These include adjusting planting and harvesting dates, using climate-resilient crops and livestock varieties, implementing sustainable water and pest management, and shifting toward more adaptive fisheries and aquaculture systems. The indicator reflects behavioral change across the agrifood value chain and helps assess the effectiveness of adaptation outreach, support systems, and incentives. By disaggregating by actor type, age, and gender, this indicator also enables the identification of social inclusion gaps in climate change adaptation. This indicator differs from headline indicator 1 as headline indicator 2 tracks the rate of adoption by different actors across the value chain—together, they provide a fuller picture of both the coverage and behavioural uptake of adaptation efforts in agrifood systems.

Rationale for inclusion: The adoption of climate-resilient agricultural practices reflects behavioural changes among farmers and other stakeholders, indicating the uptake of practices that enhance resilience to climate-related risks such as droughts, floods, and pest outbreaks. Several studies have demonstrated the positive impacts of adopting climate-

smart agriculture practices. For instance, adoption of climate resilience practices like crop rotation and integrated soil management has been linked to significant increases in crop yields and household incomes (Jena, et.al, 2023). Similarly, use of climate-resilient and indigenous plant genetic resources is critical for enhancing agricultural adaptation to climate change as they provide genetic diversity essential for developing crop varieties that can withstand environmental stresses like drought, salinity, and extreme temperatures (FAO, 2019; Yang *et al.*, 2025). Adoption rates also serve as a proxy for the effectiveness of policy incentives, climate information services, and farmer training programs.

Sub-indicator 2.1: Proportion of farmers adjusting planting and harvesting dates
Sub-indicator 2.2: Proportion of producers using climate-resilient varieties and breeds of crops, livestock, fisheries.
2.3 Proportion of food processors adopting climate-resilient technologies and practices.
Sub-indicator 2.4: Proportion of producers adopting climate-resilient water management practices and technologies, including water harvesting, storage and supply infrastructure, improving water use efficiency, and sustainable irrigation.
Sub-indicator 2.5: Proportion of livestock keepers adopting adaptive livestock management practices, including adaptive feed and pasture management.
Sub-indicator 2.6: Proportion of agricultural producers engaging in adaptive management of agricultural pests and diseases
Sub-indicator 2.7: Proportion of farmers engaged in sustainable fisheries and aquaculture practices.
Sub-indicator 2.8: Proportion of agricultural producers accessing and using climate-resilient and/or indigenous plant genetic resources from medium- or long-term conservation facilities.

HEADLINE INDICATOR 3. CLIMATE RESILIENCE OF FOOD AND AGRICULTURAL SUPPLY AND DISTRIBUTION

Description of the Indicator: This indicator assesses the resilience of food and agricultural supply and distribution systems such as the extent to which infrastructure, post-harvest management practices, and food reserves are existing and being adopted to withstand and recover from climate-induced disruptions such as extreme weather events, temperature fluctuations, and supply chain interruptions.

Rationale for inclusion: By monitoring improvements in infrastructure, adoption of adaptive post-harvest practices, and the coverage of food reserves, this indicator allows for the tracking critical aspects of physical adaptation in supply and distribution systems. It has been shown that investing in climate-resilient infrastructure, such as flood-resistant roads and storage facilities, is essential to maintain supply chain functionality during adverse climate events (UNEP, 2021). This indicator assesses the physical adaptation of logistics and market systems, which are critical for maintaining food flows during extreme weather events (FAO, 2017). At the same time, tracking this indicator provides insight into the adaptive capacity and resilience of agrifood systems during slow-onset climate change. The indicator allows Parties to assess the preparedness of actors along agricultural value chains to reduce climate-related post-harvest losses, especially under changing conditions of heat and humidity (Hodges et al., 2011).

Sub-indicator 3.1: Share of food and agriculture and supply and distribution infrastructure with improved resilience.
Sub-indicator 3.2: Proportion of agricultural value chain actors adopting adaptive post-harvest management technologies and practices
Sub-indicator 3.3: Coverage of climate-responsive food reserves and storage support

HEADLINE INDICATOR 4. DIVERSIFICATION OF LIVELIHOODS AND ECONOMIES

Description of the Indicator: This indicator assesses the extent to which agrifood systems are diversifying livelihoods and economic activities in order to enhance resilience against climate-related disturbances. It captures shifts away from reliance on climate-sensitive practices, such as rainfed agriculture, toward more varied and climate-

resilient income sources. This includes the development of value-added enterprises and climate-resilient income-generating activities.

