ADVANCING ON THE GLOBAL GOAL ON ADAPTATION THROUGH AGRICULTURE AND FOOD SYSTEM TRANSFORMATION

POLICY GUIDANCE FOR ADDRESSING ADAPTATION NEEDS IN AGRICULTURE AND FOOD SYSTEMS

CONTENTS

Citation

WWF (2025). Advancing on the Global Goal on Adaptation Through Agriculture and Food System Transformation. WWF, Berlin, Germany

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Acknowledgements:
The report would not have been possible without advice and generous contributions of WWF Germany.

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CH-550.0.128.920-7

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EXECUTIVE SUMMARY

Climate change impacts are no longer a future threat, but a devastating reality unfolding worldwide. Billions of people are already experiencing the severe impacts of climate change.

These impacts are most pronounced in the agriculture and food systems, as increasing weather and extreme climate events have exposed millions of people to acute food insecurity and reduced water security. The most severe impacts are seen in developing countries, and globally among Indigenous peoples, small-scale food producers, and low-income households. There is an urgent need for agriculture and food systems to adapt to the changing climate to ensure accessible and affordable healthy food for all. Effective holistic measures across food systems can help to build climate resilience while providing mitigation as well as biodiversity benefits, enabling progress towards global goals for climate, nature, and sustainable development.

Despite the urgency of climate adaptation, it has been a secondary priority on the international climate agenda. It was only in 2015 under the Paris Agreement that countries set the **Global Goal on Adaptation (GGA)** for enhancing adaptive capacity, strengthening resilience, and reducing vulnerability to climate change.

Finally, in 2023, after nearly a decade of lagging progress, countries adopted the **UAE Framework for Global Climate Resilience** to operationalize the GGA, providing a clear structure with targets to guide global adaptation efforts and enhance support for adaptation in developing countries.

For effective operationalization and implementation of the UAE Framework, governments will need to resolve remaining issues and questions ahead of COP30 in Brazil, particularly the final list of 100 indicators for progress monitoring towards the UAE Framework targets. Reaching consensus on these indicators is critical to establishing a robust framework and enabling implementation that reflects the needs of developing countries.

This ongoing development of indicators for the UAE Framework provides an opportunity to review and strengthen it from a food systems perspective.

This policy guidance explores climate change adaptation responses in the agriculture and food systems to inform policymakers about the adaptation needs in global food systems, makes recommendations for relevant indicators, and highlights the potential to enhance the operationalization of the GGA Framework through agriculture and food systems transformation.

KEY RECOMMENDATIONS

Agriculture and food systems transformation must be at the center of global and national adaptation efforts – including the implementation and monitoring of the UAE Framework – as this transformation can enable adaptation and resilience across sectors. However, this requires a collective effort at the international and national levels:

At the international level:

1. **Take a holistic approach to developing the GGA monitoring framework:** As experts finalize qualitative and quantitative indicators for assessing progress towards achieving the UAE Framework targets, they must recognize the unique opportunities that agriculture and food systems provide for advancing all targets. With food systems interventions cutting across all the UAE Framework targets, existing frameworks, methods, and indicators for food systems policy interventions can serve as the basis for a framework that assesses progress towards these targets.

2. **Focus on equity and justice:** International efforts to operationalize the GGA and the UAE Framework must include equity and justice as a foundational principle to ensure that adaptation measures do not worsen existing inequalities in agriculture and food systems and undermine food security. Countries that face climate change threats to their food systems also often burdened by poverty, food insecurity, and high levels of debt and thus, it is critical to ensure that the needs of all countries, especially the most vulnerable, , are fully included and addressed the UAE Framework is enhanced and implemented. For example, finance mechanisms should be designed to avoid increasing debt levels for these countries.

3. **Align efforts across international policy regimes**: Given the integrated nature of issues and responses in agriculture and food systems, these sectors are well-positioned to serve as a bridge across global development and environmental agendas – including the Sustainable Development Goals, the Kunming-Montreal Global Biodiversity Framework, and the United Nations Convention to Combat Desertification. International policy frameworks must capitalize on these synergies by aligning adaptation efforts across conventions and frameworks.

4. **Close adaptation finance gap:** Despite the accelerating climate impacts on agriculture and food systems around the world, finance for adaptation remains vastly insufficient compared to what is needed. Developed countries must not only deliver on their current financial commitments for adaption, but also ramp up finance beyond those existing commitments.

5. **Facilitate technological transfer**: Many developing countries lack the necessary scientific expertise, technical capacity, and data to develop robust adaptation strategies, which can hinder tracking of targets and progress. Facilitating technology and knowledge transfer to developing countries is therefore crucial for developing local adaptive capacities. This includes data sharing about local climate impacts and vulnerabilities for effective adaptation planning.

At the national level:

1. **Take a multistakeholder approach to adaptation:** National governments must enable meaningful participation of all stakeholders including all vulnerable groups, including farmers, Indigenous peoples, women, and youth. Equitably engaging all food systems stakeholders up front is critical to tackle asymmetries, structural inequities, and knowledge gaps in climate and food governance processes. Meaningful participation of underrepresented groups including Indigenous peoples and local communities is key to inclusive policy development and implementation processes. Existing multi-stakeholder approaches and mechanisms for policymaking and implementation can be leveraged for inclusive decision-making on adaptation strategies.

2. **Align national policy processes:** Periodic national vulnerability self-assessments, National Adaptation Plans (NAPs), Nationally Determined Contributions (NDC)s, and other processes at local to national scales can be synthesized to monitor the extent to which adaptive capacity and resilience are facilitated.

3. **Support local efforts**: Parties must tailor context specific national adaptation strategies that consider the needs of local communities and prioritize community led efforts especially among small-scale farmers, and Indigenous peoples. Such bottom-up adaptation strategies can encourage ownership, boost resilience, and reinforce social cohesiveness, allowing flexibility in adaptation responses, which is key given the dynamic nature of climate change. This includes investing in the support of locally managed food systems which align with communities' traditional agricultural or pastoral practices, and Indigenous innovations, as building capacities of local communities can further advance the achievement of adaptation goals.

4. **Integrate traditional and Indigenous knowledge:** Adaptation in food systems should be based not only on available science and emerging scientific advancements, but also traditional and Indigenous knowledge to ensure effective and context-relevant strategies. National and local adaptation efforts should recognize the importance of integrating Indigenous Peoples' wisdom, respecting their rights and knowledge systems, and promoting their active involvement in decision-making and designing responses.

5. **Ensure access to finance for farmers and local communities**: Climate and nature finance pledges and agreements should explicitly include dedicated finance for farmers and local communities and be fulfilled in a timely manner. Supporting the livelihoods of farmers, fishers, and aquaculture workers ensures income stability, enabling continued access to food despite economic and climate-related challenges.

6. **Redesign harmful subsidies to support transformative food system approaches:** Policymakers can redesign subsidies to encourage crop diversification, agroecology, agroforestry, and resilient agricultural practices to incentivize the adoption of these practices.

7. **Ramp up research for new technologies:** Research on new technologies for food systems adaptation that reach local communities and farmers- including monitoring systems, climate information, and risk management systems- is necessary to prevent disease and negative health repercussions, as well as to reduce food waste and loss.

8. **Support technological transfer:** Donors and investors can aid governments by implementing technological transfer and exchange, sharing tools that already exist to ensure food safety, from early warning systems to soil and food system pest and disease surveillance. Where new technology is found to be beneficial to communities, they must ensure that it is also affordable and accessible.

CONTEXT

Climate impacts are no longer a future threat, but a devastating reality unfolding worldwide. Billions of people across around the world are already experiencing the severe impacts of climate change. While climate mitigation remains crucial, strengthening climate resilience and adaptation efforts has never been more pressing.

The IPCC continues to stress the increasing and cascading impacts of climate change, including widespread and rapid consequences for the atmosphere, ocean, cryosphere, and biosphere.[1] Across every region of the planet, climate change is already driving weather and climate extremes that cause significant losses and damages to nature and people, with disproportionate impacts to vulnerable communities that have historically contributed the least to the climate crisis. Climate change has caused substantial damages, and increasingly irreversible losses, in terrestrial, freshwater, cryospheric, coastal, and open ocean ecosystems.[2]

Approximately 3.3 to 3.6 billion people live in areas that are highly vulnerable to climate change.[3] Increasing weather and extreme climate events have exposed millions of people to acute food insecurity and reduced water security, with the largest negative impacts seen in communities residing in the least developed countries and small island nations, as well as across Africa, Asia, Central and South America, and the Arctic.[4] Within these regions, Indigenous peoples, small-scale food producers, and low-income households are among the most vulnerable communities (see Figure 1).

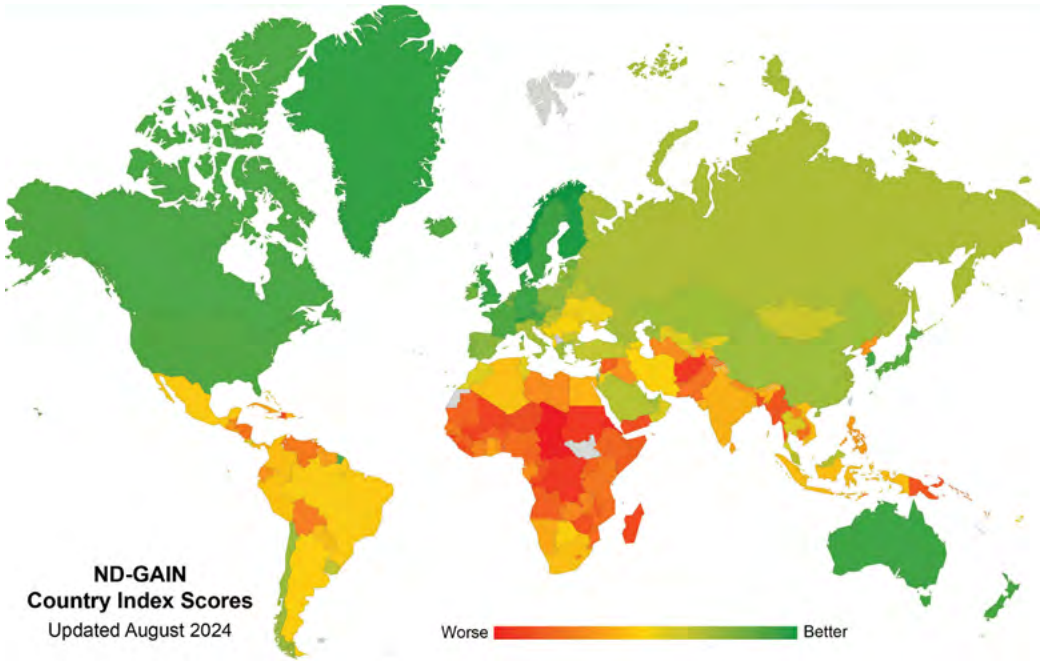


Figure 1. Adaptation Index showing climate change vulnerability and readiness to address its impacts. Source: ND-GAIN.

The ND-GAIN Country Index summarizes a country's vulnerability to climate change in combination with its readiness to improve resilience. The map presents countries most vulnerable to climate change impacts and least ready (red) to least vulnerable and most ready (green). See **https://gain.nd.edu/our-work/country-index/**

Despite the urgency of climate adaptation, since its inception in 1994, the UNFCCC's primary focus has been on greenhouse gas mitigation, with adaptation as a secondary priority.[5]

For over thirty years, developing country Parties and the scientific community have consistently pushed for the equal recognition of adaptation alongside mitigation (see Figure 2). The IPCC's third assessment report in 2001 marked a turning point on this front, clearly stating that mitigation alone would not be enough to address climate impacts.[6] Yet, in the years since, the multilateral efforts to elevate adaptation as a priority have been inconsistent. For instance, the adoption of dedicated funds in 2001, such as the Adaptation Fund, was a step in the right direction, but the capitalization of the funds never reached sufficient levels. While other funds have included adaptation in their portfolios, the provision of finance at scale continues to be a thorny topic, including at COP29 in Baku in 2024, with the finance for adaptation remaining continuously low, as the UNEP reports in their annual Adaptation Gap Report.[7] Similarly, the adoption of the Cancun Adaptation Framework, under decision 1/CP.16 in 2011, encouraged countries to plan and implement adaptation strategies in key sectors, including agriculture and water resources, promoting a country-driven and gender-sensitive approach that considers vulnerable groups and communities under their National Adaptation Plans (NAPs).[8] However, while NAPs remain an important national framework for adaptation, their implementation has remained extremely slow due to lack of adequate finance, capacity and knowledge transfer to countries in need.

The adoption of the Paris Agreement in 2015 marked the most significant milestone thus far in prioritizing adaptation alongside mitigation in global climate efforts, with the agreement establishing the Global Goal on Adaption (GGA).

Article 7 of the Paris Agreement established the GGA which sets the goals of enhancing adaptive capacity, strengthening resilience, and reducing vulnerability to climate change. The GGA also encompasses contributions toward sustainable development and ensuring an adequate adaptation response in the context of holding the temperature well below 2°C above preindustrial levels, while pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, referred to in Article 2. The GGA's inclusion in the Paris Agreement also means adaptation is reviewed as part of the Agreement's collective stocktaking. The GGA has paved the way for a response to adaptation that is targeted and assessable and cements the practice of adaptation as an indispensable part of a successful climate regime. This also means setting specific, measurable targets and guidelines for global adaptation action, as well as enhancing adaptation finance and other types of support for developing countries.

