



SCALING AND ACCELERATING ADAPTATION IN FOOD SYSTEMS IN AFRICA

An Assessment of Nationally Determined Contributions and National Adaptation Plans

WWF Food Practice

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Authors:

Haseeb Bakhtary (Climate Focus),
Allison Tucker (Climate Focus),
Martina Fleckenstein (WWF International Food Practice)

Special thanks for reviewing the report:

Brent Loken (WWF International Food Practice)
Shirley Matheson (WWF EPO)
Ravic Nijbroek, (WWF Germany)
Franziska Haupt (Climate Focus)
Melaina Dyck (Climate Focus)
Imogen Long (Climate Focus)
Ivan Palmegiani (Climate Focus)
Alice Estelle Nkongo Nchare (WWF Cameroon)
Nancy Rapando (WWF Kenya)

Contact:

Martina Fleckenstein (WWF International Food Practice) mfleckenstein@wwfint.org

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Design:

Silke Roßbach (mail@silke-rossbach.de)

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WWF, 28 rue Mauverney, 1196 Gland, Switzerland.

Tel. +41 22 364 9111

CH-550.0.128.920-7

For contact details and further information, please visit our international website at

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1. EXECUTIVE SUMMARY

ADAPTATION IN FOOD SYSTEMS IN AFRICA

While climate change is affecting food systems globally, the consequences are most alarming for food systems in Africa.

Food systems in these countries are already experiencing impacts such as changes in growing seasons, and the frequency and intensity of dry spells and heavy rainfalls. Countries in Africa have historically faced socio-economic challenges that include high rates of poverty and food insecurity to increasing water scarcity, ecosystem loss, and desertification, stemming from the legacies of colonialism. These factors have impeded economic growth and the creation of jobs to meet the needs of a growing population, as millions of smallholder farmers are affected by changes in climate conditions.

African nations need to adapt their food systems to the changing climate to ensure accessible and affordable healthy food for all people. Effective holistic measures across food systems can help build resilience while providing mitigation benefits, putting the continent on a sustainable development pathway. Most African countries recognize the urgency of, and potential in, building adaptive food systems, as evidenced by their climate pledges, but rich countries must ramp up international climate finance and support to these countries to achieve these pledges.

The Nationally Determined Contributions (NDCs) under the Paris Agreement and National Adaptation Plans (NAPs) under the UN Framework Convention on Climate Change (UNFCCC) provide a platform to bring all policy priorities together and implement food systems adaptation measures in a holistic manner. As of June 2022, 53 out of 54 African¹ countries had submitted an NDC, and 12 had submitted a NAP.²

WWF's #NDCsWeWant Checklist aims to shine a spotlight on all kinds of progress, encourage best practices, identify key challenges, with the goal of increasing the overall ambition of the NDC process and their implementation. Climate change adaptation in food systems is considered as an important part of contributions of NDCs and NAPs to furthering the Paris Agreement goals, alongside linkages to the Sustainable Development Goals (SDGs). To complement the work on the #NDCsWeWant, this report focuses the integration of adaptation measures for food systems transformation in the NDCs and NAPs in Africa to identify opportunities for enhancing actions and accelerating progress in the continent.

¹ Libya has not submitted an NDC or a NAP

² The 12 countries that submitted a NAP are Burkina Faso, Cameroon, Central African Republic, Chad, Democratic Republic of Congo, Kenya, Madagascar, Sierra Leone, South Africa, South Sudan, Sudan, and Togo.



SUMMARY FINDINGS

Overall, comprehensive measures for food systems adaptation have been integrated in the NDCs and NAPs. However, there are generally more actions planned for adaptation in food production than for building adaptive capacities in other parts of food systems.



ADAPTATION MEASURES IN FOOD PRODUCTION SYSTEMS

57% of NDCs and seven NAPs include soil conservation measures for food systems adaptation.

58% of NDCs and 11 NAPs have crop diversification measures as part of the adaptation plans.

75% of NDCs and all 12 NAPs have included building irrigation systems to improve resilience of food systems.

58% of NDCs and nine NAPs have measures for sustainable and resilient livestock practices including for breeding and feed for livestock.

68% of NDCs and all 12 NAPs include Climate-smart agriculture measures for food systems adaptation.

68% of NDCs and all 12 NAPs plan forest-related measures including reforestation, afforestation, and sustainable forest management.

62% of NDCs explicitly plan for agroforestry and **21% of NDCs** plan for agroecology. Nine NAPs include agroforestry measures and three countries (Togo, Madagascar, and the Democratic Republic of the Congo) include agroecology in NAPs.

30% of NDCs and 10 NAPs include plans to advance and promote sustainable aquaculture and fishing practices in freshwater. 17% of NDCs and Chad's NAP plans for freshwater restoration measures.

51% of the NDCs and six of the eight NAPs with coastal ecosystems include plans to develop marine aquaculture, including seagrass, algae, shellfish and farming.

In general, **46% of NDCs and six NAPs** plan for marine restoration. Specifically, 46% of NDCs and four NAPs include plans to protect and conserve mangroves as part of these efforts.

25% of NDCs and two NAPs, Madagascar and Kenya, include savannah or grassland measures.



ADAPTATION IN POST-HARVEST COMPONENTS OF FOOD SYSTEMS

36% of African countries consider food processing measures in their NDCs while seven NAPs do.

26% of countries in their NDCs and five countries in their NAPs (South Sudan, Sierra Leone, Chad, Cameroon, and Burkina Faso) include food storage interventions.

32% of NDCs and seven NAPs plan for disease and pest monitoring in food value chains to ensure food safety.

Only four countries – 8% of NDCs, and Kenya in its NAP, include measures to change consumption patterns, through nutrition guidelines, dietary public awareness initiatives, and promoting the consumption of local foods.



EQUITY CONSIDERATIONS IN FOOD SYSTEMS ADAPTATION

79% of NDCs and eight NAPs contain specific quantified finance allocations or needs for adaptation measures.

72% of NDCs and all 12 NAPs include early warning or early action systems as part of food systems adaptation.

43% of NDCs and four countries' NAPs (South Sudan, Kenya, Chad, and Burkina Faso) consider some type of insurance policy for food systems.

55% of NDCs and all 12 NAPs consider livelihoods effects of food systems measures.

While 87% of NDCs mention gender, 58% of the NDCs and all 12 NAPs consider gender explicitly in their adaptation measures.

Only three countries have land tenure measures, and nine countries consider community-based or participatory land management in their NDCs. Madagascar and Burkina Faso include land tenure measures in their NAPs and six countries consider community-based management in their NAP.

40% of NDCs and ten NAPs consider Indigenous Peoples and Local Communities (IPLCs).

53% of NDCs refer to Monitoring, Reporting and Verification (MRV) plans that are in-development or make unclear reference to that the status of its MRV systems. Seven NAPs similarly state Monitoring, Reporting and Verification (MRV) plans that are in-development or unclear with regards to MRV system implementation.



2. RECOMMENDATIONS

The findings from the assessment of NDCs and NAPs of countries in Africa indicate a recognition of the need to build the adaptation capacities of their food systems in the face of a rapidly changing climate. While there are also clear indications of ambitious plans and promising examples of policies and interventions to achieve this, there is still room to raise ambition, increase finance, and accelerate the implementation of these plans.