Rationale for inclusion: This indicator monitors how adaptation efforts in livelihood diversification can create more secure rural livelihoods. Tracking the extent of diversification, including shifts to climate-resilient income sources and value addition--indicates progress in reducing structural vulnerabilities (Ellis, 2000). For example, measuring reduced dependence on rainfed systems or increased participation in climate-resilient income activities helps evaluate the success of strategies in building economic resilience. This indicator supports tracking adaptation actions that strengthen livelihood resilience and long-term transformation in vulnerable agrifood economies.

Sub-indicator 4.1: Proportion of farmers significantly dependent on rainfed agriculture
Sub-indicator 4.2: Number of households whose income has increased following the development of income-generating activities resilient to climate change
Sub-indicator 4.3: No. of business plans that develop added value through primary transformation in value chains in areas vulnerable to climate change

HEADLINE INDICATOR 5. ACCESS TO CLIMATE-RESPONSIVE SOCIAL PROTECTION, CREDIT AND INSURANCE SCHEMES FOR AGRIFOOD SYSTEM DEPENDENT POPULATION

Description of the Indicator: This indicator assesses the extent to which populations dependent on agrifood systems (including producers, labourers, and related value chain actors) have access to social protection mechanisms, financial credit, and insurance schemes that are specifically designed or adapted to address climate-related risks and vulnerabilities. This includes the availability of relevant products and services, the proportion of the target population accessing them, and the level of coverage provided. Climate-responsive social protection includes safety nets and assistance programs that help individuals and households cope with climate shocks. Climate-responsive credit schemes offer financial resources to invest in adaptation measures and recover from climate-related losses. Climate-responsive insurance products help transfer and manage climate-related risks.

Rationale for inclusion: Access to climate responsive social protection, credit, and insurance is a key indicator of an agrifood system's capacity to adapt to climate shocks (IPCC, 2023). These mechanisms address vulnerabilities like income loss from climate events (Downing & Patwardhan, 2005). Agricultural insurance (demonstrates risk transfer capacity (Barnett & Mahul, 2007). Social safety nets build resilience for vulnerable populations, preventing negative coping strategies (Davies et al., 2009; Schneider, 2013). Climate-responsive credit enables investments in adaptation technologies (Morduch, 1999). Monitoring these sub-indicators reveals the enabling environment for climate adaptation, indicating the system's progress in managing risks, protecting livelihoods, etc.

Sub-indicator 5.1: Proportion of agricultural population accessing insurance products and services
Sub-indicator 5.2: Proportion of the value of food and agricultural sector insured
Sub-indicator 5.3: Proportion of agricultural population with access to social safety nets and social assistance for climate risk management
Sub-indicator 5.4: Proportion of agricultural population with access to credit schemes for climate risk management
Sub-indicator 5.5: Proportion of rural population with access to subsidy schemes tailored to climate change adaptation, delivered through social protection systems

HEADLINE INDICATOR 6. FINANCING FOR CLIMATE RESILIENT AGRICULTURE

Description of the Indicator: This indicator assesses the volume and alignment of financial resources allocated to climate change adaptation in the food and agriculture sectors. It captures both domestic public spending, international

climate finance and official development assistance (ODA) dedicated to building resilience across agriculture, livestock, forestry, fisheries, and aquaculture systems.

Rationale for inclusion: Adequate and well-targeted financing is a critical enabler of climate resilience in agrifood systems (Buchner et al., 2019). Monitoring this indicator helps assess the enabling financial environment for climate-resilient agriculture and identify funding gaps, institutional constraints, or misalignment between needs and flows (Nakhooda et al., 2016). Appropriate finance must be designed to address specific characteristics of adaptation investments in agriculture such as risk, delayed returns, high social values, and new and unproven activities (OECD, 2015). Tracking disaggregated types of finance by financial instruments allows us to assess if appropriate financial instruments are being used to address adaptation needs in agrifood systems (FAO, 2020).