Article 7 of the Paris Agreement

To address climate change impacts, Article 7 of the Paris Agreement defines a Global Goal for Adaptation (GGA) to enhance adaptive capacity for, and resilience to, climate change; and to reduce vulnerability while contributing to sustainable development. The Agreement also requires all Parties to engage in adaptation planning and implementation and to communicate their priorities, plans, actions, and support needs through adaptation communications. Implementation of these actions will feed into to the Global Stocktake to assess collective progress towards achieving the goals of the Agreement.

Recognizing the global nature of adaptation challenge faced by all with local, subnational, national, regional, and international dimensions, and that it is a key component of and makes a contribution to the long-term global response to climate change to protect people, livelihoods and ecosystems, Article 7 underlines the need to take into account the urgent and immediate needs of those developing country Parties that are particularly vulnerable to the adverse effects of climate change. Similarly, it acknowledge that adaptation action should follow a country-driven, gender-responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems, and should be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous peoples and local knowledge systems, with a view to integrating adaptation into relevant socioeconomic and environmental policies and actions, where appropriate.

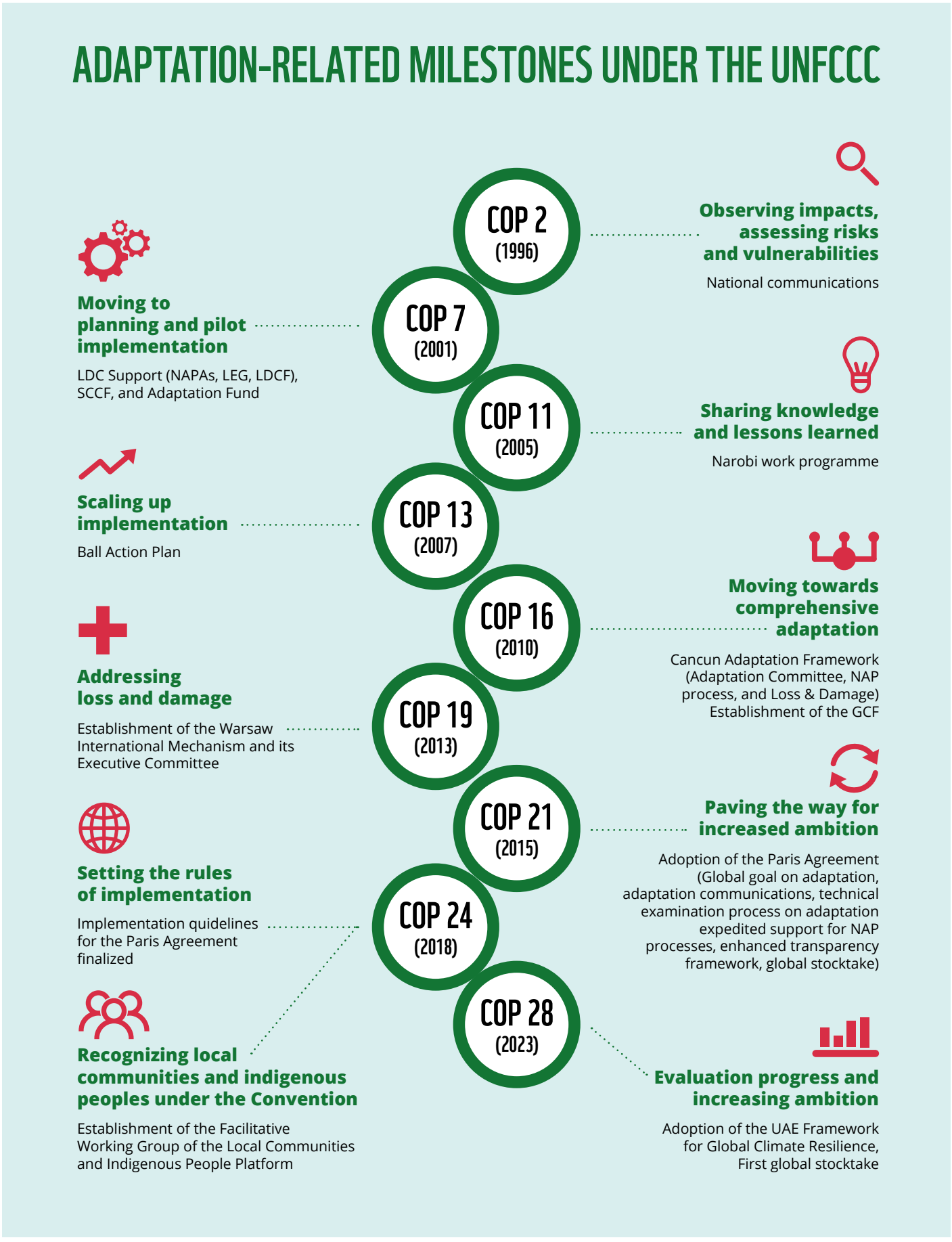
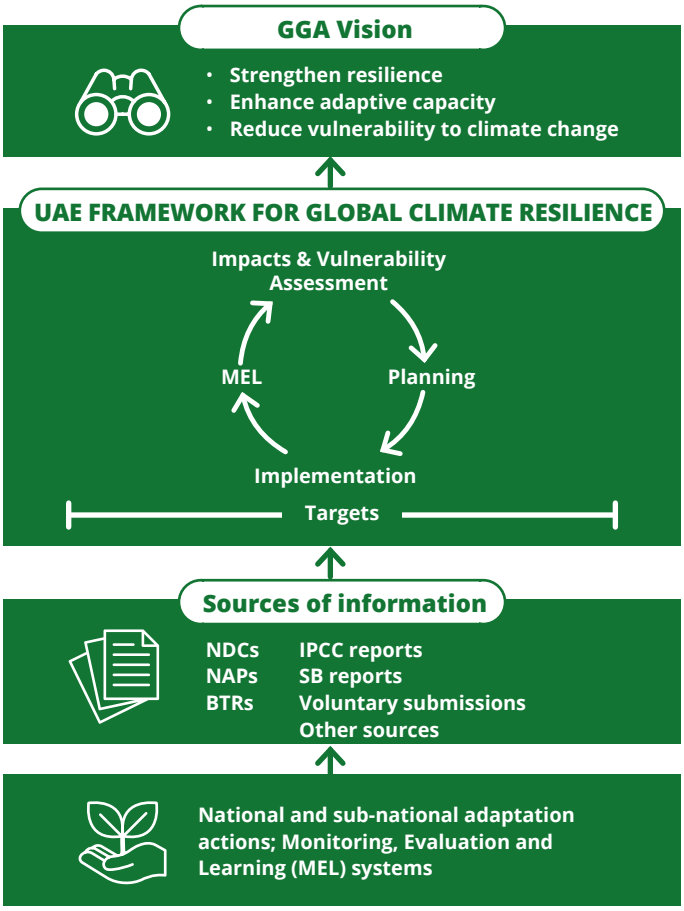


Figure 2. A timeline of international decisions on climate adaptation under the UNFCCC

However, the operationalization of the GGA has been slow, with Parties initiating the development of a framework in 2022 – seven years after its initial inclusion in the Paris Agreement – to guide the achievement of the GGA and to review progress in achieving it.

It was only at COP28 in 2023 in Dubai that Parties adopted the UAE Framework for Global Climate Resilience (UAE Framework) to operationalize the GGA by providing a clear framework with targets that can guide global adaptation efforts and enhance support for adaptation in developing countries. The UAE Framework outlines four overarching global targets which will help guide countries in developing and implementing adaptation plans, as well as seven thematic targets related to; water supply, agriculture and food, public health, ecosystems and biodiversity, infrastructure and human settlements, poverty and livelihoods, and cultural heritage. These thematic targets can help bridge the gap between national and global adaptation priorities and plans to ensure ambitious action across all sectors and all countries (see Figure 3).



COP30 in Belém is pivotal for accelerating adaptation action under the GGA, as adaptation is a key focus- – COP30 President has called on governments, businesses, subnational stakeholders, financial institutions, and universities to put adaptation at the same level of engagement and centrality as mitigation.

It also marks the end of the two-year UAE-Belém work program to develop indicators for measuring progress towards the targets outlined in the UAE Framework. As part of the UAE-Belém work program, Parties are now aiming to finalize and adopt the indicators for this framework at COP30 in late 2025. The Global Stocktake of the Paris Agreement will report on adaptation progress under the GGA based on this framework. As metrics and indicators to assess progress towards these targets are finalized at COP30, periodic national vulnerability self-assessments, NAPs, and other processes at local to national scales can be synthesized to monitor the extent to which adaptive capacity and resilience are enhanced under the seven thematic and four overarching targets of the UAE Framework.[9]

Overarching Targets by 2030:

1. **Impact, vulnerability and risk assessment**
2. **Country-driven transparent and gender-responsive planning**
3. **Implementation**
4. **Monitoring, evaluation and learning (MEL)**

Thematic Targets by 2030:

1. **Water and Sanitation:** Reducing climate-induced water scarcity and attaining climate-resilient water supply, sanitation, and towards access to safe and affordable potable water for all
2. **Food and Agriculture:** 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
3. **Health:** Attaining resilience against climate change related health impacts, promoting climate-resilient health services, and reducing climate-related morbidity and mortality
4. **Ecosystems:** Reducing climate impacts on ecosystems and biodiversity, and accelerating the use of ecosystem-based adaptation and nature-based solutions
5. **Infrastructure:** Increasing the resilience of infrastructure and human settlements to ensure essential services for all
6. **Livelihoods:** Reducing climate change impacts on poverty eradication and livelihoods, and promoting adaptive social protection
7. **Cultural Heritage:** Protecting cultural heritage from the impacts of climate-related risks guided by traditional and local knowledge, and Indigenous Peoples' knowledge

Figure 3. The UAE Framework for Global Climate Resilience – adapted from International Institute for Sustainable Development.

CLIMATE ADAPTATION AND AGRICULTURE AND FOOD SYSTEMS

Climate change is accelerating the degradation of agriculture and food systems by negatively affecting crop yields, pollinators, livestock production, and aquaculture. increasing temperatures, changing precipitation, and more frequent pests and diseases are further exacerbating these impacts, especially for vulnerable smallholder farming systems.[10]

To illustrate the scale of the impact of climate change on food availability, consider that climate-driven disasters have caused the loss of about USD 3.8 trillion worth of crops and livestock over the past 30 years globally, equating to USD 123 billion per year.[11] Additionally, 22% of the cultivated land used for the world's major crops is likely to experience adverse impacts from climate change by 2050. Extreme and unpredictable weather patterns are expected to significantly affect food security and crop yields. In Africa, agricultural yields alone are estimated to decline by over 30% by 2050.[12] The European Union is already losing about 6% of their crop and livestock (Euro 28 billion) annually due to extreme weather, with projections indicating that losses could exceed Euro 90 billion per year by 2050.[13]

Each additional degree of temperature increase will exacerbate these impacts across food production systems.[14] For each degree Celsius increase in mean global temperature, yields for the four most significant crops for human caloric intake are estimated to decrease on average by 6% (wheat), 3.2% (rice), 7.4% (maize), and 3.1% (soybeans) if no improved adaptation strategies are taken.[15]

Similarly, livestock production systems are facing major threats from climate change with direct and indirect impacts.[16] Direct impacts include the immediate effects of climate change on livestock thermoregulation, metabolism, and immune system function. Indirect impacts stem from climate-driven changes in feed production, water availability, and pest and pathogen populations. Over the course of the next century, major domestic livestock populations – including cattle, sheep, goats, poultry, pigs – will face increasing risks from extreme heat stress and other impacts of climate change, limiting the quality of livestock products and overall productivity of the livestock sector. Small-scale farmers and pastoralists will be particularly affected by climate change risks compared to large-scale producers. This is due to increased production costs in farm management and lack of support systems to recover from climate change effects.[17]

Both crop and livestock production are impacted by growing threats from pests and diseases due to climate change. Global warming and changes in precipitation affect the quantity and spread of vector-borne pests such as flies, ticks, and mosquitoes.[18] In addition, disease transmission between hosts will be more likely to happen in warmer conditions.[19] Aquaculture also faces production challenges in both the short and long term from direct and indirect impacts of climate change.[20]

Over 90% of aquatic food production, which is essential to over 3.2 billion people, faces challenges of maintaining supply in a changing environment and climate.[21] Small-scale scale fisheries and aquaculture provides livelihoods for over 100 million people and sustenance for around 1 billion people, particularly in developing countries.[22] Climate change leads to the redistribution of marine fish stocks, increasing risk of transboundary management conflicts among fishing communities, negatively affecting equitable distribution of food provisioning services as fish stocks shift from lower to higher latitude regions.[23]

Climate change is expected to exacerbate global food access challenges by reducing agricultural productivity, driving up food prices, and limiting land suitable for production, which will particularly impact low-income populations and worsen global hunger.