ENHANCING AMBITION

What can governments do to raise ambition?

- 1. Coordinate sectoral policies to ensure coherent and holistic policies and actions.** Policies must support a just transition to resilient, equitable and inclusive food systems, considering the concerns of women, youth, Indigenous people, local communities, and other marginalized groups. Coordination of national priorities linked to food systems including adaptation and mitigation plans can ensure policy coherence across climate, environment, agriculture, health, and other sectors and create holistic positive impacts. The development of food systems policies must be shaped by people, communities, and their institutions through participatory and inclusive approaches.
- 2. Align NDCs and NAPs.** Measures for food systems in NAPs and NDCs and the costs of implementation are not always aligned because they are developed by different government agencies. Better coordination in policy-making through a designated agency can improve alignment of policies across sectors.
- 3. Value the role of Nature-based Solutions and Ecosystem-based Adaptation in addressing food security and promoting resilient food systems within NDCs and NAPs, especially through agroforestry and agroecology.** Agroecology and agroforestry help to protect, restore and improve agriculture and food systems in the face of climate change. These approaches and practices make use of traditional and local crops and tree species to promote ecosystem diversification, which in turn provides livelihood diversification and poverty alleviation, while also advancing decarbonization.
- 4. Maximize opportunities to reduce food loss.** Design and implement technologies that can safely store crops and support renewable energy for agrifood systems. Storage infrastructure and technologies must withstand climate change impacts, including floods, storms, and extreme heat, have mechanisms for air circulation to prevent rot, and prevent pests from entering.



INCREASING FINANCE

How can governments and investors increase finance to implement adaptation measures in food systems?

- 1. Redesign agri-food subsidies to support transformative food system approaches.** Policymakers can redesign subsidies to encourage crop diversification, agroecology, agroforestry and Climate-smart resilient agriculture to incentivize adoption of these practices.
- 2. Articulate finance and investment needs for specific adaptation measures geared towards food systems transformation.** Quantifying the investment needed will help investors, international funders, and donors get a clear picture of the level of commitment needed.
- 3. Increase climate finance for adaptation in agriculture and food systems.** For countries in Africa to implement adaptation measures in general, and in food systems in particular, they need new and additional climate finance to help farmers to access to the capital, savings, and insurance mechanisms that safeguard against the shock of crop failures, livestock losses, and other climate change risks. Donor countries must increase climate finance flows to adaptation measures. We also need a specific financing window for agriculture and food systems in UNFCCC climate finance mechanisms.
- 4. Increase readiness and capacity building funding.** National and local governments will benefit from technical and financial support in designing and implementing adaptation projects and programs as part of their NDC implementation. However, donors and investors should deliver promptly on funding promises once progress in readiness and capacity is demonstrated.
- 5. Align donor funding priorities with adaptation and food systems policy priorities.** To secure sufficient finance for food systems adaptation in Africa, donors and investors should assess their portfolios and ensure sufficient funding is being made available and allocated for adaptation projects and programs in food systems.
- 6. Invest in research and innovation.** There is appetite and need for innovation in food systems, including for new types of crops and livestock that are resilient and adaptive to climate change. Donors and investors can support governments in developing these and ensuring their equitable distribution to farmers and communities.



SCALING AND ACCELERATING IMPLEMENTATION

How can governments advance implementation of adaptation measures in food systems?

- 1. Engage all relevant food systems stakeholders in implementation.** Equitably engaging all food systems stakeholders up front is critical to tackle asymmetries, structural inequities, and knowledge gaps in climate and food governance processes. In particular, meaningful participation of underrepresented groups including Indigenous people and local communities is key to inclusive policy development and implementation processes.
- 2. Invest in local food systems.** Investing in supporting local management of food systems according to communities' traditional agricultural or pastoral practices and Indigenous innovations, and in building capacities of local communities can further the achievement of adaptation goals.
- 3. 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, and to reduce food waste and loss.
- 4. 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 actually found to be beneficial to communities, they must ensure that it is also affordable and accessible.



3. SETTING THE SCENE

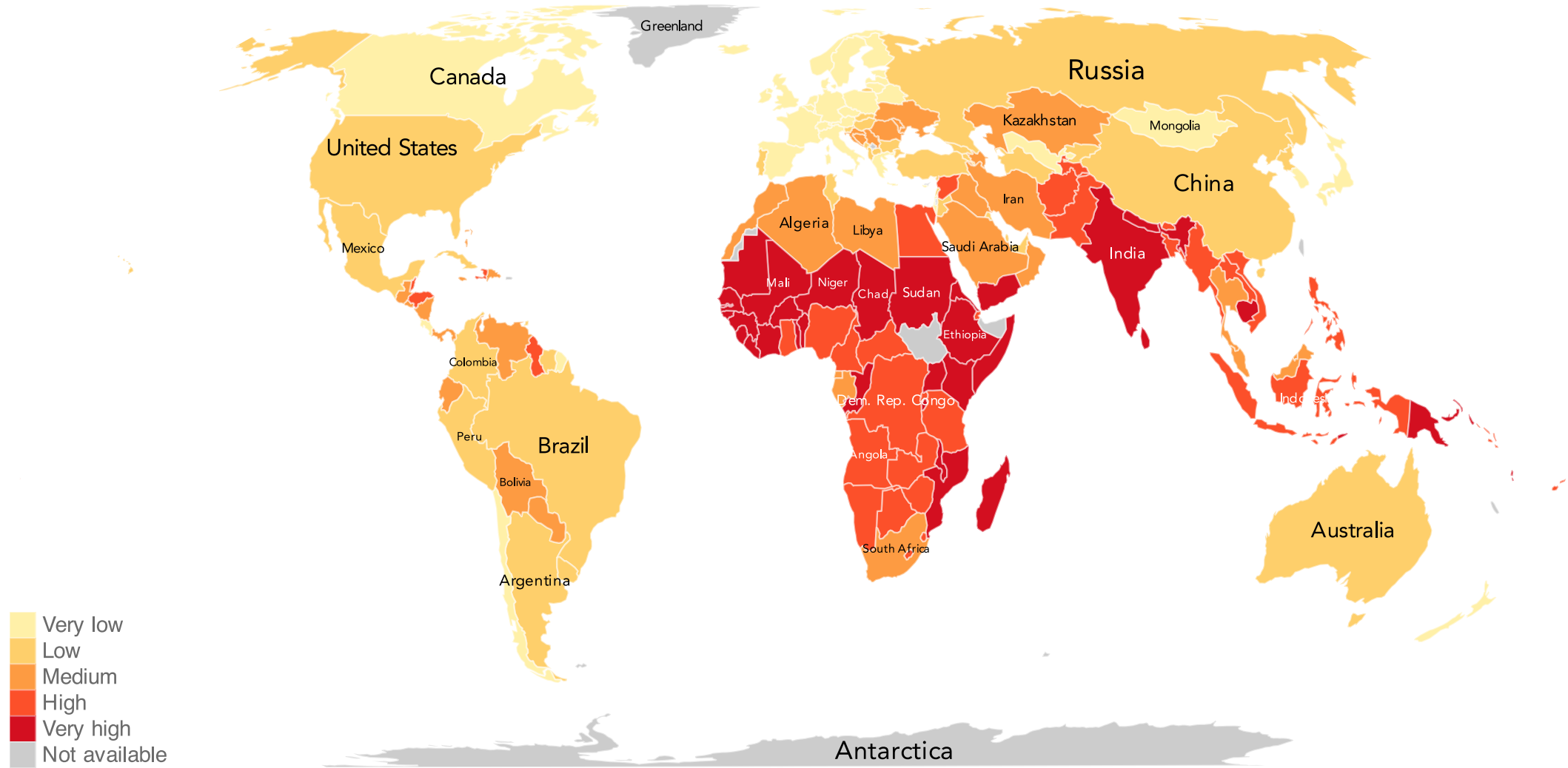
The negative impacts of climate change on food systems – including on food production, water security, health and well-being, and settlements and infrastructure – are already hindering efforts to meet Sustainable Development Goals across continents and countries.