Sub-indicator 6.1: Public expenditures in climate change adaptation in food and agriculture relative to agriculture GDP
Sub-indicator 6.2: Value of climate finance and ODA allocated to adaptation in food and agriculture sector via different channels (bilateral, multilateral, regional) and financial instruments (grant, concessional loan, non-concessional loan, equity, guarantee, insurance, other)

HEADLINE INDICATOR 7. EXISTENCE AND ACCESS TO CLIMATE INFORMATION SYSTEMS TO SUPPORT ADAPTATION IN AGRIFOOD SYSTEMS INCLUDING EARLY WARNING AND AGROWEATHER INFORMATION SYSTEMS

Description of the Indicator: This indicator assesses the presence, operational status, and accessibility of Climate Information Services (CIS) and Early Warning Systems (EWS) tailored for the agrifood sector. It assesses the extent to which these systems are integrated into national and subnational frameworks, their reach among agricultural stakeholders, and their role in informing adaptation planning and actions.

Rationale for inclusion: Monitoring the existence of operational CIS and EWS reflects a country's commitment to integrating climate risk management into its agrifood sectors (FAO, 2017). Assessing the accessibility of these systems ensures that the information reaches end-users, particularly smallholder farmers, who are often the most vulnerable to climate variability (Ziervogel et al., 2016). By tracking both the establishment and utilization of CIS and EWS, this indicator provides a comprehensive view of the adaptive capacity within agrifood systems (Hellmuth et al., 2007).

Sub-indicator 7.1: Number of countries with operational Climate Information Services and Early Warning Systems for food and agriculture
Sub-indicator 7.2: Proportion of agricultural actors accessing climate information services and agroweather information
Sub-indicator 7.3: Number of countries that have conducted impact, vulnerability risk assessments and scenario analysis for the food and agriculture to inform adaptation planning at national and subnational level
Sub-indicator 7.4: Number of countries with operational data and tracking systems for assessing adaptation actions and results in food and agriculture

HEADLINE INDICATOR 8. INSTITUTIONAL AND ORGANIZATIONAL CAPACITIES FOR CLIMATE CHANGE ADAPTATION IN FOOD AND AGRICULTURE

Description: This indicator measures the institutional readiness and organizational capacity of countries to integrate and implement climate change adaptation across the food and agriculture sectors. It assesses the degree of integration of climate adaptation into agrifood systems as well as the extent to which adaptation priorities for crops, livestock, fisheries, aquaculture, and forestry are embedded within national and sectoral policies, strategies, and plans, and whether dedicated institutional structures exist to support and coordinate adaptation efforts.

Rationale for inclusion: Monitoring this indicator helps identify the presence and strength of these institutional enablers, revealing critical gaps and progress in adaptation governance across food and agriculture. Strong institutional frameworks provide the basic elements for implementation and scaling-up of climate change adaptation measures in the agrifood systems, ultimately contributing to enhanced resilience.

Sub-indicator 8.1 Number of countries integrating climate change adaptation priorities into crops, livestock, fisheries, aquaculture, and forestry policies, strategies and plans
Sub-indicator 8.2 Number of countries integrating climate change adaptation priorities for food and agriculture into national and subnational adaptation strategies, including NAPs and NDCs
Sub-indicator 8.3 Number of countries with climate change coordination units incorporating the food and agriculture sector

HEADLINE INDICATOR 9. CAPACITY BUILDING AND KNOWLEDGE TRANSFER FOR CLIMATE CHANGE ADAPTATION IN FOOD AND AGRICULTURE SECTOR

Description: This headline indicator assesses the status of knowledge transfer, awareness raising, training, advocacy, research and capacity building actions towards adaptation in the food and agriculture sectors. It includes the reach and quality of extension services, training programs, R&D investments, and the integration of indigenous and traditional knowledge systems.

Rationale for inclusion: Monitoring progress on this indicator over time can help to understand the existence and improvement of the enabling environment (knowledge sharing, training, extension services, awareness campaigns, and investment research) for adaptation in the agriculture and food sectors. Extension services, on-farm and related training programmes play a key role in equipping producers and other stakeholders with the necessary skills and knowledge to implement adaptive practices (Leeuwis & Aarts, 2011; FAO, 2010). Investments in R&D are an important way to nurture innovation in climate-resilient technologies and practices (Spielman ET al., 2020), while the integration of indigenous and traditional knowledge ensures that adaptation strategies are context-specific and culturally appropriate (Berkes, 2018; Nakashima et al., 2012).