Food access is already a major global problem: evidence suggests that currently, between two and three billion people cannot afford a healthy diet, defined as the least expensive combination of locally available items that meet a food-based dietary guideline.[24] Additionally, temperature volatility due to climate change has a major impact on food price inflation, as decreased agricultural productivity will worsen inflation by causing a reduced global food supply, therefore raising average food prices globally.[25] Global temperatures projected for 2035 could increase food inflation significantly. [26] For example, for Europe, this cumulatively would amplify food inflation by 30-50% by 2035.[27]

In fact, countries exposed to climate extremes face significantly heightened risks of undernourishment, particularly in regions where agriculture is a primary source of employment and where agricultural systems are sensitive to climate variability. In 2021, the World Food Programme estimated that, by 2050, the risk of hunger and malnutrition could increase by 20% if no action was taken to mitigate climate change impacts.[28]

Additionally, climate change is likely to threaten global food access by impacting land use system dynamics and restricting the area of land suitable for production, although severity of impacts will vary by region.[29]

As food prices increase due to climate change, it will likely not only reduce overall food access, but also restrict access to food that is high quality, nutritious, and safe.[30]

Climate change is projected to undermine food consumption and diets by increasing food safety risks through rising food-borne pathogens, degrading food quality due to temperature fluctuations, and causing nutritional deficiencies, with millions more at risk of protein deficiency by 2050.

Changes in temperatures and precipitation are affecting the geographic distribution and persistence of foodborne pathogens.[31]

Higher incidences of infections by several pathogens – like *Salmonella* spp. – in different parts of the world can be linked to increasing temperatures, as well as in higher-income countries.[32] Thus, degradation, contamination, and spoilage of food products in storage and transport may increase due to changes in humidity and temperature.[33]

Climate change is also worsening water quality by promoting conditions for harmful algal blooms, driven by factors like excessive fertilizer use and intense precipitation, which lead to eutrophication. These blooms are expanding to new areas, putting public health at risk, and creating hypoxic “dead” zones that harm marine ecosystems and local economies.[34]

On land, rising temperatures are increasing the uptake of heavy metals in crops, while heavy rainfall in mining regions releases toxic metals, compromising food and water quality. Additionally, accelerated permafrost thawing is releasing trapped heavy metals like mercury into freshwater systems, where they can bioaccumulate.[35] Furthermore, changes in pest distribution due to climate change are increasing pesticide use, which harms soil, water, and biodiversity, while volatilization of pesticides is spreading them to remote regions, further contaminating the environment and food chain.[36]

ADAPTATION RESPONSES IN AGRICULTURE AND FOOD SYSTEMS AND THE GLOBAL GOAL ON ADAPTATION

So far, climate adaptation efforts have been fragmented and unevenly distributed across regions and income groups. These efforts are typically small-scale, sector-specific, incremental, and designed to respond to current impacts or near-term risks.[37]

Because adaptation measures often require implementation over long timeframes (as emphasized by the IPCC) but are urgently needed, both long-term planning and accelerated implementation in this decade are essential to closing adaptation gaps. At times, adaptation actions may present trade-offs for other goals – like mitigation, sustainable development, or equity and just transitions. As a result, international-, national-, and local-level adaptation must embed equity, justice, and effectiveness in all steps of development and implementation of policies,[38] and adaptation actions must be based on local contexts to ensure they do not lead to maladaptation practices (see Box 1). While there are feasible and effective measures to reduce climate risks to people and nature, these vary across sectors and regions, with integrated solutions – such as agriculture and food systems adaptation that address social inequities and differentiate responses based on climate risk and cut across sectors and systems – being the most effective.

Box 1. Main climate change adaptation concepts and approaches. Source: the IPCC (various)[39]

Overarching concepts

Adaptation & resilience: Differences and nuances between the terms have been discussed and contested in the academic field. For the IPCC, adaptation is the process of adjustment to the actual or expected climate and its effects, to moderate harm or exploit beneficial opportunities; while resilience is the capacity of a system to bounce back from disturbance and recover its essential functions.

Maladaptation: Actions that may lead to increased risk of adverse climate-related outcomes, including via increased greenhouse gas (GHG) emissions, increased, or shifted vulnerability to climate change, more inequitable outcomes, or diminished welfare, now or in the future.

Planning approaches

Transformational adaptation: Adaptation that changes the fundamental attributes of a social-ecological system in anticipation of climate change and its impacts. A transformative change is a system-wide change that beyond technological change requires more than technological change through consideration of social and economic factors that, with technology, can bring about rapid change at scale.

Incremental adaptation: Adaptation that maintains the essence and integrity of a system or process at a given scale.[40] In some cases, incremental adaptation can accrue to result in transformational adaptation.[41]

Adaptation pathways: A series of adaptation choices involving trade-offs between short-term and long-term goals and values. These are processes of deliberation to identify solutions that are meaningful to people in the context of their daily lives and to avoid potential maladaptation. This can be planned dynamically over time considering changing circumstances.[42]

Adaptation vs Loss and damage: Loss and damage refers to the unavoidable and irreversible impacts of the climate crisis. While in theory this is distinct from adaptation as loss and damage starts where adaptation is no longer possible (see adaptation limits above), in practice there is some overlap between adaptation and loss and damage at the level of disaster risk management (disaster risk reduction approaches and building capacity for disaster recovery).[43]

Implementation approaches

Ecosystem based Adaptation: The integration of the use of biodiversity and ecosystem services into an overall adaptation strategy.[44] It is a subset of nature-based solutions that seeks to harness ecosystem services towards climate adaptation, thereby also providing co-benefits for nature conservation.

Community-based adaptation: Local, community-driven adaptation. Community-based adaptation focuses attention on empowering and promoting the adaptive capacity of communities. It is an approach that takes context, culture, knowledge, agency, and preferences of communities as strengths.

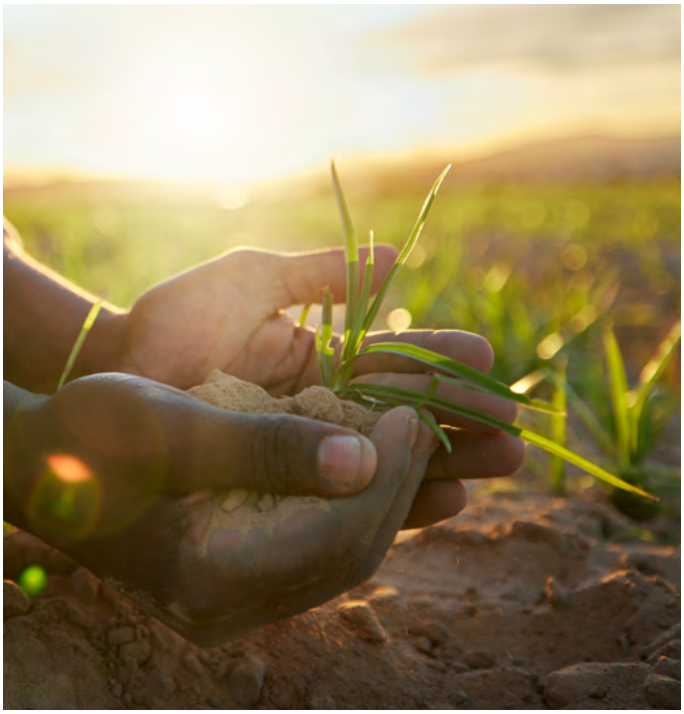
A FOOD SYSTEMS APPROACH TO GLOBAL GOAL ON ADAPTATION

A food systems approach to climate change adaptation and resilience acknowledges that food and agriculture are among the main drivers of climate change, land degradation, and biodiversity loss, but can also be important levers of change to address these crises.[45] Pathways for agriculture and food systems transformation entail holistic and context-specific interventions that consider the totality of food systems and their interactions with other natural and human systems, thus enabling wider societal changes.[46]

Food systems and nature interact through political, economic, social, cultural, and demographic systems in complex ways, leading to positive and negative outcomes for food security, environmental degradation, and climate change. Natural ecosystems provide multiple services: regulating climate, pollination, decomposition, erosion and flood control; drinking water and food; and supporting income and livelihoods. Food security and nutrition strongly depend on the driving forces connecting food and natural systems, which in turn both positively or negatively influence them.[47]

Adaptation through agriculture and food systems transformation therefore goes beyond incremental changes in production practices and considers all aspects of food systems including food security, availability, quality, safety, and affordability, as well as dietary diversity and nutrition. Adaptation policies and measures in agriculture and food systems are based on community-based adaptation and human rights-based adaptation; they encourage farm and landscape diversification and focus on peoples' right to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems.

Below is a summary of key intervention areas and policy measures in agriculture and food systems, and their potential to contribute to the UAE Framework targets, including suggested indicators from the current indicators shortlisted by experts to monitor progress towards specific targets (See Annex) as well as new indicators. These areas are deeply intertwined and are expected to foster, directly or indirectly, the ability of food systems to provide sufficient healthy and nutritious food for all in a changing climate.



The interconnectedness of agriculture and food systems with other sectors underscores its vital role in building long-term resilience to climate change. By fostering more resilient food systems and strengthening ecological services, adaptation measures in agriculture and food systems can contribute to overall sustainable development goals, thus enabling progress towards all adaptation targets under the UAE Framework for Global Climate Resilience (see Table 1).

Table 1. Summary overview of adaptation measures in agriculture and food systems, their benefits, and linkages to UAE Framework targets. Source: Based on IPCC (2022) and the UAE Framework for Global Climate Resilience

Intervention area	Adaptation measures	Benefits	UAE Framework Targets
Nature-positive food production (Crops)	Ecosystem-based integrated approaches such as agroecology that increase soil organic matter, enhance soil, and water conservation, and diversify food production systems	• Enhanced resilience of food systems • Mitigation benefits and co-benefits in health, ecosystem services and other SDGs • Higher and stable yield	Targets 2, 4, and 6
Nature-positive food production (Crops, livestock, aquaculture, mixed, agro-forestry systems)	Increasing agroecosystem diversification through-expanding crop, animal, fish, and other species genetic diversity-varying spatial and temporal arrangements including mixed planting, crop rotations, integrated crop, livestock, and agroforestry systems	Increased resilience, productivity, and sustainability of farming systems	Targets 2, 4, and 6
Nature-positive food production (Crops-livestock mixed system)	• Changing the relative emphasis on crops and livestock • Changing crop varieties and livestock breeds and species	Increased resilience	Targets 2, 4, and 6
Nature-positive food production (Crops, forestry, fisheries)	Indigenous and local knowledge including participatory plant breeding or community-based adaptation	Increased resilience and sustainability of food, fiber, forest, and small-scale fisheries production	Targets 2, 4, and 6
Nature-positive food production (Mixed system)	• Land restoration • Agroforestry • Silvo-pastoral systems	Improved resilience and productivity	Targets 2, 4, and 6

Intervention area	Adaptation measures	Benefits	UAE Framework Targets
Nature-positive food production (Fisheries)	• Improved management practices that consider fish stocks and the ecosystem • Adopting complementary productive activities to reduce economic dependence on fisheries • Developing capacity • Improving information flows in adaptive co-management transboundary resource management Gear or vessel modifications	Sustainable harvesting and fair distribution of wild fish products and revenues Proactive dynamic fisheries management and diversification based on scientific, Indigenous, and local knowledge will facilitate adaptive fisheries planning and reduce conflict over resources	Targets 1, 2, 4, and 6
Nature-positive food production (Aquaculture)	Adaptation options that incorporate ecological knowledge and risk into management decisions in the near and long term	Enhanced sustainable aquaculture production	Targets 1, 2, 4, and 6
Nature-positive food production (Freshwater fisheries and aquaculture systems)	Effective linkage of freshwater aquatic food provisioning management to the adaptation plans of other water-using sectors, considering trade-offs of production with community nutritional needs	Reduced risk of food insecurity and livelihood loss for those reliant on freshwater for inland fisheries and aquaculture	Targets 1, 2, 3, 4, 6, and 7
Nature-positive food production (Mixed systems)	Agricultural production systems that integrate crops, livestock, forestry, fisheries, and aquaculture	• Increased food production per unit of land • Reduced climate risks • Reduced GHG emission • Buffering capacity • Household resilience, though the benefits and challenges depend on local context	Targets 1, 2, 3, 4, 6, and 7
Sustainable and resilient supply chains (post-harvest)	Investments in improved humidity and temperature control in storage facilities for perishable items, and changes in public policy that control international trade and domestic market transactions	Improved food utilization and access and thereby resilience to climate change	Targets 1, 2, 3, 4, 5, 6, and 7