An increasing number of extreme weather and climate events have already exposed millions of people to acute food and water insecurity.

The *IPCC Sixth Assessment Report on Climate Change Impacts, Adaptation and Vulnerability*, published in March 2022, states that if the current rate of global emissions continues, food production in some regions will become impossible, and it will become costlier to prevent food spoilage and maintain quality. These impacts will affect global populations disproportionately, with the largest impacts observed in Africa, Asia, Central and South America, and the Small Island states (see Map below). Losses of food production and access to food, compounded by decreased diet diversity, have increased malnutrition in many communities. Indigenous Peoples, small-scale food producers, and low-income households are particularly impacted.

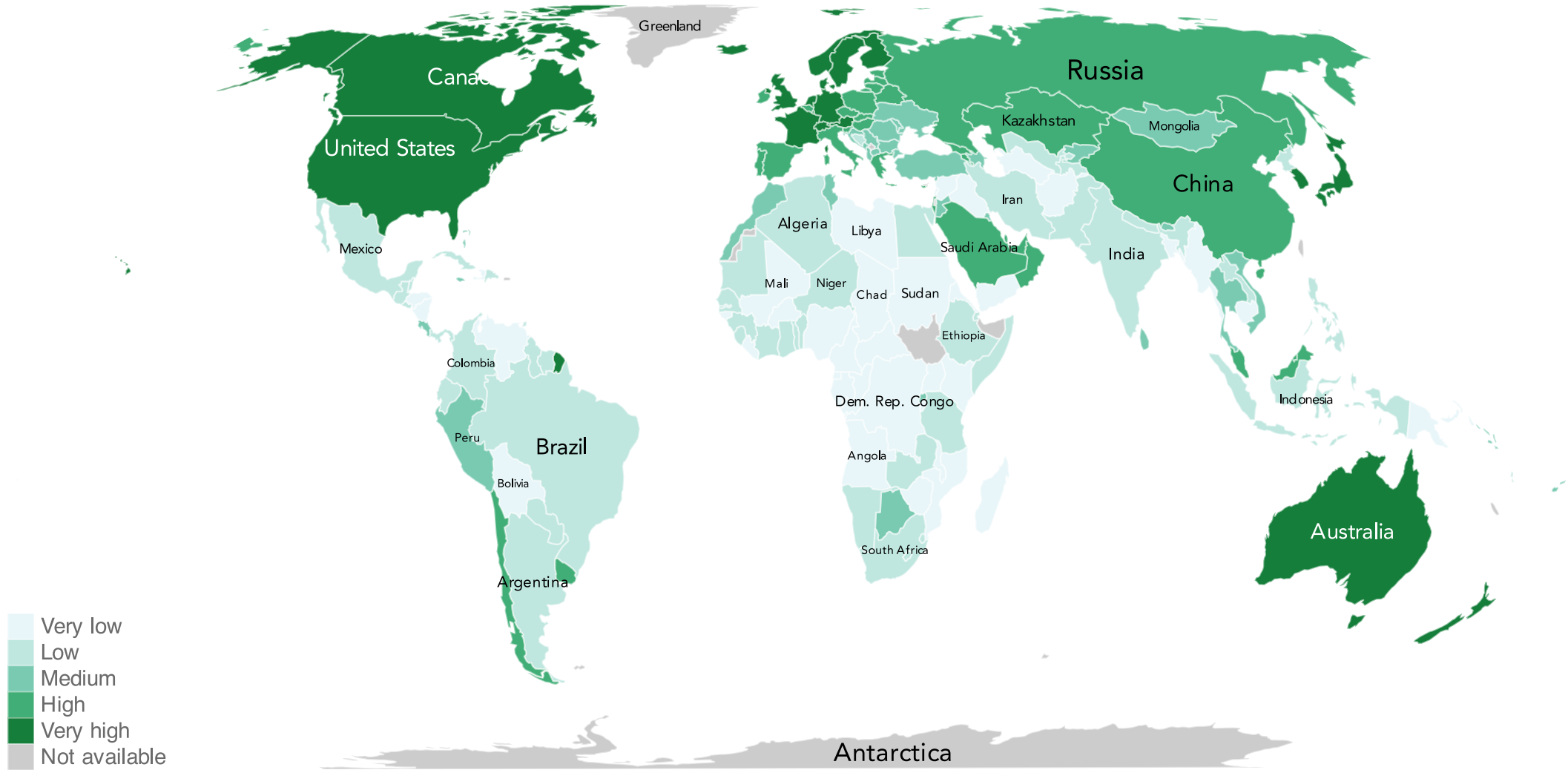


Figure 1A. Food system vulnerability across countries



Source: Food Vulnerability Index. (2020). University of Notre Dame Global Adaptation Index. Food vulnerability is composite considerations of projected change of cereal yields, food import dependency, agriculture capacity (Fertilizer, Irrigation, Pesticide, Tractor use), projected population change, rural population, child malnutrition. See: <https://gain-new.crc.nd.edu/ranking/vulnerability/food>

Figure 1B. Climate change adaptive capacity across countries



Source: Adaptive Capacity Index.(2020). University of Notre Dame Global Adaptation Index. Adaptive capacity scores consider multi-sectoral preparedness in health, food, water, infrastructure, habitat and ecosystem services. See: <https://gain-new.crc.nd.edu/ranking/vulnerability/capacity>

While Africa accounts only for about 2-3% of global greenhouse gas emissions, it suffers disproportionately from climate change impacts.¹ Water stress combined with more frequent droughts and heat events is putting additional pressure on already scarce water resources in many African countries. This has severe implications for sectors that depend heavily on water, such as agriculture and food. These effects are in turn driving the displacement of people within countries and across international borders. High water stress is estimated to affect about 250 million people in Africa and is expected to displace up to 700 million people by 2030.²

The differential impacts of climate change in countries in the Global South including in Africa reflects the historical exploitation of lands and resources that have fuelled the engine of development in countries in the Global North, while impoverishing countries in the Global South. Commercial agricultural systems for food export by multinational companies are increasing throughout Africa – especially cotton, cocoa, coffee, palm oil, and groundnuts – degrading land while threatening local food sovereignty and security.³ Meanwhile, the continent increasingly relies on food imports for domestic consumption at an annual cost of \$43 billion, which could rise to \$110 billion by 2025.⁴

In 2020, one in five people in Africa faced hunger – more than double the proportion of hungry people in any other region.⁵ About 282 million people in Africa are undernourished, with millions in immediate need of food assistance, due to a combination of drought, poverty, high food import prices, environmental degradation, displacement, poor trade integration, and conflict.⁶ Throughout the continent, climate change is reducing crop yields, shortening growing seasons and increasing water stress. In Sub-Saharan Africa, with each drought or flood, food security in the continent drops by 5 to 20%. Climate change also threatens livestock, marine and freshwater aquaculture, and terrestrial crop production across the continent.