Sub-indicator 9.1 Number of agricultural producers receiving extension services to support climate change adaptation.
Sub-indicator 9.2 Number of agricultural population**s** reached through capacity building interventions (disaggregated by age, gender, actor type, e.g**.,** producer, processor, distributor)
Sub-indicator 9.3 Value of investments for research and development for adaptation in food and agriculture.
Sub-indicator 9.4 Proportion of research and development programs integrating indigenous and traditional knowledge on climate change adaptation in food and agriculture

HEADLINE INDICATOR 10. CHANGES IN AGRICULTURAL PRODUCTIVITY AND BIOPHYSICAL IMPACT DRIVERS ASSOCIATED WITH CLIMATE VARIABILITY AND CHANGE

Description: This indicator can be used in two ways. Firstly, it can be used to assess the extent of climate change induced impacts on productivity and natural resources such as water. Secondly, it can also be used to assess the effectiveness of adaptation actions taken to address the impacts. For instance, improved effectiveness of adaptation actions can lead to improved productivity and decline in land degradation.

Rationale for inclusion: This indicator is directly linked with climate change impacts and corresponding adaptation actions. Changes in sustainable water supplies, land degradation, incidence of pest and disease attacks and productivity of crops, fisheries, aquaculture and livestock can help examine the effectiveness of adaptation measures against changes in precipitation and temperature patterns, and other climatic changes.

Sub-indicator 10.1 Level of water stress: freshwater withdrawal for agriculture as a proportion of available freshwater resources
Sub-indicator 10.2 Extent of land degradation and soil quality
Sub-indicator 10.3 Incidences of crop/livestock pests and diseases linked to climate variability
Sub-indicator 10.4 Incidences of crop/livestock pests and diseases linked to climate variability
Sub-indicator 10.5 Changes in yield and productivity (livestock, crop, fisheries).
Sub-indicator 10.6 Proportion of fish stocks within biologically sustainable levels

HEADLINE INDICATOR 11. IMPACT OF CLIMATE CHANGE ON AGRICULTURAL INCOME

Description: The variable is a good measure for assessing the temporal change in income of households/producers due to climate resilient activities in all nodes of supply chain.

Rationale for inclusion: Climate change can disrupt traditional farming practices, reduce crop yields, increase production costs, and increasing economic losses for the agricultural sector, leading to low-income levels. This indicator helps assess the effectiveness of climate resilient activities to reverse the income trend (from decline to incline) to achieve stability in income for improved adaptive capacity and better purchasing power of households for diverse food items.

Sub-indicator 11.1 Reduction in share of household incomes from agriculture attributed to climate change
Sub-indicator 11.2 Average income of food-producers (disaggregated by producer type, e.g., small vs large scale, sex, age, indigenous status)

HEADLINE INDICATOR 12. LOSSES AND DAMAGES IN FOOD AND AGRICULTURE

Description: This indicator tracks the losses and damages experienced within agrifood systems. It captures immediate physical and economic damage to crops, livestock, fisheries, aquaculture, and forestry. It assesses post-harvest losses (e.g., spoilage, decay, storage loss) associated with temperature extremes, humidity, and erratic rainfall patterns. It tracks how long climate events disrupt processing, transportation, and distribution systems across staple crops, perishable foods, and livestock-based products. It also measures macroeconomic losses by assessing the decline in agricultural GDP.

Rationale for inclusion: By measuring changes in the scale and frequency of agricultural losses, post-harvest disruptions, and economic setbacks, this indicator helps determine whether adaptation interventions—such as climate-resilient infrastructure, early warning systems, improved crop varieties, or risk-informed storage and logistics—are reducing exposure, minimizing impacts, and stabilizing value chains (FAO, 2017; IPCC, 2023). It also signals whether agrifood systems are becoming more resilient to climate shocks, especially when observed losses decline despite increasing hazard frequency or intensity (UNEP, 2021). Conversely, persistent or increasing losses may point to adaptation gaps, insufficient risk management, or systems reaching limits of adaptation (Holleman et al., 2020). While adaptation aims to reduce vulnerability and build resilience, this indicator provides an outcome-oriented lens to assess whether these efforts are translating into reduced losses and damage over time.