Intervention area	Adaptation measures	Benefits	UAE Framework Targets
Nature-positive food production and sustainable and healthy diets (Production and diets)	• Integrated multi-sectoral food system adaptation approaches that address food production, consumption, and equity issues • Nutrition and gender-sensitive agriculture programs, adaptive social protection and disaster risk management are examples	• Protection of vulnerable groups against livelihood risks • Enhanced responsiveness to extreme events	Targets 1, 2, 3, 4, 5, 6, and 7
Food governance	Rights-based approaches, including legislation, gender transformative approaches to agriculture, recognition of rights to land, seeds, fishing areas and other natural resources, and community-based adaptation	• Improved food security and nutrition for marginalized groups • Increased resilience through capacity-building of marginalized groups • Better access to resources for marginalized groups	Targets 1, 2, 3, 4, 5, 6, and 7
Food governance (Climate services)	• Early warning systems increasing resilience to climate variability by improving response times to extreme weather events • Affordable monitoring systems to minimize usage of water in agricultural production and/or the emission of pollutants • Improved storage and transportation infrastructures to minimize post-harvest food loss • Modelling fisheries to optimize location and timing of catches for sustainability	• Improved resilience and adaptive capacity	Targets 1, 2, 3, 4, 5, 6, and 7

Nature-positive food production

Food production approaches – like agroecology, climate-smart agriculture, sustainable land management techniques, agroforestry, and Indigenous and local farming and fishing practices – that increase food system resilience have multiple benefits for nutrition, health, biodiversity, poverty alleviation, and greenhouse gas emissions reductions through increased carbon sequestration.[48]

Agroecological farming systems clearly identify and target key ecological functions and aim to integrate these various elements carefully into the farming systems, creating multiple levels of positive interactions as opposed to merely substituting external inputs and engaging in isolated, singular interventions.[49] Such a holistic, bottom-up approach for sustainable agriculture and land management that weds ecological concepts with Indigenous knowledge and agricultural, socio-economic aspects can address food insecurity, alleviate poverty and inequality, and prevent biodiversity loss while mitigating climate change and building resilience.[50,51]

For example, agroforestry that combines trees with agricultural crops and/or livestock is an interconnected approach that increases social, economic, and environmental benefits, from improved soil health up to crop and livelihood diversification.[52] Both agroforestry and agroecology are types of ecosystem-based adaptation, which, if planned and implemented strategically, can advance the adaptation needs of a diverse set of sectors, including energy production, agriculture and food production, urban development, forestry, fisheries, water and sanitation, health, disaster relief, infrastructure, and transportation, among others.[53] Similarly, climate-responsive agricultural practices like improved soil management, water-efficient irrigation, and stress-tolerant crop varieties, that target emissions reduction and climate resilience as part of climate-smart agriculture, can have biodiversity and livelihood benefits.[54]

These practices support long-term productivity and ecosystem services such as pest control, soil health, pollination and buffering of temperature extremes, but potential and trade-offs vary by socioeconomic context, ecosystem zone, species combinations and institutional support. For example, diversifying crops in response to changing weather patterns, such as warmer or wetter conditions, can bolster food security while simultaneously improving the resilience of ecosystems and reducing the risk of monoculture-related failures.[55] Similarly, higher tree cover can influence rainfall patterns, contributing to water availability for both agriculture and urban areas, while plant cover can stabilize soil, preventing landslides and safeguarding key infrastructure such as roads. Healthy soils and floodplains, by acting as natural buffers, not only protect crops from floods but also store water essential for crop production, enhancing resilience across agricultural and urban landscapes.

In addition to these ecological benefits, adaptation measures in agriculture and food systems can provide significant co-benefits for climate mitigation and sustainable development. For instance, natural fertilization from healthy ecosystems reduces reliance on chemical fertilizers, which cuts down on associated emissions and transportation impacts, aligning with broader climate goals, and integrates trees in mixed production systems, helping carbon sequestration. An agroecological approach can further expand these services, promoting water purification and delivering public health benefits. Strengthening food sovereignty and ensuring a sustainable food system also addresses non-communicable diseases linked to poor nutrition, thus enhancing overall community well-being.

In the fisheries sector, scaling sustainable practices like selective harvesting, adopting fishing gears that reduce by-catch, limiting trail fishing to minimize impacts on the sea-floor ecology, and temporal and spatial habitat protection in aquatic and marine ecosystems can conserve genetic diversity of fish and other marine and aquatic organisms, rebuild overfished stocks, and reduce pollution.[56] Hence, these measures not only help restore depleted fish populations but also enhance the overall health of marine and aquatic ecosystems, benefiting both biodiversity and fishing communities. Hence, building the resilience of these ecosystems and communities is essential.[57]

Nature-positive food production practices can contribute to several thematic targets under the UAE Framework:

Directly, these contribute to:	
Target 2 **Food and Agriculture**	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 Alignment with the global mission of halting and reversing biodiversity loss by 2030
Suggested indicators and sub-indicators:	**Agricultural land under climate resilient agriculture practices and technologies** • Proportion of agricultural land under productive, sustainable and climate resilient practices and technologies. • Proportion of agricultural land under agroforestry and agrosilvopastoralism. • Proportion of agricultural land under soil and water conservation and restoration measures, including flood protection and sustainable irrigation • Proportion of agricultural land with crop and livestock diversity at farm and landscape level • **New indicator suggestion: Proportion of agricultural land under agroecological practices** **Adoption rate of climate resilient agriculture practices and technologies (disaggregated by actor type (producer, processors, distributors), age, gender** • **New indicator suggestion: Proportion of farmers and producers adopting agroecological practices** • Proportion of farmers adjusting planting and harvesting dates • Proportion of producers using climate-resilient varieties and breeds of crops, livestock, fisheries) • 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 • Proportion of livestock keepers adopting adaptive livestock management practices, including adaptive feed, pasture, and rangeland management. • Proportion of agricultural producers engaging in adaptive management of agricultural pests and diseases • Proportion of farmers engaged in sustainable fisheries and aquaculture practices • Proportion of agricultural producers accessing and using climate-resilient and/or indigenous plant genetic resources from medium- or long-term conservation facilities **Changes in agricultural productivity and biophysical impact drivers associated with climate variability and change** • Level of water stress: freshwater withdrawal for agriculture as a proportion of available freshwater resources • Extent of land degradation and soil quality • Incidences of crop/livestock pests and diseases linked to climate variability • Volume of food and agriculture production per labour unit (disaggregated by subsector [crops, livestock, fisheries]) • **New indicator suggestion: Changes in diversity of food produced** • Changes in yield and productivity (livestock, crop, fisheries). • Proportion of fish stocks within biologically sustainable levels

Target 3 **Health**	Attaining resilience against climate change related health impacts, promoting climate-resilient health services, and reducing climate-related morbidity and mortality
Suggested indicators and sub-indicators:	**SDG 6.3.2: Proportion of bodies of water with good ambient water quality** **Health impacts of climate-related disasters** **Food security and undernutrition** **Climate change and health vulnerability and adaptation assessment conducted in the past 5 years** **Incorporation of climate data in health systems** • Number of vulnerable groups (e.g., children, women, elderly) covered by climate and health monitoring systems

Target 4 **Ecosystems**	Accelerating the use of ecosystem-based adaptation and nature-based solutions
Suggested indicators and sub-indicators:	**Number of Nature-based Solutions (NbS) projects implemented, categorized by their stage of implementation (e.g., pilot, scaled-up, mainstreaming) and reporting on key outcomes related to adaptive capacity, resilience, and vulnerability reduction.** **Managed terrestrial, inland waters, coastal and marine areas under climate-resilient management practices as a proportion of the total area of the country** **Policy and/or incentives for green infrastructure as nature-based solutions** • Number of training programs implemented regarding ecosystem services and ecosystem restoration Number of individuals who have received training • No. of people benefiting from Ecosystem- Based Adaptation (EbA) interventions/ projects • Level of implementation of climate actions in National Biodiversity Strategy and Action • Investment for ecosystem and biodiversity • Number of community-based climate adaptation strategies implemented aimed at enhancing local capacity to manage and respond to changes and hazards related to ecosystems • Managed terrestrial, inland waters, coastal and marine areas under climate-resilient management practices (%, ha, km) • Changes in provision of ecosystem services critical for climate adaptation • Total climate regulation services provided by ecosystems by ecosystem type • Proportion of fish stocks within biologically sustainable levels

Indirectly, these contribute to:	
Target 1 **Water and Sanitation**	Reducing climate-induced water scarcity and attaining climate-resilient water supply, sanitation, and towards access to safe and affordable potable water for all
Target 6 **Livelihoods**	Reducing climate change impacts on poverty eradication and livelihoods, and promoting adaptive social protection
Target 7 **Cultural Heritage**	Protecting cultural heritage from the impacts of climate-related risks guided by traditional and local knowledge, and Indigenous Peoples' knowledge

Sustainable and resilient supply chains

Improved processes and infrastructures across supply chains can reduce post-harvest losses, increasing food availability. Climate-resilient distribution systems ensure that food reaches consumers even in case of extreme weather events, supporting stable supplies and safe utilization by maintaining food quality.

Climate change is already impacting food processing, storage, and transport capacities of countries as it is becoming costlier to prevent spoilage and maintain quality with increased temperatures. For instance, rising temperatures can damage roads and ports, disrupting transit times and delivery reliability, which in turn affects food availability and prices.[58] Therefore, while unique to each country, transportation and infrastructure systems built with food-systems in mind can reduce spoilage, expedite market access, and increase rural communities' connectivity, in case of climate disaster or other emergency food needs.[59]

Furthermore, higher humidity and temperature fluctuations can compromise food safety during storage, increasing the risk of spoilage and foodborne illnesses.[60] After crops are harvested, or after livestock is slaughtered, appropriate storage and processing techniques are imperative to enable food preservation for later consumption. These could include drying and dehydrating processing equipment and cold storage for produce and meat and metal drums and hermetic bags for grain storage.[61] Equally important is surveillance and detection systems for food monitoring to detect and mitigate spoilage and related health risks early on.[62] For example, insects are a main driver of food loss post-harvest and may increase in their reproductive rates with rising temperatures which can cause diseases and threaten public health.[63]

Climate-resilient infrastructure such as aggregation points that help bring products to market and improve transport conditions with increased cold storage capacity can also help connect farmers to markets in rural areas and expedite market access for rural communities in case of climate disaster or other emergency food needs.[64] The risk of overreliance on long supply chains is exemplified by the disruptive effect of COVID-19 pandemics on global food supply,[65] the armed conflict following Russian invasion of Ukraine – the two countries representing nearly 12% of the total calories traded in the world[66] – and, the ongoing cocoa crisis triggered by climate change and by a crop disease breakout in West Africa.[67]

Building resilience of food supply chains can contribute to several thematic targets under the UAE Framework:

Directly, these contribute to:	
Target 2 **Food and Agriculture**	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
Suggested indicators and sub-indicators:	**Climate resilience of food and agricultural supply and distribution** • Share of food and agriculture and supply and distribution infrastructure with improved resilience • Proportion of agricultural value chain actors adopting adaptive post-harvest management technologies and practices • Coverage of climate responsive food reserves and storage support **Losses and damages in food and agriculture** • **New indicator suggestion: Share of agricultural post-harvest losses** • Share of agricultural post-harvest losses associated with climate change • Frequency and length of supply chain disruptions in different food groups associated with climate shocks
Target 5 **Infrastructure**	Increasing the resilience of infrastructure and human settlements to ensure essential services for all
Suggested indicators and sub-indicators:	**% of municipalities with climate change adaptation plans that integrate nature-based solutions (NbS) and ecosystem-based adaptation (EbA) measures (green/ blue infrastructure) to manage and reduce climate change impacts, with identified actions, targets, and resource allocations.** **Proportion of NbS and EbA projects (e.g., wetlands, urban forests – green/ blue infrastructure) that have been monitored and shown to reduce at least two climate hazards (e.g., flood attenuation + heat mitigation).** **Proportion of total international funding (e.g., GEF/GCF/Adaptation Fund) allocated to support natural habitat creation/restoration/management to enhance the adaptive capacity of green/blur infrastructure in cities.** **Percentage of newly constructed infrastructure adhering to climate resilient, co benefit oriented design codes. E.g., % of new builds using design standards that address compound and cascading risks while delivering co benefits (e.g., green cooling corridors).**

Indirectly, these contribute to:	
Target 3 **Health**	Attaining resilience against climate change related health impacts, promoting climate-resilient health services, and reducing climate-related morbidity and mortality
Target 6 **Livelihoods**	Reducing climate change impacts on poverty eradication and livelihoods, and promoting adaptive social protection
Target 7 **Cultural Heritage**	Protecting cultural heritage from the impacts of climate-related risks guided by traditional and local knowledge, and Indigenous Peoples' knowledge

Sustainable and healthy diets

As climate variability intensifies, supporting local, diverse food production and consumption becomes critical to building resilience of agriculture and food systems and enhancing access to affordable, nutritious food options for all.[68]

Promoting and optimizing physical and economic access to healthy and sustainable foods can boost local economies, improve environmental sustainability, and support small-scale producers. Specific attention should be paid to implementing policies that support and protect smallholders, family farms, peasants, Indigenous peoples, local communities, women, and youth. Food systems here could significantly benefit from agroecology and agroforestry production systems that include livestock, which contribute organic fertilizer to soil, as well as income to local communities, thus improving their food security and livelihoods.[69] In these systems, neglected and underutilized crops, typically native to the environments in which they are grown, are an important part of adaptation strategies as they require fewer external inputs than conventional crops and can thrive in land considered unsuitable for other purposes.[70] For example, given the rise in undernourishment and micronutrient deficiency globally, adopting national food-based dietary guidelines that are practical, culturally appropriate, and context- and population-specific can help increase access to diverse food sources and transitioning to sustainable and healthy diets.