Improving and strengthening adaptive capacities of food systems in Africa is essential, as adaptive food systems address more than just hunger. The International Fund for Agricultural Development (IFAD) found that economic growth from agriculture is 11 times more effective at reducing extreme poverty than any other sector.⁷

Actions that increase food system resilience, like agroecology, climate-smart agriculture, sustainable land management techniques, agroforestry, and indigenous and local farming practices have multiple co-benefits for nutrition, health, biodiversity, poverty alleviation, and greenhouse gas (GHG) emissions reductions through increased carbon sequestration.⁸

Food systems adaptation must also consider the distinct aspects of food security (availability, food quality and safety, and affordability,) as well as dietary diversity; malnutrition can arise from monocropping or reliance on commodity crops which have high commercial market value but which reduce dietary diversity. Thus, adaptive policies need to be based on measures that increase Community-based Adaptation and human rights-based adaptation, encourage farm and landscape diversification, and focus on peoples' right to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, as well as their right to define their own food and agriculture systems.

The Paris Agreement recognizes that urgent action is needed to address the impacts of climate change on food systems. Its preamble makes specific reference to food security and ending hunger, as well as to human rights, gender, ecosystems and biodiversity, all issues that are central to agriculture and food systems. With the immediate need for effective adaptation policies to enhance food stability and reduce food insecurity in Africa, backed by the mandate of the Paris Agreement, this paper assesses best practices and opportunities in food systems adaptation measures as planned in the Nationally Determined Contributions (NDCs) and National Adaptation Plans (NAPs) of countries in the continent. The paper outlines key recommendations for enhancing and implementing adaptation measures for food systems in Africa.

Box 1. Climate change adaptation in food systems under the UNFCCC and Paris Agreement

The preamble of the Paris Agreement calls for “safeguarding food security and ending hunger, and the particular vulnerabilities of food production systems to the adverse impacts of climate change.” Similarly, Article 2.1 of the Agreement states, “the Agreement aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by ... increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production...”. Other articles make specific references to human rights, gender, ecosystems, biodiversity, and other areas that intersect with agriculture.

Global Goal for Adaptation:

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. Since COP21, there has been increasing pressure to advance the GGA, culminating in the two-year Glasgow-Sharm el-Sheikh work programme that was established and launched at COP26 in 2021. Through 2022 and 2023, subsidiary bodies to the UNFCCC are hosting workshops

with a wide range of stakeholders, including government representatives, the private sector, UNFCCC constituted bodies, vulnerable groups, civil society, multilateral development banks and international financial institutions, to contribute to a better understanding of successful, scalable and replicable adaptation actions, and to advance adaptation planning and implementation through identifying finance and capacity-building needs.

Koronivia Joint Work on Agriculture:

In 2017 at COP23, Parties adopted the Koronivia Joint Work on Agriculture, which is the only programme under the UNFCCC to focus on agriculture and food security. This decision started mitigation and adaptation capacity-building sessions that frame agriculture as part of the climate change problem and part of the solution, acknowledging adaptation measures can help to strengthen the resilience of those most vulnerable to climate change while ensuring food security. The Koronivia Joint Work on Agriculture will be re-considered at COP27 in November 2022. Progress of the GGA will be assessed as part of the key findings from the Global Stocktake in 2023 at COP28.

Adaptation Communications in NDCs:

Under the Paris Agreement and Katowice decisions, adaptation components of NDCs are considered part of adaptation communications. Under Decision 9/CMA.1 of the Conference of Parties held in Katowice in 2018, the purpose of the adaptation communication is to: (a) Increase the visibility and profile of adaptation and its balance with mitigation; (b) Strengthen adaptation action and support for developing countries; (c) Provide input to the global stocktake; (d) Enhance learning and understanding of adaptation needs and actions.



4. METHODOLOGY AND APPROACH

This paper reviews the most up to date NDCs and NAPs from all countries in Africa. This paper focuses solely on adaptation measures within NDCs.

As of June 2022, 53 countries had submitted an NDC, and 12 countries submitted a NAP to the UNFCCC.³ The 12 countries that submitted an NAP are Burkina Faso, Cameroon, Central African Republic, Chad, Democratic Republic of Congo, Kenya, Madagascar, Sierra Leone, South Africa, South Sudan, Sudan, and Togo. Simultaneously, similar research was implemented to compare how food systems are integrated in previous and updated NDCs of all Parties to the Paris Agreement, reviewing 134 Parties who have submitted at least two NDCs.

The review and analysis involved three steps:

- 1. The assessment framework was developed** through a literature review which consolidated the best practices in food system adaptation measures globally. Two of the Intergovernmental Panel on Climate Change (IPCC)'s reports – “Climate Change and Land” a Special Report on climate change, desertification, land degradation, sustainable land management, and food security (2019), and the IPCC WGII Sixth Assessment Report, “Climate Change 2022: Impacts, Adaptation and Vulnerability” – served as meta-analyses, compiling and assessing quantitative and qualitative studies at the local, regional, national, and international level to determine appropriate food system adaptation measures. The literature review was used to create a framework to assess countries' NDCs and NAPs. This framework was piloted by applying it to assess three countries' NDCs and NAPs and then it was refined. The framework included 45 categories of measures relevant for food systems adaptation as identified in the literature.⁴ A simplified framework table is included in the Annex. These measures were grouped under four themes reflecting the food value chain: pre-production and production, post-harvest (e.g., storage, transport, and distribution), and consumption, and cross-cutting issues (including governance and financial enablers, gender and IPLC equity considerations, just transition, and food security considerations).

³ Libya was excluded from the sample as it has not submitted an NDC or a NAP.

⁴ See Annex 1 for detailed framework.



- 2. A qualitative assessment of adaptation measures in NDCs and NAPs was implemented** using the above framework to assess if, and to what extent, food system measures are considered in the 53 NDCs and 12 NAPs within the scope of this review. After completing qualitative text-based data collection and analysis, reviewers analyzed trends across countries.
- 3. Trends and gaps were identified** using the predefined food systems adaptation measures from literature included in the framework to analyse how adaptation in food systems are considered in NDCs and NAPs.



5. FINDINGS

This paper identifies positive trends and areas for improvement in integration of measures relevant for food systems adaptation in the NDCs and NAPs. “Positive trends” highlight areas where many countries have included relevant measures in their NDCs and NAPs and “areas for improvement” highlight areas where fewer countries have included relevant measures in their NDCs and NAPs.