Sub-indicator 12.1 Direct agricultural losses and damages attributed to disasters
Sub-indicator 12.2 Share of agricultural post-harvest losses associated with climate change
Sub-indicator 12.3 Frequency and length of supply chain disruptions in different food groups associated with climate shocks
Sub-indicator 12.4 Losses in agricultural GDP associated with climate change

HEADLINE INDICATOR 13. IMPACT OF CLIMATE CHANGE ON FOOD SECURITY AND NUTRITION

Description: The indicator integrates nutritional and food security outcomes that are sensitive to climate variability and shocks, such as: undernourishment and malnutrition, particularly among vulnerable groups (e.g., women and children); dietary diversity, as a proxy for the quality and nutritional adequacy of food; experiential food insecurity, and price volatility, which directly affects affordability and access to nutritious food. Together, these metrics assess the multidimensional effects of climate change on food security and nutritional outcomes.

Rationale for inclusion: As mentioned above, this indicator can be considered as an outcome indicator of several actions taken on different nodes of food supply chain, enabling environment (i.e. capacity, research, finance etc.). For instance, a decline in the proportion of the malnourished population and improved prevalence of minimum dietary diversity can indicate the effectiveness of actions for water use, increased quantity and diversity in production, enhanced capacity, research, and investment, and other aspects.

Sub-indicator 13.1 Proportion of national population classified as under/ malnourished (disaggregated by gender, age, location)
Sub-indicator 13.2 Prevalence of minimum dietary diversity among women and children
Sub-indicator 13.3 Impact of climate shocks on food security and undernutrition
Sub-indicator 13.4 Prevalence of moderate or severe food insecurity in the population, based on the Food Insecurity Experience Scale (FIES)
Sub-indicator 13.5 Price volatility of food staples

4. Recommendations

4.1 INTEGRATE CLIMATE RISKS AND HAZARDS CONTEXT INTO GGA INDICATORS

To effectively monitor progress toward the GGA, it is essential to include indicators that reflect climate risks and hazards shaping adaptation needs (IPCC, 2023). These provide critical context for interpreting adaptation outcomes—helping to distinguish between effective adaptation measures and shifts driven by changes in climate exposure. While climate hazards differ by region and sector, common drivers—such as temperature extremes, shifting rainfall patterns, and storm intensity—are widespread. Including cross-cutting climate hazard indicators will help capture the environmental pressures influencing both adaptation needs and results. The expert group on food and agriculture has used the following steps to ensure climate relevance is embedded across indicators:

1. Used theory of change and pathway-based approach linking climate risks to actions and anticipated results. Start from identified climate hazards, define climate-sensitive solutions, and link them to expected outcomes. For example, tracking pest outbreaks and corresponding management practices offers a climate-relevant indicator, given their link to warming and rainfall variability.

2. Tailored existing indicators to reflect climate sensitivity. Adapt development indicators to focus on climate-vulnerable areas or groups. For instance, monitor adoption of resilient practices in districts exposed to droughts or floods.

3. Enhanced methodologies to incorporate climate dimensions. Refine the measurement of established indicators (e.g., SDG 2.4.1 on sustainable agriculture) by incorporating climate-specific variables such as exposure to drought or temperature anomalies.

While expert group has taken these steps to ensure climate considerations are integrated into the selection and refinement of indicators, the group also recommends normalizing or adjusting indicators by using climate data in addition to the steps taken above, as explained below

Recommendation: Normalize development indicators using climate data.

Many existing development indicators can yield adaptation insights if analyzed alongside climate data (Brooks, et al, 2013). This approach enhances interpretability by accounting for climate variability. For example, agricultural yields can be normalized against rainfall or temperature anomalies to assess whether stable yields during stress periods signal successful adaptation.

A practical approach involves:

- Collecting yield data (e.g., per hectare or per livestock unit);
- Gathering corresponding climate data (e.g., rainfall anomalies, heatwave days);
- Applying normalization methods (e.g., use statistical analyses to establish relationships between yield trends and climate conditions, calculate standardized indices to help isolate climate effects on yields).
- Tracking trends over time to assess resilience and adaptation effectiveness.

This approach allows indicators to reflect not just performance, but performance under climate stress, making them more suitable for tracking progress under the GGA.