On the other hand, homogeneous diets depending on few crops and proteins are inherently more vulnerable to climate fluctuations and extreme weather events than largely diversified, locally adapted diets. More than 90% of crop varieties have disappeared from farmers' fields and half of the breeds of many domestic animals have been lost, so that just ten major global crops—barley, cassava, maize, oil palm, rapeseed, rice, sorghum, soybean, sugar cane and wheat—account for approximately 83% of all harvested food calories.[71] Relying on a narrow genetic base restricts farmers' options for adapting to changing climatic conditions. When faced with new pests or diseases, farmers in homogeneous systems may lack alternative crop varieties that could thrive under altered conditions. This lack of adaptability not only threatens individual farms but also undermines broader agricultural resilience within communities.

Furthermore, the erosion of Indigenous and local knowledge about food sources and preparation methods has not only diminished dietary diversity but also undermines community resilience by stripping away adaptive strategies that have historically enabled communities to thrive in their environments.[72] As younger generations grow increasingly disconnected from these traditions, the opportunity for intergenerational knowledge transfer fades – resulting in irrecoverable cultural loss affecting both individuals and communities.[73]

Building sustainable and healthy diets can contribute to several thematic targets under the UAE Framework:

Directly, these contribute to:	
Target 2 **Food and Agriculture**	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
Suggested indicators and sub-indicators:	**New indicator suggestion: Equitable access to adequate food and nutrition** • **Extent of food diversity required in public procurement** • **Adoption and implementation of laws regulating marketing of unhealthy and unsustainable foods** • **Including courses on production and benefits of healthy and nutritious food in school curricula** • **Adoption and implementation of laws promoting healthy and nutritious food through dietary diversity** • **Adoption and implementation of laws regulating food waste in the public institutions and gastronomy sector** • **Extent or volume of food wasted at the consumption stage** **Impact of climate change on food security and nutrition** • Proportion of national population classified as under/ malnourished (disaggregated by gender, age, location) • **New indicator suggestion: Prevalence of minimum dietary diversity among all populations** • Impact of climate shocks on food security and undernutrition • Prevalence of moderate or severe food insecurity in the population, based on the Food Insecurity Experience Scale (FIES) • Price volatility of food staples
Target 3 **Health**	Attaining resilience against climate change related health impacts, promoting climate-resilient health services, and reducing climate-related morbidity and mortality
Suggested indicators and sub-indicators:	**SDG 6.3.2: Proportion of bodies of water with good ambient water quality** **Health impacts of climate-related disasters** **Food security and undernutrition** **Climate change and health vulnerability and adaptation assessment conducted in the past 5 years** **Incorporation of climate data in health systems** • Number of vulnerable groups (e.g., children, women, elderly) covered by climate and health monitoring systems

Indirectly, these contribute to:	
Target 1 **Water and Sanitation**	Reducing climate-induced water scarcity and attaining climate-resilient water supply, sanitation, and towards access to safe and affordable potable water for all
Target 4 **Ecosystems**	ucing climate impacts on ecosystems and biodiversity, and accelerating the use of ecosystem-based adaptation and nature-based solutions
Target 6 **Livelihoods**	Reducing climate change impacts on poverty eradication and livelihoods, and promoting adaptive social protection
Target 7 **Cultural Heritage**	Protecting cultural heritage from the impacts of climate-related risks guided by traditional and local knowledge, and Indigenous Peoples' knowledge

Food governance

Strengthening governance through rights-based approaches to agriculture and food, including recognition of rights to land, seeds, fishing areas and other natural resources, and community-based adaptation is crucial to achieving long-term resilience of agriculture and food systems. Similarly, investment in innovation, research, and development initiatives, participatory and gender-responsive governance, and equity considerations must complement and further the implementation of adaptation measures.

A transition to resilient and adaptative food systems must go beyond a narrow focus of increasing crop yields, which fails to adequately take into consideration the structural inequities in distribution of benefits within food systems which poses a critical issue for climate adaptation.[74] While climate change potentially impacts all producers, the benefits of food trade and market operations might concentrate among wealthier entities and countries.[75] As a result, smallholder farmers and marginalized communities frequently lack access to resources, technology, and markets that could enhance their resilience to climate shocks.[76] For example, as price volatility increases due to reduced yields, or due to increased costs of production resulting from climate change impacts, low-income households face heightened food insecurity and economic strain.[77] Furthermore, price volatility can deter investment in agriculture, as producers become uncertain about future returns, ultimately undermining long-term food security and adaptation efforts in vulnerable regions.[78] This disparity not only exacerbates existing inequities but also hinders collective adaptation efforts, as those most affected by climate change are often excluded from decision-making processes that shape market dynamics and resource allocation.

Therefore, measures such as strengthening and harmonizing land and water tenure systems, direct technical assistance for farmers and economic incentive programs such as payment for ecosystem services programs can help to build farmers' resilience by safeguarding or restoring connectivity between ecosystems, reducing pollution, and controlling invasive species.[79] In addition, measures such as seed governance can promote biodiversity, improve resilience, and ensuring equitable resource management.[80]

Similarly, when considered holistically, adaptation efforts in other sectors, such as sustainable governance of natural ecosystems, climate-resilient livelihood strategies, early warning systems, and adaptive social protection, can directly or indirectly support food systems by reducing vulnerability to climate shocks.[81] Measures that enhance sustainable governance of natural ecosystems and ecosystem services in agriculture and food systems include integrated spatial planning at the landscape, seascape, and watershed level to avoid, reduce, and mitigate ecosystem conversion, overexploitation, and unequitable and unfair use of natural resources. Additionally, implementing buffer zones for natural or semi-natural species habitats within and around food production areas and implementing and expanding protected and conservation areas, especially in intact ecosystems, can support biodiversity conservation and restoration.[82]

Agriculture and food system workers are deeply embedded in local economies, especially given that the food sector can provide an overwhelming portion of livelihoods in many communities. The physical, social, and economic well-being of these workers is essential to maintaining the critical services they provide. Safeguarding their livelihoods requires climate-resilient economies that reduce risk and support long-term adaptation. Adaptation measures like constructing defenses against sea level rise, protecting mangroves, and fortifying infrastructure against both extreme weather events and slow-onset events don't just protect ecosystems – they also provide overall adaptation benefits that sustain food systems by, for instance, protecting critical trade infrastructure, fishing equipment, and coastal agriculture.

To ensure aquatic ecosystems can continue contributing to food systems and food security, adaptation measures including sustainable aquaculture practices, vulnerability assessments, ecosystem restoration and conservation initiatives, and aquatic management and ecosystem governance efforts are needed. Vulnerability assessments are the first step for countries to take before planning for what adaptation measures are needed to increase aquatic food systems resilience. Given broad differences across regions in a country, local vulnerability assessments are needed to plan adaptation appropriately.

Early warning systems can help to anticipate and manage natural disasters, pest outbreaks and yield failures, and enable local governments, communities, and farmers to prepare and take timely actions.[83] Financial insurance mechanisms can help expedite improved crop variety adoption and implementation. These types of food system-related insurance can be indexed to weather events, specific to one type of crop or livestock, or focus on supply chains, like insurance specific to shipping and processing. The 2021 IPCC report reflects that food system insurance, and related financial tools, can help minimize climate risks.

Strengthening food governance can contribute to several overarching and thematic targets under the UAE Framework:

Directly, these contribute to:	
Target 1 **Water and Sanitation**	Reducing climate-induced water scarcity and attaining climate-resilient water supply, sanitation, and towards access to safe and affordable potable water for all
Suggested indicators and sub-indicators:	**SDG 6.4.2: Level of water stress: freshwater withdrawal as a proportion of available freshwater resources** **SDG 6.4.1: Change in water-use efficiency over time** **SDG 6.5.1: Degree of integrated water resources management** • Water use index • Territory affected by water scarcity **Proportion of bodies of water with good ambient water quality** **Implementation of actions in drought risk management plans** **SDG 6.b.1: Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management** **Number of major river basins with comprehensive water resources assessment using climate lens increased** • Rate of access to financing for adaptation projects involving the promotion of integrated water resource management Investments to enable improvement in systems for enhanced capture capacity for water supply • Investments to enable improvement in systems for enhanced capture capacity for water supply
Target 2 **Food and Agriculture**	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
Suggested indicators and sub-indicators:	**Diversification of livelihoods and economies** • Proportion of farmers significantly dependent on rainfed agriculture • Number of households whose income has increased following the development of income-generating activities resilient to climate change • No. of business plans that develop added value through primary transformation in value chains in areas vulnerable to climate change

Suggested indicators and sub-indicators:	**Access to climate-responsive social protection, credit and insurance schemes for agrifood system dependent population.** • Proportion of agricultural population accessing insurance products and services (disaggregated by gender, value chain [crops, livestock, fisheries], location) • Proportion of the value of food and agricultural sector insured • Proportion of agricultural population with access to social safety nets and social assistance for climate risk management (disaggregated by gender [crops, livestock, fisheries, forestry], location) • Proportion of agricultural population with access to credit schemes for climate risk management (disaggregated by gender [crops, livestock, fisheries, forestry], location) • Proportion of rural population with access to subsidy schemes tailored to climate change adaptation, delivered through social protection systems (disaggregated by gender and income) **Financing for climate resilient agriculture** • Public expenditures in climate change adaptation in food and agriculture relative to agriculture GDP • 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) **Existence and access to climate information systems to support adaptation in agri-food systems including early warning and agro-weather information systems** • Number of countries with operational Climate Information Services and Early Warning Systems for food and agriculture • Proportion of agricultural actors accessing climate information services and agro-weather information • Number of countries that have conducted impact, vulnerability risk assessments and scenario analysis for the food and agriculture • Number of countries with operational data and tracking systems for assessing adaptation actions and results in food and agriculture **Institutional and organizational capacities for climate change adaptation in food and agriculture** • Number of countries integrating climate change adaptation priorities into crops, livestock, fisheries, aquaculture, and forestry policies, strategies, and plans • Number of countries integrating climate change adaptation priorities for food and agriculture into national and subnational adaptation strategies, including NAPs and NDCs • Number of countries with climate change coordination units incorporating the food and agriculture sector **Capacity building and knowledge transfer for climate change adaptation in food and agriculture sector** • Number of agricultural producers receiving extension services to support climate change adaptation (disaggregated by gender, subsector, location) • Number of agricultural populations reached through capacity building interventions (disaggregated by age, gender, actor type e.g., producer, processor, distributor) • Value of investments for research and development for adaptation in food and agriculture. • Proportion of research and development programs integrating indigenous and traditional knowledge on climate change adaptation in food and agriculture

Suggested indicators and sub-indicators:	**Impact of climate change on agricultural income** • Reduction in share of household incomes from agriculture attributed to climate change • Average income of food-producers (disaggregated by producer type eg small vs large scale, sex, age, indigenous status)
Target 4 **Ecosystems**	Reducing climate impacts on ecosystems and biodiversity, and accelerating the use of ecosystem-based adaptation and nature-based solutions
Suggested indicators and sub-indicators:	**Number of community-based climate adaptation strategies implemented aimed at enhancing local capacity to manage and respond to changes and hazards related to ecosystems** **Managed terrestrial, inland waters, coastal and marine areas under climate-resilient management practices (%, ha, km)** **Changes in provision of ecosystem services critical for climate adaptation** **Total climate regulation services provided by ecosystems by ecosystem type (Source: CBD Target 8.2.1.)**
Overarching Target a **Impact, vulnerability, and risk assessment**	
Suggested indicators and sub-indicators:	**Number of Parties with an officially adopted National Adaptation Plan (NAP) or equivalent policy instrument** • Number of Parties with institutionalized processes for adaptation-related capacity development for (or: in the context of) NAP formulation, including training programs or technical support platforms for government officials and stakeholders **Level of integration of climate change adaptation at national and subnational levels in strategies and plans of key sectors** **Proportion of countries integrating climate change adaptation into national (and sectoral) development plans** **Number of (or proportion of) sectoral and local authorities that have integrated adaptation into relevant processes** **Number of national and sector-wide policies, legal frameworks, plans and processes developed and strengthened to identify, prioritize and integrate adaptation strategies and measures** **Number of Parties with formal institutional mechanisms (e.g., inter-ministerial committees) for cross-sectoral coordination of adaptation** **Number of Parties where national budgets reflect adaptation allocations across sectors and ministries** **Proportion of government budget allocated to climate adaptation and resilience** **Health component of National Adaptation Plan developed**

Overarching Target b

Planning

Suggested indicators and sub-indicators:	**[TARGET LANGUAGE] By 2030 all Parties have in place national adaptation plans, policy instruments, and planning processes and/or strategies** **Number of Parties with an officially adopted National Adaptation Plan (NAP) or equivalent policy instrument** • Number of Parties that have established national adaptation goals or targets • Number of Parties that have adopted national legislation or other legislative frameworks on adaptation • Number of Parties with institutionalized processes for adaptation-related capacity development for (or: in the context of) NAP formulation, including training programs or technical support platforms for government officials and stakeholders **Level of integration of climate change adaptation at national and subnational levels in strategies and plans of key sectors** **Proportion of countries integrating climate change adaptation into national (and sectoral) development plans** **Number of (or proportion of) sectoral and local authorities that have integrated adaptation into relevant processes** **Number of national and sector-wide policies, legal frameworks, plans, and processes developed and strengthened to identify, prioritize and integrate adaptation strategies and measures** **Number of Parties with formal institutional mechanisms (e.g., inter-ministerial committees) for cross-sectoral coordination of adaptation** **Number of Parties that have systems in place for considering climate risks in public procurement** **Number of Parties where national budgets reflect adaptation allocations across sectors and ministries**