5.1 Adaptation in food production systems

5.1.1 Positive trends

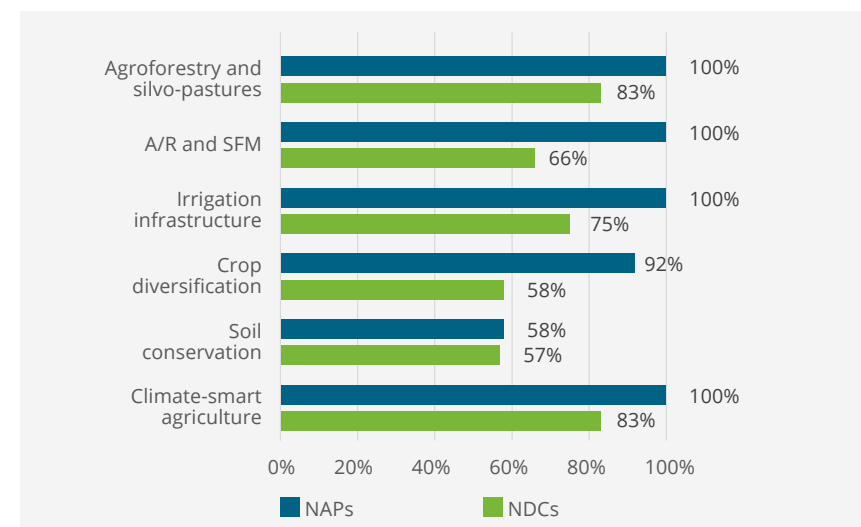
The majority of NDCs and all NAPs include at least three ecosystem-based adaptation measures (see Figure 2).

As defined by the UN’s Food and Agricultural Organization (FAO), ecosystem-based adaptation measures in food systems protect and enhance agro-ecosystems and biodiversity for food and agriculture, increase agricultural productivity and the resilience of agricultural livelihoods, and increase food security.⁹ These measures also help to reduce and sequester greenhouse gas emissions, reduce social and environmental vulnerabilities, generate societal benefits, restore, maintain, or improve ecosystem health, and are supported by policies at multiple levels while furthering equitable governance.¹⁰ Notably, ecosystem-based adaptation measures align with the priorities found in the UNFCCC synthesis analysis of the 62 Parties that submitted Long Term Low-Emission Development Strategies. 75% of Parties prioritise terrestrial and wetland ecosystems, and 74% of Parties prioritise food security and production (which includes agriculture, livestock and fisheries) as the highest priorities for adaptation in their Long Term Low-Emission Development Strategies to the UNFCCC. Out of the countries included in this paper, Benin, Gambia, Nigeria, and South Africa have submitted Long Term Low-Emission Development Strategies.¹¹

57% of NDCs include soil conservation measures. Six of the 12 NAPs also include soil conservation.

Soil conservation measures can protect natural resources and watersheds, restore habitats for plants and wildlife, improve water quality, and make soil healthier, contributing to increased water and nutrient use efficiency and to improved and sustained crop production.¹²

Figure 2. Inclusion of key ecosystem-based adaptation measures in the assessed NDCs and NAPs. Total: 53 NDCs and 12 NAPs.



Conservation measures include precise farming techniques such as anti-erosion measures like contour farming and terracing, water run-off regulation, integrated soil fertility techniques that include composting through crop-livestock integration, and agroforestry or agro-pastoral systems. **Burkina Faso** states in its NDC, that it plans to implement integrated soil management for agricultural productivity and environmental restoration and **Congo** reports in its NDC its plans to implement soil stabilization measures. Other countries like **Rwanda** state in its NDC plans to develop and implement cross-cutting agricultural adaptation measures like agroforestry and sustainable agriculture techniques specifically with the aim of improving soil fertility. **Togo** in its NAP states plans to implement integrated

soil fertility management techniques to combat land degradation, as the country projects increased leaching of soils (already observed in some regions) and increased soil erosion in hilly areas, due to increased rainfall intensity projections.

58% of NDCs and 11 of NAPs have crop diversification measures as part of adaptation plans.

Crop diversification – or moving from monocropping towards increased crop diversity – is an adaptive measure that can regulate and improve ecosystem services like soil fertility and health, pollination, water conservation, and nutrient cycling.¹³ Intentional crop diversification increases food supply and resilience as the risk of loss is mitigated in the event of extreme weather, pests, or disease, and increases livelihood diversification as farmers are not reliant on one cash crop whose price may be volatile in the globalized market.

While the level of detail within such measures varies across NDCs and NAPs, several countries outline clear measures for crop diversification. For example, **Egypt** states in its 2022 NDC that it aims to preserve and expand the biodiversity (genetics, species, or ecosystems) of strategic crops and livestock varieties and introduce new traits (i.e., heat and salinity tolerant, water conserving, pests) to maximize production efficiency under the expected extreme climatic conditions in the most vulnerable ecosystems. **Malawi**, in its 2021 NDC, plans to promote legumes and other multiple impact crops that contribute to soil fertility and dietary improvement. **Madagascar**, in its NAP, states plans to adopt new species and varieties, and to modify cropping calendars as necessary specifically stating the food security and system resilience benefits that crop diversification brings.

75% of NDCs and all 12 NAPs have included building irrigation systems to improve resilience of food systems.

Sustainable food systems depend on resilient irrigation and water management systems. In Africa, food production depends predominantly on rain-fed agriculture, which is practised by millions of smallholders who are increasingly under pressure from irregular rainfalls and droughts.¹⁴ Building sustainable irrigation systems could mitigate these risks and increase food security. Based on the Global Center on Adaptation's findings in their 2021 report, Eritrea, Eswatini, Lesotho,

Zambia, and Zimbabwe are highly vulnerable to short-term climate hazards and long-term water resource depletion in both the 1.5°C and the 3°C scenarios because their storage and recharge rates are below the African average.¹⁵

Based on the analysis for this report, all these countries except Zambia have irrigation measures in their NDCs. However, irrigation measures are necessary for countries even where water availability is threatened, because such measures can generally help increase yields and can have other benefits, like soil conservation and fertility. **Mali**'s NDC includes plans to convert surface and sprinkler irrigation to localized irrigation on large areas for agriculture and market gardening, while **Egypt** includes aims to scale up solar pumping for irrigation needs in its NDC. **Cabo Verde**, in its 2021 NDC, states several different plans to address irrigation needs. First, it plans to increase water storage capacity per capita through building small dams, terraces, tanks, and reservoirs. With this water storage capacity, it plans to build efficient micro-irrigation and smart hydroponic systems, with the goal of increasing land-based drip irrigation and using treated wastewater for irrigation when possible. **Cabo Verde** also plans to implement agriculture measures like slowing down the runoff through nature-based solutions (NbS) like increased soil cover and silt stabilization to reduce water losses before increasing water use. **Cameroon** in its NAP, states plans to promote irrigation and collaborative water management, especially in lowlands and watersheds, as well as water conservation techniques to extend agricultural seasons.

58% of NDCs and nine NAPs have measures for sustainable and resilient livestock practices including for breeding and feed for livestock.