4.2 RECOGNISE AND INTEGRATE CROSS-CUTTING INDICATORS

There is a critical need to consider cross-cutting indicators that, while not directly tied to a specific target, are essential for assessing overall progress in adaptation. These indicators capture systemic shifts, enabling a more holistic view of resilience beyond and across the thematic targets of the GGA. Their inclusion will help identify synergies and trade-offs across thematic areas and support integrated reporting under the GGA.

4.3 REVIEW INDICATORS OF SPECIFIC ASPECTS SUCH AS TRANSBOUNDARY CLIMATE RISKS

Incorporating indicators that address transboundary and cascading risks is essential to fully capturing the complex and interconnected nature of climate impacts in a globalized world. Climate-related risks such as droughts, floods, and extreme weather events can cross national borders, disrupting regional food systems, water resources, supply chains, and ecosystems. Cascading effects—where one climate shock triggers a chain of impacts across sectors or regions—can significantly amplify vulnerabilities and undermine adaptation efforts. By including such indicators, the GGA framework can promote coordinated action and risk-informed planning across borders and sectors, encouraging countries to consider shared risks and joint adaptation strategies. These indicators also support a more systemic understanding of climate resilience, ensuring that adaptation measures are not only locally effective but also regionally coherent and globally aligned. However, such indicators have not strongly been incorporated at this stage, and it is also important to consider potential data sources.

4.5 POST-SB 62: ORGANIZE SECTORAL CONSULTATIONS TO REFINE LANGUAGE, DATA SOURCES AND METHODOLOGIES

Following SB 62, it will be important to convene consultations with additional sectoral actors—including practitioners, researchers, and statistical institutions—to refine the wording of indicators, refine methodologies and identify appropriate data sources. This collaborative process will enhance clarity, feasibility, and uptake of the indicators across diverse country contexts.

4.4 CONTINUE WITH A PHASED AND EFFICIENT APPROACH TO FINALISING GGA INDICATORS

To ensure an efficient and focused process for establishing indicators under the GGA we recommend that discussions at SB62 prioritize two key objectives: adopting indicators where there is broad agreement and identify gaps requiring further technical input. This phased approach would allow experts, in the post-SB62 period, to concentrate on refining metadata and methodologies for a more targeted set of indicators—particularly those most likely to be adopted at COP30. This avoids expending resources on developing detailed guidance for indicators that may ultimately not be retained. Furthermore, experts could be mandated to continue supporting the operationalization of the indicators beyond COP30, including through capacity-building, methodological guidance, and integration into national adaptation monitoring systems.

4.5 PROVIDE OPPORTUNITIES AND RESOURCES FOR CONTINUED EXPERT COLLABORATION

Adequate resources and structured opportunities would allow the experts supporting work on GGA indicators to further refine and expand the provisional indicator set. This includes convening multi-day, in-person technical workshops where experts can collaborate both across and within thematic groups. These avenues will allow for more in-depth work on:

- Documentation of metadata and data sources
- Development of methodologies aligned with CMA guidance
- Processing Parties' feedback, including recommendations for revisions or new indicators
- Integration of indicators proposed by other stakeholder groups

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ANNEX 1: DEFINITIONS OF COMPONENTS OF TARGET 9B (SB 60 DECISION PARAGRAPH 12A), DIMENSIONS OF AN ADAPTATION THEORY OF CHANGE OR PATHWAY, AND INDICATOR FUNCTIONS (CMA6 GGA DECISION PARAGRAPH 20C)

Annex 1.1 Definitions of components of target 9b

Target component	Definition
Food production	Indicators that measure adaptation actions and interventions related to agricultural production, including uptake of sustainable and regenerative production, harvest management, as well as improving soil health and water use.
Food supply and distribution	Indicators related to improving the movement of food from production sites (farms) to markets and consumers, including storage, processing, packaging, transportation, and wholesale and retail distribution. Ensuring the stability and efficiency of these systems is essential for maintaining a reliable food supply, especially in the face of disruptions related to climate change.
Food access	Indicators that capture the ability of individuals and communities to obtain food, including interventions on economic factors such as affordability (e.g. food price stability index), availability, and physical access to markets or food outlets.
Nutrition and food security	Indicators related to whether individuals are consuming sufficient, diverse, and nutritious foods to meet dietary needs and prevent malnutrition or diet-related diseases (eg prevalence of stunting). Nutrition is closely linked to both food access and food security, focusing on the adequacy of diets for physical health and well-being.
Cross cutting	Indicators relevant across the value chain such as institutional and governance processes that target food and agriculture sector in general.