Overarching Target c

Implementation

Suggested indicators and sub-indicators:	**Share of public climate finance (international and domestic) allocated to adaptation that is dedicated to capacity building, including communication, training, education and awareness-raising actions on climate change risks and adaptation measures** **Percentage of the target population with skills improved by capacity building interventions that have implemented adaptation actions, by sex; age; people with disabilities; migrants and displaced people; Indigenous Peoples; and profession across the GGA targets.**

Suggested indicators and sub-indicators:	**Direct economic losses (property, assets, infrastructure, agricultural production and revenue) as a result of climate hazards, as a proportion of GDP** • Proportion of population who decreased food intake as a result of climate change, by sex and household composition (single/double adult, with/without children) • Proportion of land or livestock users who noted drops in yield as a result of climate change, by sex and whether this was their main source of income • Proportion of population whose time spent on production of environmental goods increased as a result of climate change, by sex and type of good (fetching water, fuels, waste management, fishing, aquaculture, livestock raising, food processing, mining, collecting plants or other forest products, hunting, farming **Percent of agricultural population covered by climate risk insurance mechanisms** **Share of urban spaces occupied by green spaces, by type (parks/gardens, agriculture, primary/wild forests)** **Share of river basins covered by management plans, by (a) whether plans are in place and (b) whether implementation is on track according to annual targets**

Overarching Target d

Monitoring, evaluation, and learning (MEL)

Suggested indicators and sub-indicators:	**Number of Parties that have established a system for monitoring, evaluation and learning for their national adaptation efforts** • Adequate institutional arrangements for the national adaptation MEL system have been established • The MEL system covers adaptation of at-risk sectors as identified in the assessments described under para 10a **Adaptation has been integrated into M&E systems of relevant development or sectoral plans** **Number of Parties that have operationalized a system for monitoring, evaluation and learning for their national adaptation efforts** • NAP implementation is monitored regarding achievements of the defined NAP goals or targets • Number of countries that publish an adequately detailed report about the implementation progress of their national adaptation efforts **Number of Parties that have built the required institutional capacity to fully implement the national adaptation MEL system** • Systems and processes for building and maintaining capacity for national adaptation MEL system are in place • Inclusion of vulnerable and Indigenous and Local People in capacity building for the MEL system of national adaptation efforts

Indirectly, these contribute to:	
Target 3 **Health**	Attaining resilience against climate change related health impacts, promoting climate-resilient health services, and reducing climate-related morbidity and mortality
Target 6 **Livelihoods**	Reducing climate change impacts on poverty eradication and livelihoods, and promoting adaptive social protection
Target 7 **Cultural Heritage**	Protecting cultural heritage from the impacts of climate-related risks guided by traditional and local knowledge, and Indigenous Peoples' knowledge

CASE STUDIES OF ADAPTATION INTERVENTIONS AND PRACTICES IN AGRICULTURE AND FOOD SYSTEMS

While adaptation efforts to enhance resilience of agriculture and food systems have been slow and fragmented and there is still considerable progress to be made, there are already good examples of interventions and projects implemented by governments in collaboration with civil society, donors, research organizations and the private sector.

Below case studies[84] demonstrate examples of how adaptation practices in agriculture and food systems can build resilience and provide multiple climate and sustainable development benefits.

Local Technical Agroclimatic Committees enhance resilience of farmers in Vietnam

Since 2020, the Alliance of Bioversity International and CIAT has been working with Vietnam's Department of Crop Production (DCP) to improve climate risks management among smallholder farmers, introducing Local Technical Agroclimatic Committees (LTAC) approach, as part of the DeRISK SE Asia project. This new methodology helps to develop and disseminate seasonal agroclimatic advisories, in a participatory way. The LTAC approach entails an extensive dialogue process, involving experts, local authorities, technicians, representatives from the public and private sectors, and farmers; it is aimed at understanding the climate forecast in a province and generate context-specific recommendations to reduce risks associated with climate variability. They provide farmers with information about the expected weather conditions, such as rainfall, temperature, humidity, and related risks.

This process results in seasonal, monthly and 10-day provincial and district level local agroclimatic bulletins distributed to end-users or farmers, which contains tailored seasonal climate and short-term weather forecasts, potential impacts on crops, as well as recommendations for agricultural production planning and decision-making. The advisories are generated with support of Crop Decision Trees that provide specific information on crop stages, agricultural practices, climate risk and response strategies under different climate scenarios. Farmers can access agroclimatic advisories via multiple communication channels, including messaging apps, farmer-to-farmer sharing, loudspeakers, printed posters among others.

Supported by Germany, the project reached 130,000 farmers by the end of 2022. These farmers have used the agroclimatic advisories for seed varieties selection, land preparation, planting methods, water management, pest control, and harvesting dates identification based on predicted climate and weather forecast. Evidence shows that agroclimatic advisory services are a cost-effective way to improve agricultural productivity and resilience to climate change. Improved access and enhanced understanding of seasonal forecasts and agroclimatic advisories has helped farmers better plan and manage their farms and make informed decisions about their crops. It has also helped to reduce the use of pesticides and cope with climate risks related with excessive rainfall, flooding, drought, among others.

Strengthening integrated water and land management for climate resilient agroecosystems in Uzbekistan

Implemented by FAO, the GEF-funded Central Asia Water and Land Nexus (CAWLN) program is designed to improve the health of agricultural land and watersheds, reduce deforestation, and promote rural development. Through collaborative, science-based approaches, CAWLN is building the resilience of natural and agricultural landscapes at both the national and regional level through transformational changes in the management of water and land use resources and biodiversity for agriculture.

The program is structured around five key activities. First, it strengthens transboundary and cross-sectoral co-operation within the Amu Darya and Syr Darya river basins, facilitating a harmonized approach to integrated watershed management. Second, it enhances governance frameworks and mechanisms and improves stakeholder capacities to apply gender-responsive and integrated land-water-biodiversity management practices aligned with national commitments. Third, the program enhances decision-making tools and capacities, including satellite imagery use for Monitoring and Decision Support Systems, to support planning related to water, land, agriculture, and ecosystem management. Fourth, it promotes gender-responsive sustainable land management practices in sustainable agriculture and ecosystem restoration, by integrating multi-stakeholder mechanisms and incentives to achieve Land Degradation Neutrality. Finally, the program focuses on restoring key aquatic and terrestrial habitats, protecting native biodiversity, and improving livelihoods of rural communities through enhanced ecosystem service benefits.

The CAWLN program is designed to promote transformational changes through integrated land-water-biodiversity management for the resilience of Uzbekistan's natural landscapes and agroecosystems. By building governance frameworks, enhancing decision-making processes, addressing gender inequalities and social norms, and enhancing cross-sectoral cooperation, the program will enable Uzbekistan to deliver on key adaptation goals for climate resilient agriculture and natural resource management stated in its NDC, including the restoration of degraded ecosystems and biodiversity and improved rural livelihoods thus contributing to several targets under the UAE Framework for Global Climate Resilience.

Restoring irrigation systems for enhanced climate resilience, food and nutrition security, and rural livelihoods in Sri Lanka

The project "Healthy Landscapes: Managing Agricultural Landscapes in Socio-ecologically Sensitive Areas to Promote Food Security, Well-being and Ecosystem Health" (short name: Healthy Landscapes Project) focuses on the rehabilitation and sustainable management of the TCS. Aligning with national priorities for climate resilience in the agriculture and water sectors outlined in Sri Lanka's NDC and in partnership with local governments and communities, the project has restored five water tanks and 500 hectares of forests and micro-land uses. At the same time, 300 farmers were trained in sustainable land management (SLM) practices such as the preparation of soil bunds, use of drip irrigation, and application of organic fertilizer (e.g., manure and compost). The project also partnered with two local women's farming organizations to strengthen the livelihoods of 120 women farmers by supporting them with maize cultivation, ensuring they benefit from the growing demand for this crop. Finally, by organizing a workshop on smart agriculture for participants from both academia—including students, lecturers, and researchers—and government, the project highlighted emerging opportunities for local youth, encouraging them to stay in the cascade landscape, as opposed to moving to urban areas to pursue better livelihoods.

The Healthy Landscape Project's restoration efforts improved the TCS's ability to capture and store rainwater, enhancing local communities' resilience to increasing rainfall variability and extreme weather events, including floods and droughts, in the dry zone. In fact, well water levels were maintained in surrounding villages during the prolonged drought of 2023-2024.[85] Farmers trained in SLM practices applied their knowledge across 1,000 hectares of agricultural land minimizing soil erosion and water loss in their fields while improving soil fertility and helping to sustain crop productivity even under changing climate conditions.

CONCLUSION

Climate adaptation in agriculture and food systems is a key component of broader climate resilience, benefiting both the sector and the wider environment. By fostering more resilient food systems and strengthening ecological services, these measures contribute to overall sustainability and climate mitigation goals. However, this calls for systematically considering traditional and local knowledge, investing, and scaling up bottom-up initiatives and local action through agroecology and other innovative approaches that would increase food security and resilience while harnessing the power of nature as a multiplier solution to the crises of climate change, biodiversity loss, and land degradation.

Therefore, governments in both developed and developing countries must work together to ensure action towards strengthening the resilience of global agriculture and food systems through stronger protections, better infrastructure, technical support, and funding for farmers, fisherfolk, and local communities facing the impacts of climate change worldwide.

ANNEX: FULL LIST OF RELEVANT INDICATORS TO MONITOR PROGRESS ON AGRICULTURE AND FOOD POLICIES UNDER THE UAE FRAMEWORK

At COP28 in Dubai in 2023, UNFCCC Parties launched a two-year UAE–Belém work program on developing indicators for measuring progress achieved toward the UAE Framework targets. Parties also requested that the Subsidiary Body chairs organize workshops to assist with the development of the indicators under the work program. Following the initial compilation and refined mapping of indicators, at COP29, Parties requested the Chairs of the subsidiary bodies to invite the experts to produce a consolidated list of indicator options.

The experts have now produced a consolidated list of indicator options, along with information for each indicator – including rationale for inclusion, available metadata, and status of relevant data collection – is available on the UNFCCC website (see **https://unfccc.int/documents/645725**). Experts have now shortlisted 490 indicators to be discussed by Parties in the 62nd Subsidiary Bodies Meetings in June 2025 in Bonn. From these indicators, Parties aim to finalize 100 indicators and adopt them at COP30 in November 2025.

From the 490 indicators for the seven thematic targets and four targets for planning and implementation of adaptation policies, **66** are for the target on 'food and agriculture' and another 163 under other targets are directly or indirectly relevant to monitoring and reporting progress on adaptation measures for agriculture and food systems transformation (see Table 2 and Table 3).

Table 2. Number of food related indicators in the shortlisted indicators for the UAE Framework. See Annex for the list of these indicators.

Target	Total indicators	Total indicators relevant to food
9a. Water supply and sanitation	33	24
9b. Food and agricultural production	66	66
9c. Health impacts and health services	62	14
9d. Ecosystem and Biodiversity	40	34
9e. Infrastructure and human settlements	99	20
9f. Poverty eradication and livelihoods	24	3
9g. Cultural heritage and knowledge	63	17
10a. Impact, vulnerability, risk assessment	18	6
10b. Planning	26	13
10c. Implementation	39	15
10d. Monitoring, evaluation, and learning	20	17
Total indicators	**490**	**229**

In the compilation of 490 indicators by experts, indicators are categorised as main indicators and sub-indicators. Similar indicators are consolidated into broader main indicators or headline indicators to streamline assessment and improve coherence. These main/ headline indicators capture overarching themes. Sub-indicators are disaggregations of main indicators and provide disaggregated or specific elements to support more detailed monitoring and analysis.

In the published indicators list, some indicators are given a new ID (e.g.: 9a01) and others are not. The ID starts with the target number followed by the serial number. If indicator or sub-indicator does not have an ID yet, cell is left blank.

In the table below, dark color rows are the main indicators and light color rows are the sub-indicators that are relevant to agriculture and food systems.

Table 3. List of indicators relevant to agriculture and food systems from the consolidated list of indicators for the UAE Framework.