Livestock are an integral part of social, cultural, and economic life in Africa. They are critical for rural incomes, nutrition and food security, and for mixed crop/livestock production systems.¹⁶ Climate change threatens livestock production throughout the continent with decreased rainfall, and the projected increased prevalence of vector-borne livestock diseases and severe heat stress that would impede livestock wellbeing.¹⁷ Adaptation measures to build resilience include crossbreeding cattle to enhance heat stress tolerance, switching from cattle to more heat-resilient species such as goats or camels, improving cattle nutrition with feed additives, setting up low-cost shading, fanning and bathing devices where applicable, and relocating the animals to more climatically suitable regions.¹⁸

Many countries have recognized the need to implement adaptation measures for food security through building climate resilient livestock production systems. 21% of African countries are considering livestock research for more drought-resistant or heat-resistant animal species in their NDCs. 58% of NDCs and nine NAPs include livestock breeding measures that consider feed availability and supply to build resilience against climate change impacts on feed production. 28% of NDCs also explicitly considered livestock welfare and management measures, which include clinics, veterinarian resources, or livestock governance initiatives.

In its NDC, **Ethiopia** describes several livestock adaptation measures including research into drought-resistant animal breeds, breeding practices, and livestock governance. Ethiopia specifically plans to diversify its livestock mix, including with poultry and small ruminants, and to improve rangeland and pasture-land management. In its 2022 NAP, **Madagascar** includes aims to prioritize and increase adaptive capacity within its livestock sector by prioritizing local breeds that are adapted to harsher climatic conditions and resistant to disease, in all types of livestock including cattle, pigs, sheep, goats, and poultry. **South Sudan's** NDC includes plans to conduct rangeland mapping to control livestock overgrazing and land degradation. After the mapping, it aims to replace status quo techniques with the adoption of modern grazing techniques, including rotational grazing, common grazing, and zero grazing after re-seeding with new high-quality grass seeds. This measure is complementary to the other livestock plans **South Sudan's** 2021 NDC, like improving the management of resources for haymaking and formulating pastoral development policies.

68% of NDCs and all 12 NAPs include Climate-smart agriculture as part of their adaptation plans.

The overall objective of Climate-smart agriculture is to sustainably increase agricultural productivity and incomes while adapting and building resilience to climate change and reducing and/or sequestering greenhouse gas emissions.¹⁹ Climate-smart agriculture can include many different practices like access to climate information, agroforestry systems, drip irrigation or other precision irrigation methods, and erosion control techniques. For example, agroforestry

systems in which trees are planted or retained and cultivated in farmland along with crops and livestock support the production of a wide variety of foods, which increases food and nutrition security.²⁰

Côte d'Ivoire aims to support Climate-smart agropastoral and fisheries systems that protect natural resources and to support men, women, and youth differently in the implementation of climate resilient agro-pastoral and fish systems described in its NDC. As part of its NDC, **Guinea-Bissau** plans to implement Climate-smart agricultural techniques, specifically with the goal of increasing soil fertility and water conservation by expanding rain-water harvesting using the Zaï technique, which involves creating cavities (20-40 cm in diameter and 10-15 cm in depth) to accumulate water before planting with or without organic fertilizer in the cavities. This is a traditional form of farming, blending traditional knowledge with modern climate change adaptation measures. **Madagascar** states in its NDC its development of pilot initiatives to implement Integrated Models of Resilient Agriculture, which fall under Climate-Smart techniques. These pilot initiatives include watershed management, use of adapted varieties, fertilization by locally produced compost, conservation agriculture and agro-forestry, improved and rainfed rice cultivation systems, and rainfed rice cultivation. Then **Madagascar** aims to implement large-scale application of Integrated Models of Resilient Agriculture, specifically targeting major cash crop areas, extensive livestock areas, priority fisheries, mangroves, and areas sensitive to drought. **Kenya**, in its NAP, states the promotion of sustainable Climate-smart agriculture methods are key to making the agricultural sector more resilient to the impacts of climate change and mentions the national *Kenya Climate Smart Programme (2015-2030)*.

62% of all NDCs explicitly plan for agroforestry and 21% of NDCs plan for agroecology – two inter-connected ecological land-use management approaches that can increase food security and climate resilience. Nine NAPs include agroforestry measures and three countries (Togo, Madagascar, and the Democratic Republic of the Congo) include agroecology in NAPs.

Agroecology is a holistic, bottom-up approach for sustainable agriculture practice and land management that wed ecological concepts with Indigenous knowledge and agricultural, socio-economic food system aspects.²¹ If implemented, agroecology can address food insecurity, alleviate poverty and inequality, and prevent biodiversity loss while building climate change resiliency.²² Agroforestry that combines trees with agricultural crops and/or livestock is an inter-connected approach that increases social, economic and environmental benefits, from increased soil conservation to crop and livelihood diversification.²³ Both agroforestry and agroecology are types of Ecosystem-based adaptation (EbA), which, if 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 according to recent research from the United Nations Environment Programme.²⁴

Burkina Faso includes in its NDC, plans for its recovery and rehabilitation of 225,000 ha of degraded land for agro-sylvo-pastoral purposes. **Guinea** states in its updated NDC support for the adaptation efforts of rural communities to develop agro-silvicultural techniques, including diversification and deployment of low-input farming techniques and agro-ecological fish farming. **South Sudan** reports in its NAP measures to promote agroforestry for diversifying land production systems, specifically using multi-use forest species, which create alternative livelihood options for local communities. **Madagascar** in its NAP states there is a diversity of agroecological practices in place that will be supported and developed more widely: sowing on permanent plant cover, improved rice cultivation, agriculture-livestock integration, among others. Madagascar also states plans to develop and implement training programmes for the professionalization of rural youth on agroecology in its NAP.

68% of NDCs and all 12 NAPs plan forest-related measures including reforestation, afforestation, and sustainable forest management.

Forests support food security by providing food rich in nutrients, ecosystem services for food production, and incomes from the production and sale of forest products., Mushroom cultivation and foraging of wild foods, including baobab, shea and nere from plants and animals, are all part of forest ecosystems that

contribute to diets and nutritional diversity in arid and semi-arid regions of Africa.²⁵ Forests and trees also improve food system resilience because trees are more likely to survive extreme weather events than annual crops, which can make them more reliable food sources in the face of increased regularity of extreme weather events due to climate change.²⁶

The Central African Republic states in its NDC plans to restore and maintain 1,000,000 ha, including degraded forest landscapes in mining areas by 2030. **Rwanda** similarly in its NDC states plans to promote afforestation and reforestation of designated areas, improving the forest management for degraded forest areas. **Madagascar**, in its 2022 NAP, reports its plans to plant of 150,000 ha/year, restoring 4 million ha by 2030 while conserving natural forests and improving protected area management. The Malagasy SNGF (Silo National des Graines Forestières) will implement research, distribution, collection, storage, sale, and supply of forest seeds.



5.1.2 Areas for Improvement

25% of NDCs, as well as Madagascar and Central African Republic in their respective NAPs, include savannah or grassland measures.