Annex 1.2 Dimensions of an adaptation theory of change or pathway,

Adaptation theory of change/pathway dimension	Definition
Climate risks, hazards, impacts as vulnerability context	The vulnerability context in terms of climate hazards and impacts sets the foundation for understanding the rationale behind adaptation actions. It identifies the climate hazards and their potential impacts, which form the rationale for the adaptation measures being implemented. These include Indicators that capture exposure to climatic hazards and focus on indicators of change in climate conditions/ hazards, establishing an adaptation rationale and context within which to assess the adequacy and effectiveness of adaptation measures. This variable covers indicators on climate parameters, such as changes in annual/ seasonal precipitation (mm), temperature (oC), number of hot days per year, etc. This variable also captures immediate impacts such as increased prevalence of pests and diseases and their further effects such on food and agriculture production and nutrition.

Adaptation actions	Adaptation actions are targeted interventions designed to reduce vulnerability to climate change by minimizing exposure and sensitivity to climate shocks, enhancing adaptive capacity, and building resilience. These actions operate at different scales—household, community, sectoral, and national—and may include technological solutions, ecosystem-based approaches, institutional reforms, and behavioral changes. They represent the essential bridge between a system's vulnerability and its desired climate-resilient outcomes. Including corresponding indicators for adaptation actions is crucial for tracking implementation progress. These indicators help determine whether actions are being carried out, where implementation is taking place, and by whom. By measuring the uptake of adaptation measures—such as the adoption of climate-smart practices, early warning systems, or resilience-building infrastructure—countries and stakeholders can assess not only the scale and scope of adaptation, but also the effectiveness of efforts in reducing climate risks over time.
Results	
Adaptive capacity	Adaptive capacity refers to the ability of human and natural systems to adjust to climate risks, shaped by both material resources—such as finance and infrastructure—and immaterial ones, like institutions, social networks, and information systems. These are essential means of implementation that support effective adaptation. Tracking adaptive capacity requires input-focused indicators that capture actions such as the adoption of climate-smart agricultural practices, strengthening of institutional frameworks, investment in adaptation, awareness-raising efforts, and access to climate information services. These indicators reflect how adaptation improves knowledge, policies, and institutions, enabling systems to better absorb and recover from climate shocks. For example, integrating climate change into national policies and planning demonstrates institutional readiness, while support for farmer groups and targeted investments reflects efforts to build resilience on the ground.
Vulnerability	These are indicators that help to assess changes in sensitivity and exposure to climate change and are reflected through improvements in ecological and socio-economic conditions that determine the susceptibility of systems to the impacts of climate change. Examples include the status of ecosystems supporting agriculture production, livelihood sources, poverty levels. These indicators explain vulnerability in terms of susceptibility to harm and as a function of exposure.
Resilience	Indicators of the outcomes and impacts of adaptation actions, including strengthening the ability of systems to respond to, recover from and address climate risks. It includes indicators related to wellbeing, agricultural economies and livelihoods, food security and nutrition, enabling the assessment of adaptation adequacy and effectiveness.

Annex 1.3 Indicator functions

Indicator function	Definition

Input indicators	Input indicators measure the financial, human, material resources and information required to enable the implementation of adaptation actions. These indicators help assess the level of commitment and readiness to act on adaptation priorities
Process indicators	Process indicators track the development and implementation of organizational, institutional, regulatory, and planning mechanisms that enable adaptation. They highlight progress in mainstreaming climate adaptation into policy and governance structures.
Output indicators	Output indicators measure the direct and immediate results of adaptation activities, providing evidence of implementation progress and actions completed.
Outcome indicators	Outcome indicators assess behavioral or intermediary systemic changes resulting from adaptation efforts. They demonstrate how adaptation interventions influence practices and decisions.
Impact indicators	Impact indicators measure the long-term effects of adaptation actions on human and ecological well-being. These indicators capture whether adaptation efforts are reducing vulnerability and increasing resilience.