New indicator ID	Final indicator name
9a. Water supply and sanitation	
9a01	**SDG 6.4.2: Level of water stress: freshwater withdrawal as a proportion of available freshwater resources**
9a02	**SDG 6.4.1: Change in water-use efficiency over time**
9a03	**SDG 6.5.1: Degree of integrated water resources management**
9a04	*Water use index*
9a05	*Territory affected by water scarcity*
9a06	**Proportion of bodies of water with good ambient water quality**
9a10	**Early Warnings for All Initiative (EW4All) by WMO – Observation Networks (2.1): number of countries with multi-hazard monitoring systems and stations sharing data internationally. This ensures comprehensive data collection for water-related hazards like floods and droughts**
9a11	**SDG 15.1.2: Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type**
9a12	**Implementation of actions in drought risk management plans**
9a13	**Proportion of government expenditure on DRR in relation to GDP**
9a16	**SDG 6.1.1: Proportion of population using safely managed drinking water services**
9a17	**UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) indicator – A4. Proportion of countries undertaking climate risk assessments for national planning of drinking water, sanitation, and hygiene (WASH)**
9a18	**SDG 6.b.1: Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management**

9a19	*Number of males and females with year-round access to reliable and safe water supply despite climate shocks and stresses*
9a21	**SDG 6.2.1a: Proportion of population using safely managed sanitation services**
9a24	*Number of people reached with climate- resilient at least basic sanitation services*
9a25	**UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) indicator – A9. Proportion of countries taking measures to improve and extend WASH services to populations disproportionately affected by climate change**
9a26	*Percentage of poor people in vulnerable communities with access to safe and reliable water disaggregated by gender*
9a27	**SDG 6.a.1: Amount of water- and sanitation-related official development assistance (ODA) that is part of a government-coordinated spending plan**
9a28	**Existence of plans and mechanisms for the integration of strategies on water-related hazards and infrastructure across national development plans to reduce vulnerabilities across sectors**
9a29	**Number of major river basins with comprehensive water resources assessment using climate lens increased**
9a30	*Rate of access to financing for adaptation projects involving the promotion of integrated water resource management Investments to enable improvement in systems for enhanced capture capacity for water supply*
9a31	*Investments to enable improvement in systems for enhanced capture capacity for water supply*
9a33	**Appropriate technologies on IWRM, CCA and mitigation**

9 (b) Food and agricultural production

9b01	**Headline indicator 1. Agricultural land under climate resilient agriculture practices and technologies**
9b02	*1.1 Proportion of agricultural land under productive, sustainable and climate resilient practices and technologies.*
9b03	*1.2 Proportion of agricultural land under agroforestry and agrosilvopastoralism.*
9b04	*1.3 Proportion of agricultural land under soil and water conservation and restoration measures, including flood protection and sustainable irrigation*
9b05	*1.4 Proportion of agricultural land with crop and livestock diversity at farm and landscape level.*
9b06	**Headline indicator 2. Adoption rate of climate resilient agriculture practices and technologies (disaggregated by actor type (producer, processors, distributors), age, gender**
9b07	*2.1 Proportion of farmers adjusting planting and harvesting dates*
9b08	*2.2 Proportion of producers using climate-resilient varieties and breeds of crops, livestock, fisheries)*
9b09	*2.3 Proportion of food processors adopting climate-resilient technologies and practices.*

9b10	*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*
9b11	*2.5 Proportion of livestock keepers adopting adaptive livestock management practices, including adaptive feed, pasture and rangeland management.*
9b12	*2.6 Proportion of agricultural producers engaging in adaptive management of agricultural pests and diseases*
9b13	*2.7 Proportion of farmers engaged in sustainable fisheries and aquaculture practices*
9b14	*2.8 Proportion of agricultural producers accessing and using climate-resilient and/or indigenous plant genetic resources from medium- or long-term conservation facilities*
9b15	**Headline indicator 3. Climate resilience of food and agricultural supply and distribution**
9b16	*3.1 Share of food and agriculture and supply and distribution infrastructure with improved resilience*
9b17	*3.2 Proportion of agricultural value chain actors adopting adaptive post-harvest management technologies and practices*
9b18	*3.3 Coverage of climate responsive food reserves and storage support*
9b19	**Headline indicator 4. Diversification of livelihoods and economies**
9b20	*4.1 Proportion of farmers significantly dependent on rainfed agriculture*
9b21	*4.2 Number of households whose income has increased following the development of income-generating activities resilient to climate change*
9b22	*4.3 No. of business plans that develop added value through primary transformation in value chains in areas vulnerable to climate change*
9b23	**Headline indicator 5. Access to climate-responsive social protection, credit and insurance schemes for agrifood system dependent population.**
9b24	*5.1 Proportion of agricultural population accessing insurance products and services (disaggregated by gender, value chain [crops, livestock, fisheries], location)*
9b25	*5.2 Proportion of the value of food and agricultural sector insured*
9b26	*5.3 Proportion of agricultural population with access to social safety nets and social assistance for climate risk management (disaggregated by gender [crops, livestock, fisheries, forestry], location)*
9b27	*5.4 Proportion of agricultural population with access to credit schemes for climate risk management (disaggregated by gender [crops, livestock, fisheries, forestry], location)*
9b28	*5.5 Proportion of rural population with access to subsidy schemes tailored to climate change adaptation, delivered through social protection systems (disaggregated by gender and income)*
9b29	**Headline indicator 6. Financing for climate resilient agriculture**
9b30	*6.1 Public expenditures in climate change adaptation in food and agriculture relative to agriculture GDP*

9b31	*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)*
9b32	**Headline indicator 7. Existence and access to climate information systems to support adaptation in agrifood systems including early warning and agroweather information systems**
9b33	*7.1 Number of countries with operational Climate Information Servces and Early Warning Systems for food and agriculture*
9b34	*7.2 Proportion of agricultural actors accessing climate information services and agroweather information*
9b35	*7.3 Number of countries that have conducted impact, vulnerability risk assessments and scenario analysis for the food and agriculture*
9b36	*7.4 Number of countries with operational data and tracking systems for assessing adaptation actions and results in food and agriculture*
9b37	**Headline indicator 8. Institutional and organizational capacities for climate change adaptation in food and agriculture**
9b38	*8.1 Number of countries integrating climate change adaptation priorities into crops, livestock, fisheries, aquaculture, and forestry policies, strategies and plans*
9b39	*8.2 Number of countries integrating climate change adaptation priorities for food and agriculture into national and subnational adaptation strategies, including NAPs and NDCs*
9b40	*8.3 Number of countries with climate change coordination units incorporating the food and agriculture sector*
9b41	**Headline indicator 9. Capacity building and knowledege transfer for climate change adaptation in food and agriculture sector**
9b42	*9.1 Number of agricultural producers receiving extension services to support climate change adaptation (disaggregated by gender, subsector, location)*
9b43	*9.2 Number of agricultural population reached through capacity building interventions (disaggregated by age, gender, actor type eg producer, processor, distributor)*
9b44	*9.3 Value of investments for research and development for adaptation in food and agriculture.*
9b45	*9.4 Proportion of research and development programs integrating indigenous and traditional knowledge on climate change adaptation in food and agriculture*
9b46	**Headline indicator 10. Changes in agricultural productivity and biophysical impact drivers associated with climate variability and change**
9b47	*10.1 Level of water stress: freshwater withdrawal for agriculture as a proportion of available freshwater resources*
9b48	*10.2 Extent of land degradation and soil quality*
9b49	*10.3 Incidences of crop/livestock pests and diseases linked to climate variability*
9b50	*10.4 Volume of food and agriculture production per labour unit (disaggregated by subsector [crops, livestock, fisheries])*

9b51	*10.5 Changes in yield and productivity (livestock, crop, fisheries).*
9b52	*10.6 Proportion of fish stocks within biologically sustainable levels*
9b53	**Headline indicator 11. Impact of climate change on agricultural income**
9b54	*11.1 Reduction in share of household incomes from agriculture attributed to climate change*
9b55	*11.2 Average income of food-producers (disaggregated by producer type eg small vs large scale, sex, age, indigenous status)*
9b56	**Headline indicator 12. Losses and damages in food and agriculture**
9b57	*12.1 Direct agricultural losses and damages attributed to disasters*
9b58	*12.2 Share of agricultural post-harvest losses associated with climate change*
9b59	*12.3 Frequency and length of supply chain disruptions in different food groups associated with climate shocks*
9b60	*12.4 Losses in agricultural GDP associated with climate change*
9b61	**Headline indicator 13. Impact of climate change on food security and nutrition**
9b62	*13.1 Proportion of national population classified as under/ malnourished (disaggregated by gender, age, location)*
9b63	*13.2 Prevalence of minimum dietary diversity among women and children*
9b64	*13.3 Impact of climate shocks on food security and undernutrition*
9b65	*13.4 Prevalence of moderate or severe food insecurity in the population, based on the Food Insecurity Experience Scale (FIES)*
9b66	*13.5 Price volatility of food staples*

9 (c) Health impacts and health services

9c02	**SDG 6.3.2: Proportion of bodies of water with good ambient water quality**
9c09	**Health impacts of climate-related disasters**
9c14	**National research plan on climate change and health developed**
9c17	**Food security and undernutrition**
9c18	**Climate change and health vulnerability and adaptation assessment conducted in the past 5 years**
9c19	**National adaptation plans for health (HNAP)**
9c19a	Health component of National Adaptation Plan (NAP) developed
9c20	**Existence of national emergency/disaster strategy and plans with components of public health strategies in response to climate change**

9c21	**Climate-related health emergency and disaster preparedness and management actions integrated into disaster risk reduction plans**
9c24	**Incorporation of climate data in health systems**
9c24a	*Mechanism established for collection and analysis of data to inform the management of climate-related environmental determinants of health within the health system*
9c24b	*Information on weather and climate conditions for climate-sensitive health risks integrated into the implementation of health programmes*
9c24c	*Number of vulnerable groups (e.g., children, women, elderly) covered by climate and health monitoring systems*
9c26	**Workforce capacity to understand and work on climate change and health**
9 (d) Ecosystems and biodiversity	
	Area under restoration
	Services provided by ecosystems
	Extent of natural ecosystems
	Coverage of protected areas and other effective area-based conservation measures
	Average share of the built-up area of cities that is green or blue space for public use for all
	Number of countries with policies to minimize the impact of climate change and ocean acidification on biodiversity and to minimize negative and foster positive impacts of climate action on biodiversity
	Number of countries taking action towards the full, equitable, inclusive, effective and gender-responsive representation and participation in decision-making and access to justice and information related to biodiversity by indigenous peoples and local communities, respecting their cultures and their rights over lands, territories, resources and traditional knowledge, as well as by women and girls, children and youth, and persons with disabilities, and the full protection of environmental human rights defenders
9d01	**Number of countries with NAPs and NDCs that incorporate nature-based solutions (NbS) for adaptation, categorized by the stage of NbS implementation (e.g., identified, planned, piloted, scaled-up, mainstreamed) and reporting on key outcomes related to adaptive capacity, resilience, and vulnerability reduction.**
	Government spending on conservation and sustainable use of biodiversity and ecosystems over total Government Budget
9d02	**Domestic public funding on conservation and sustainable use of biodiversity and ecosystems**
	Rate of sea-level-rise
	Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies (SDG target 1.5.4)
	Proportion of fish stocks within biologically sustainable levels

9d03	**International public funding, including official development assistance for conservation and sustainable use of biodiversity and ecosystems**
9d04	**Private funding (domestic and international) on conservation and sustainable use of biodiversity and ecosystems**
9d05	**Number of countries that have taken significant action to strengthen capacity-building and development and access to and transfer of technology, and to promote the development of and access to innovation and technical and scientific cooperation**
	Ecosystem Integrity Index
	Bioclimatic Ecosystem Resilience Index
9d06	**Number of Nature-based Solutions (NbS) projects implemented, categorized by their stage of implementation (e.g., pilot, scaled-up, mainstreaming) and reporting on key outcomes related to adaptive capacity, resilience, and vulnerability reduction.**
9d07	*Extent of natural and semi-natural ecosystems with high ecological integrity as a proportion of total area of the country*
9d08	Managed terrestrial, inland waters, coastal and marine areas under climate-resilient management practices as a proportion of the total area of the country
	Policy and/or incentives for green infrastructure as nature-based solutions
	Conservation of forest genetic resources
	Number of training programmes implemented regarding ecosystem services and ecosystem restoration Number of individuals who have received training
	No. of people benefiting from Ecosystem- Based Adaptation (EbA) interventions/ projects
	Level of implementation of climate actions in National Biodiversity Strategy and Action
	Investment for ecosystem and biodiversity
9d09	*SDG Indicator 15.b.1: (a) Official development assistance on conservation and sustainable use of biodiversity; and (b) revenue generated and finance mobilized from biodiversity-relevant economic instruments*
	5.1 Number of natural resource assets created, maintained or improved to withstand conditions resulting from climate variability and change (by type and scale) Source: (Adaptation Fund Strategic Results Framework)
	Number of community-based climate adaptation strategies implemented aimed at enhancing local capacity to manage and respond to changes and hazards related to ecosystems
	Proportion of change (delta) in adaptive capacity between two reference years for the Biodiversity and Ecosystem Services dimension
	Managed terrestrial, inland waters, coastal and marine areas under climate-resilient management practices (%, ha, km)
	Changes in provision of ecosystem services critical for climate adaptation