Terrestrial ecosystems are not just forests and agricultural lands. According to FAO, improved grassland management can increase productivity and food security, reduce the impacts of drought and increase water retention, all of which are critical for food system adaptation.²⁷ Grasslands sequester carbon, with the large majority stored below ground as roots and as soil organic carbon, while simultaneously reducing soil erosion, dust storms and desertification.²⁸ Soil organic carbon be rebuilt in grasslands through restoration actions, including temporary grazing exclusion, reduced livestock grazing, rotational grazing, and changed cropping patterns.²⁹ Thus, incorporating grassland measures can help countries reach their other food system adaptation goals while also advancing mitigation efforts. **Namibia**, in its NDC, states its plans to restore 15.5 million ha of grassland savanna, which has adaptation benefits as well as soil carbon sequestration mitigation benefits. Relatedly, **Madagascar** in its NAP states its goals to develop grassland conservation strategies and have overall better management of its grasslands. On a note that differs from the grassland restoration and conservation, the **Central African Republic**, in its NAP, shares its plans to support the development of agricultural value chains in the savannahs. This measure shows recognition of the increased productivity that improved grassland management can have, compared to simply seeing grassland as grazing land.



30% of African NDCs and ten NAPs include plans to advance and promote sustainable aquaculture and fishing practices in freshwater.³⁰

Fisheries are the main source of protein for ~30% of the population on the African continent.³¹ As the 2021 IPCC report finds, there is a spatial confluence of freshwater fisheries and areas of low food security, which highlights the critical role freshwater aquaculture from rivers and lakes can have in supporting nutritious, low-cost, and local food supply.³² However, climate change through variable temperatures and rainfall is contributing to the decline in fish productivity and fish catches in several freshwater bodies.³³

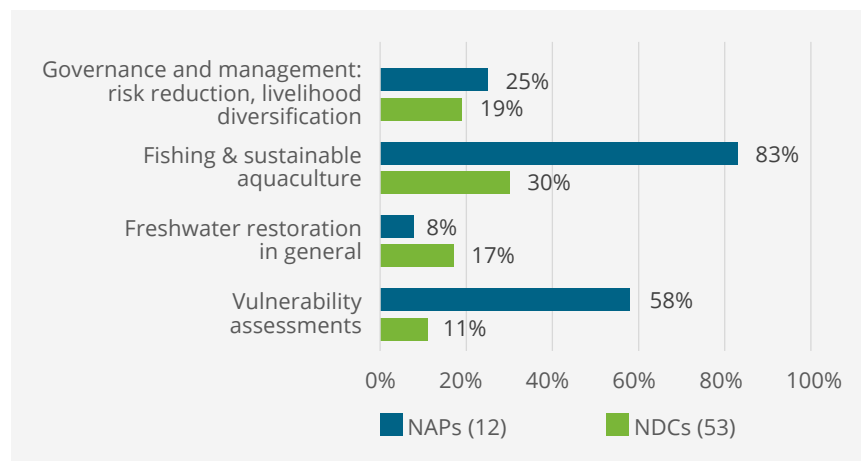
To ensure aquatic ecosystems can continue contributing to food systems and food security, adaptation measures including sustainable aquaculture practices, vulnerability assessments, ecosystem restoration and conservation initiatives, and aquatic management and ecosystem governance efforts are needed. 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.

Only 17% of NDCs and only Chad's NAP includes freshwater restoration measures.

Freshwater ecosystems have low capacity to deal with the effects of climate change and researchers have observed declines in dissolved oxygen in freshwater ecosystems 2.75 to 9.3 times greater than coastal ocean ecosystems.³⁴ This highlights the need for freshwater restoration initiatives.

The Democratic Republic of Congo, in its NDC, details plans to implement river stabilisation techniques in risk areas, like additional dredging or widening so that excess water can flow freely and prevent flooding. **Chad** in its NAP states plans to create, restore and safeguard wetland ecosystems, and to ensure the safeguarding of Lake Chad specifically.

Figure 3. Food systems measures in NDCs and NAPs for freshwater ecosystem adaptation. Total: 53 NDCs and 12 NAPs

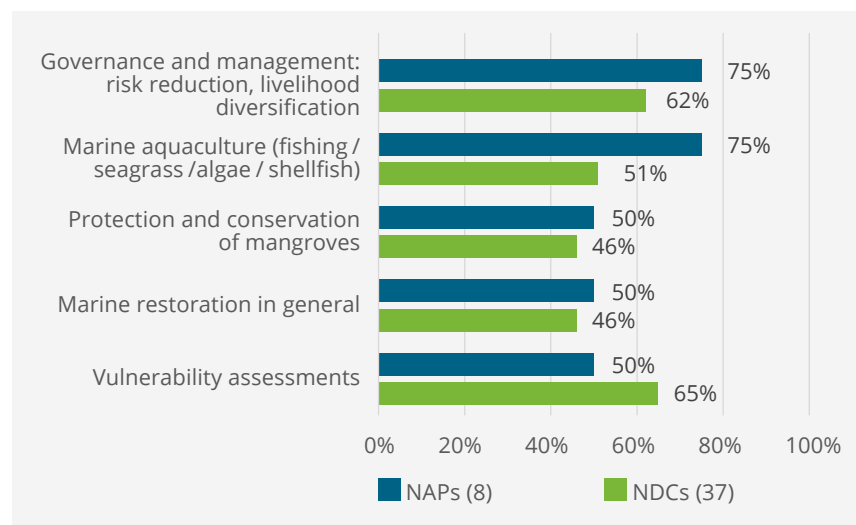


Out of the countries with coastal ecosystems, 51% of the NDCs and six of the eight NAPs include plans to develop marine aquaculture, including seagrass, algae, shellfish, and fishing.³⁵

Marine fisheries account for more than 50% of total capture fishery production in Africa. According to the 2021 IPCC report, at a 4.3°C warming scenario, the maximum catch potential from marine fisheries in Africa would decrease by 12–69% by the end of the 21st century relative to the past three centuries while maintaining warming levels below 1.6°C would decrease catch potential by 3–41%. The projected risks that food systems face in marine ecosystems point to the importance of developing sustainable aquaculture and fishing practices. **Cabo Verde states in its NDC that it aims to** implement fishing quotas and authorizations in accordance with fishing resources and replenishment rates, aiming to have safeguards in place against overfishing and overexploitation, and developing a seaweed germplasm bank. **Liberia** reports a holistic fishery plan in its NDC that aims to identify endangered and vulnerable fish species, map the areas valuable for their protection, improve management through working with fishery communities to create multiple-use conservation areas, and strengthen the capacity of the National Fisheries and Aquaculture Authority. **Kenya** in its

NAP states plans to expand the fishing zones in coastal waters, upscale sustainable aquaculture initiatives, and promote the up-scaling of climate resilient strategies and technologies, while also enhancing the capacity of the Ministry of Agriculture, Livestock and Fisheries and the Kenya Marine Fisheries Institute on the impacts of climate change on fisheries, fishing communities and the private sector.

Figure 4. Food systems measures in NDCs and NAPs for marine ecosystem adaptation. Countries without marine ecosystems are not included.



46% of NDCs and six NAPs plan for marine ecosystem restoration. 46% of NDCs and Sudan, Sierra Leone, Madagascar, and Cameroon in their NAPs also plan to protect and conserve mangroves as part of these efforts.