	8.2.1. Total climate regulation services provided by ecosystems by ecosystem type (Source: CBD Target 8.2.1.)
9e. Infrastructure and human settlements	
9e03	*Adjustment of infrastructure standards, zoning, or resilience actions based on temperature goal overshoot impacts.*
9e04	*Prioritisation of flexible, adaptive, or transformative measures for IHS in light of temperature goal overshoot risks and impacts.*
9e06	**% of municipalities with climate change adaptation plans that integrate nature based solutions (NbS) and ecosystem based adaptation (EbA) measures (green/ blue infrastructure) to manage and reduce climate change impacts, with identified actions, targets, and resource allocations.**
9e07	*Extent of NbS/EbA integration (e.g., specific actions defined; budget allocations; implementation underway)*
9e08	**Proportion of NbS and EbA projects (e.g., wetlands, urban forests – green/ blue infrastructure) that have been monitored and shown to reduce at least two climate hazards (e.g., flood attenuation + heat mitigation).**
9e11	**Proportion of total international funding (e.g. GEF/GCF/Adaptation Fund) allocated to support natural habitat creation/restoration/management to enhance the adaptive capacity of green/blur infrastructure in cities.**
9e12	*Funding by habitat type (e.g., wetlands, forests, mangroves, green corridors)*
9e14	*Proportion of projects with measurable adaptation outcomes linked to urban ecosystems*
9e23	*Inclusion of marginalized communities (e.g., informal settlements) in local DRR strategies*
9e24	**Extent of NAPs and National Disaster Risk Reduction (DRR) strategies developed in collaboration with local municipalities and /or other sub national authorities**
9e26	*Sub indicators include hospitals schools (% of facilities damaged), homes (% of houses damaged), roads (% of km of roads damaged), protected areas (% of area damaged), agricultural land (% of hectares of agriculture damaged), cultural and recreation sites (% of area damaged) after extreme weather events.*
9e30	**Number of countries providing climate services that are tailored, accessible, and actionable for local decision-makers to inform urban policy, planning, and adaptation responses.**
9e32	**Percentage of newly constructed infrastructure adhering to climateresilient, cobenefitoriented design codes. E.g. % of new builds using design standards that address compound and cascading risks while delivering cobenefits (e.g., green cooling corridors).**
9e36	*% of population in formal and informal settlements with access to water infrastructure meeting recognised climate resilience standards*
9e46	**Number of settlements with locally led and co-designed informal settlement upgrading programmes that include climate change adaptation. (Based on indicator suggested by Pakistan).**
9e47	**% of local adaptation plans for IHS co-designed with vulnerable community groups and inclusive of traditional and indigenous knowledge**

9e78	**% of national adaptation finance that is directly allocated to, or implemented through, local governments or grassroots actors for adaptation action**
9e81	*Sub indicator would include the information disaggregated by Greenland Ice Sheet, West Antarctic Ice Sheet, Arctic Sea Ice, Atlantic Meridional Overturning Circulation (AMOC), Amazon Rainforest, Boreal Forests, Permafrost, Tropical Coral Reefs, East Antarctic Ice Sheet, Monsoon Systems).*
9e97	**Number and functionality of regional and international multi-stakeholder adaptation cooperation platforms that facilitate joint planning, knowledge exchange, and implementation of adaptation actions for human settlements and infrastructure. (Based on Straatsma el al, 2020)**
9e99	*Degree of inclusion (e.g., participation of local governments, civil society, and marginalised communities) within each IHS relevant cooperation platform*

9 (f) Poverty eradication and livelihoods

9f03	SDG 1.4.1 Proportion of population living in households with access to basic services
9f10	Share of persons/communities where livelihoods transitioned into adaptation-aligned livelihoods
9f11	Percentage of population with sustained climate-resilient alternative livelihoods

9 (g) Cultural heritage and knowledge

9g02	% of climate-sensitive cultural practices adapted with climate-resilient processes
9g07	Proportion of traditional ecological knowledge (TEK) initiatives operationalized for ecosystem-based adaptation supporting heritage sites
9g09	% of cultural landscapes with ecosystem-based adaptation (EbA) interventions implemented
9g12	Im*plem*entation of initiatives to build infrastructure decision makers' competence and capacity to receive, comprehend, and value insights from Indigenous Peoples (IPs) and local communities (LCs) in the development of infrastructure, both at the individual and institutional levels.
9g21	Number of policies or regulations updated to include cultural heritage in climate adaptation plans.
9g22	Existence of dedicated budget lines for heritage climate adaptation in national/local budgets.
9g23	Percentage of adaptive strategy projects with regular evaluation and reporting mechanisms.
9g30	Percentage of adaptation measures that value and use traditional knowledge, ways and livelihoods of culturally diverse population
9g31	Percentage of application of local, indigenous and traditional knowledge in DRR
9g37	SDG 11.4.1 Total per capita expenditure on the preservation, protection and conservation of all cultural and natural heritage, by source of funding (public, private), type of heritage (cultural, natural) and level of government (Indicator '1. Expenditure on heritage' of the *UNESCO Culture|2030 Indicators* framework)
9g38	Existence of measures to foster climate change mitigation and adaptation and enhance resilience through sustainable safeguarding and management of tangible and intangible cultural heritage as well as natural heritage. (Indicator '3. Climate adaptation & resilience' of the *UNESCO Culture|2030 Indicators* framework)

9g41	Extent to which government policies and regulations to support culture's contribution to promote better safeguarding of cultural and natural heritage and livelihoods . (Indicator '12.Governance of Culture' of the *UNESCO Culture|2030 Indicators* framework)
9g43	Assess the mainstreaming of cultural knowledge to inform and enhance sustainable development practice (Indicator '14.Cultural Knowledge' of the *UNESCO Culture|2030 Indicators* framework).
9g44	Degree of inter-cultural understanding and acceptance of people from other cultures to participate together in socio-economic activities (Indicator '18.Culture for Social Cohesion' of the *UNESCO Culture|2030 Indicators* framework)
9g51	Existence of interministerial/intersectoral coordination mechanisms on adaptation that includes Cultural Heritage.
9g57	Total per capita expenditure [provide or received] on the implementation of climate adaptation strategies for preservation, protection and conservation of all cultural heritage, disaggregated by channel (bilateral, multilateral, regional); financial instrument (grant, concessional loan, non-concessional loan, equity, guarantee, insurance, other) and level of government
9g59	Share of cultural heritage professionals [involved in the implementation of adaptation strategies] and community leaders trained in conducting a climate risk assessment and implementation of climate adaptation techniques tailored to their needs, disagregated by training workshops and programmes; educational programming; knowledge exchange; public outreach and awareness.
10 a. Impact, vulnerability, risk assessment	
10a01	**[HEADLINE INDICATOR 1] Number of Parties that have conducted up-to-date assessments of climate hazards, climate change impacts and exposure to risks and vulnerabilities**
10a01a	*Number of Parties that have accessible, understandable, usable and relevant climate risk information and comprehensive risk assessment available to the people at the national and local levels*
10a01b	*Number of Parties having national tracking systems for observed climate-related hazardous events and impacts*
10a01c	*Number of Parties with risk profiles including climate hazards, climate change impacts and exposure to risks and vulnerabilities that consider different temperature scenarios*
10a01d	*Number of Parties with traditional knowledge, Indigenous Peoples' knowledge and local knowledge systems integrated into their risk information systems*
10a02	**[HEADLINE INDICATOR 2] Number of Parties that have used the outcomes of these assessments to inform their formulation of national adaptation plans, policy instruments, and planning processes and/or strategies**
10 (b) Planning	
	[TARGET LANGUAGE] By 2030 all Parties have in place national adaptation plans, policy instruments, and planning processes and/or strategies
10b01	**Number of Parties with an officially adopted National Adaptation Plan (NAP) or equivalent policy instrument**
10b01a	*Number of Parties that have established national adaptation goals or targets*
10b01b	*Number of Parties that have adopted national legislation or other legislative frameworks on adapation*

10b01e	*Number of Parties with institutionalized processes for adaptation-related capacity development for (or: in the context of) NAP formulation, including training programs or technical support platforms for government officials and stakeholders*
10b03	**Level of integration of climate change adaptation at national and subnational levels in strategies and plans of key sectors**
10b04	**Proportion of countries integrating climate change adaptation into national (and sectoral) development plans**
10b05	**Number of (or proportion of) sectoral and local authorities that have integrated adaptation into relevant processes**
10b07	**Number of national and sector-wide policies, legal frameworks, plans and processes developed and strengthened to identify, prioritise and integrate adaptation strategies and measures**
10b08	**Number of Parties with formal institutional mechanisms (e.g., inter-ministerial committees) for cross-sectoral coordination of adaptation**
10b10	**Number of Parties that have systems in place for considering climate risks in public procurement**
10b11	**Number of Parties where national budgets reflect adaptation allocations across sectors and ministries**
10b12	**Proportion of government budget allocated to climate adaptation and resilience**
10b13	**Health component of National Adaptation Plan developed**
10 (c) Implementation	
10c12	**Share of public climate finance (international and domestic) allocated to adaptation that is dedicated to capacity building, including communication, training, education and awareness-raising actions on climate change risks and adaptation measures**
10c13	**Share of international public finance provided or received for climate adaptation capacity-building, by channel (bilateral, multilateral, regional); financial instrument (grant, concessional loan, non-concessional loan, equity, guarantee, insurance, other); and by targets.**
10c15	**Percentage of the target population with skills improved by capacity building interventions that have implemented adaptation actions, by sex; age; people with disabilities; migrants and displaced people; Indigenous Peoples; and profession across the GGA targets.**
	Indicator group: Technology Development and Transfer
10c16	**Number of programmes and initiatives on development, transfer and implementation of adaptation and climate-resilient technologies, by origin/source and destination (from developed to developing countries; and from global south to global south transfer]; by theme/ GGA targets.)**
10c18	**Amount of international public finance invested in climate adaptation technology development and transfer (including technologies identified in Technology Needs Assessments). Disaggregated by channel (bilateral, multilateral, regional); financial instrument (grant, concessional loan, non-concessional loan, equity, guarantee, insurance, other); recipient of the finance [for technology development] and recipient of the technology; and by targets.**

10c19	**Total official international support (ODA plus other official flows) for the transfer and exchange of adaptation-related technology (by region, by target)**
10c20	**Proportion of countries that have conducted and updated technology needs assessments to support the achievement of the UAE Framework for Global Climate Resilience**
10c21	**Direct economic losses (property, assets, infrastructure, agricultural production and revenue) as a result of climate hazards, as a proportion of GDP**
10c22d	*Proportion of population who decreased food intake as a result of climate change, by sex and household composition (single/double adult, with/without children)*
10c22e	*Proportion of land or livestock users who noted drops in yield as a result of climate change, by sex and whether this was their main source of income*
10c22h	*Proportion of population whose time spent on production of environmental goods increased as a result of climate change, by sex and type of good (fetching water, fuels, waste management, fishing, aquaculture, livestock raising, food processing, mining, collecting plants or other forest products,hunting, farming)*
10c23	**Percent of agricultural population covered by climate risk insurance mechanisms**
10c26	**Share of urban spaces occupied by green spaces, by type (parks/gardens, agriculture, primary/wild forests)**
10c27	**Share of of river basins covered by management plans, by (a) whether plans are in place and (b) whether implementation is on track according to annual targets**

10c28	**Percentage of buildings built or retrofitted to be climate-resilient, by type (temperature, water, waste)**

10 (d) Monitoring, Evaluation and Learning

	[TARGET LANGUAGE] By 2030 all Parties have designed, established and operationalized a system for monitoring, evaluation and learning for their national adaptation efforts
10d01	**Number of Parties that have designed a system for monitoring, evaluation and learning for their national adaptation efforts**
10d01a	*A clear mandate or legislative requirement for MEL of the national adaptation efforts exists*
10d01b	*Non-state actors and vulnerable groups have been adequtely engaged in the design (and operation) of the MEL system*
10d02	**Number of Parties that have established a system for monitoring, evaluation and learning for their national adaptation efforts**
10d02a	*Adequate institutional arrangements for the national adaptation MEL system have been established*
10d02b	*The MEL system covers adaptation of at-risk sectors as identified in the assessments described under para 10a*
10d03	Adaptation has been integrated into M&E systems of relevant development or sectoral plans
10d04	Number of Parties that have operationalised a system for monitoring, evaluation and learning for their national adaptation efforts
10d04a	**NAP implementation is monitored regarding achievements of the defined NAP goals or targets**
10d04b	*Number of countries that publish an adequately detailed report about the implementation progress of their national adaptation efforts*
10d04c	*Number of countries where MEL findings have informed policy revision or adaptation planning*
10d04d	*Adequate resources and budgetary allocation to operate and sustain the MEL system*
10d04e	*Methodologies, tools and sources of verification used in the operation of the MEL system are publically accessible*
	[TARGET LANGUAGE] By 2030 all Parties have built the required institutional capacity to fully implement the system;
10d05	**Number of Parties that have built the required institutional capacity to fully implement the national adaptation MEL system**
10d05a	*Systems and processes for building and maintaining capacity for national adaptation MEL system are in place*
10d05b	*Institutional capacity to operate and sustain the MEL system has been built and funding to sustain the MEL system is available*
10d05c	*Inclusion of vulnerable and Indigenous and Local People in capacity building for the MEL system of national adaptation efforts*

ENDNOTES

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