Annually, mangroves reduce flood risks for approximately 15 million people globally, and sustain the production of fish, crustaceans, and molluscs that supports an estimated 4.1 million small scale fishers globally, providing an important supply of protein in coastal communities.³⁶ **Kenya**, in its updated NDC, states its aims to promote and expand opportunities for marine nature-based enterprises including seaweed farming and mangrove ecotourism.

The majority of countries in their NDCs (62%) and six NAPs plan for marine governance and management initiatives. In its NDC, **The Gambia** supports the planning, rehabilitation and management of buffering coastal ecosystems to build the resilience of fisheries. **Egypt** exemplifies restoration and disaster risk reduction while incorporating NbS and governance in its 2022 NDC. **Egypt** specifies plans for sand dune stabilization through the cultivation of wild plants and wooden barriers to preserve natural defence lines against sea encroachment, as well as construction and reinforcement of anti-flood protection structures (like maritime walls and submersible barriers) to protect lives, properties, and economic activities for vulnerable populations. Concordantly,

Egypt plans to have institutional capacity building and enhanced partnerships to increase the effective management and governance monitoring of coastal zones to minimize the risks and impacts of extreme weather events.

Aquatic ecosystem governance measures can be a type of Community-based Adaptation, too. Sustainable coastal management is more effective if governance is informed by local Indigenous peoples, coastal communities, small-scale fishers, and builds in aspects of community-based management, taking into consideration access rights, and land tenure.³⁷ **Sierra Leone**, both the NAP and NDC state the country's plans to develop and operationalize an integrated coastal zone management plan, managed by local councils; establish robust and long-term mangrove ecosystem health surveillance, monitoring, and analysis to map future risks; and train relevant coastal institutions on climate change adaptation and mangrove conservation. **Sudan** in its NAP includes plans to rehabilitate mangroves and coral reefs, implement mangrove reseeding initiatives, and support and work with mangrove-dependent communities to reduce mangrove destruction.

5.2 Adaptation in storage, transportation, and processing of food

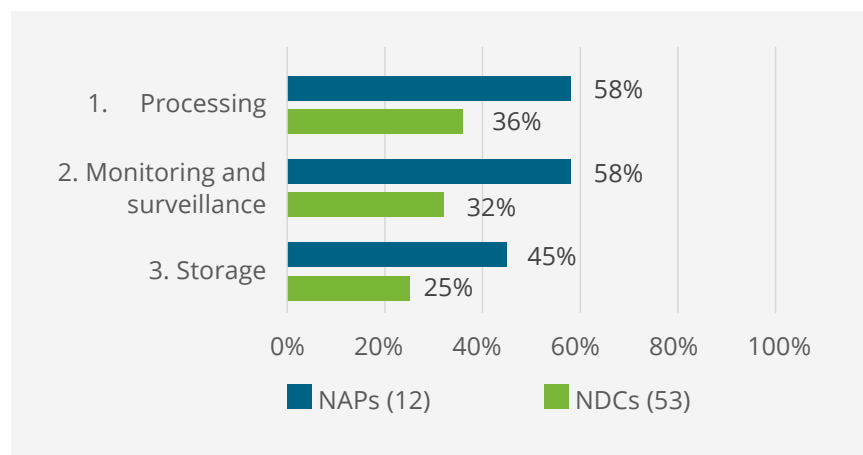
5.2.1 Positive Trends

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. After crops are harvested, or after livestock is slaughtered, appropriate storage and processing techniques are imperative to enable food preservation for later consumption. The Global Center for Adaptation finds that approximately 36% of the food produced in sub-Saharan Africa is lost or wasted, with a majority of the losses occurring at the production, processing, and handling stages.³⁸ The IPCC draws a distinction between the terms “food loss” and “food waste.” Food loss is harvest that is not usable due to spoilage, rotting, improper handling, damage from pests.

Food waste is a portion of food loss that occurs through retailers or homes and is potentially recoverable. Unless countries and food value chain companies take active steps to reduce this, even more food will be wasted post-harvest as the effects of climate change continue.

There are a range of measures to prevent and anticipate these risks proactively to increase post-harvest food supply. These could include drying and dehydrating processing equipment and cold storage for produce and meat to metal drums and hermetic bags for grain storage.³⁹

Figure 5. Positive trends in adoption of measures for adaptation in post-harvest food systems



36% of African countries consider food processing measures in their NDCs while seven of the NAPs include these measures as well.

In their NDCs, **Congo** aims to “[develop] access to products, services and infrastructure for resilient food chains” and the **Democratic Republic of Congo** plans to support “the establishment of production and marketing chains for agricultural products in order to improve the income of rural farmers.” **Cameroon** in both its NDC and NAP reports specific measures to promote improved traditional techniques and technologies for processing, drying, and storing fish and conserving fishery products. **South Sudan** states in its NAP, as part of its goal to improve post-harvest crop handling and value chain resilience, its plans to establish and improve facilities to reduce post-harvest waste and to enhance value-added food processing (e.g., pasta, biscuits and bread) in its market centres. **Liberia** states in its NDC efforts to establish five fish processing centres in the Mesurado basin by 2025 to increase livelihood capacity building, food duration, and market access. As part of this measure, **Liberia** is also considering alternative approaches to the traditional way of using mangroves for smoking fish by 2030, developing new food processing techniques while trying to conserve mangroves as an ecosystem.

26% of NDCs and five NAPs – those of South Sudan, Sierra Leone, Chad, Cameroon and Burkina Faso – include food storage measures. Five countries in their NDCs and Sudan in its NAP include food-system-specific transportation or infrastructure measures.

Higher temperatures from climate change will raise food storage costs, threatening the quality and quantity of stored food.⁴⁰ **Malawi** reports in its NDC the promotion of metallic silos & Perdue Improved Crop Storage (PICS) bags for effective grain storage to improve post-harvest management and reduce storage loss. **Burkina Faso** in its NAP states plans to introduce grain banks at village level, expanding food storage locally. **Chad** details several measures for food storage in its NAP. As part of **Chad**’s rice farming development project, it aims to improve food security and reduce poverty by providing support for storage facilities and training in production, storage, and trade. **Chad** also will build a community warehouse for agricultural storage to strengthen the resilience of Lake Chad communities to climate change.

Given the globalization of food value chains, moving food between and within countries requires transportation and infrastructure that is resilient to climate change’s impacts. **South Sudan** states in its NDC that it will develop transport infrastructure and cold-storage facilities. In their respective NDCs, **Congo** reports plans to connect farmers to markets in rural areas through climate-proof infrastructure; **Gabon** shares plans to install electric fencing to protect crops from elephants, and **The Gambia** writes its plans to establish aggregation points that help bring products to market and improve transport conditions with increased cold storage capacity. These examples of infrastructure improvements are food-system informed and are unique to each country’s context. 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.⁴¹ **Sudan**, in its NAP, states plans to construct a protective bridge or barricade for orchards to reduce destructive effects of floods.

32% of NDCs and seven NAPs plan for disease and pest monitoring in food value chains to ensure food safety.

Insects, a main source of food loss post-harvest, may see an increase in their reproductive rates with rising temperatures up to 40°C, although this varies by region.⁴² Insects can cause diseases and threaten public health, on top of their contribution to food spoilage. Hence, surveillance and detection systems for food monitoring are important to mitigate the risks climate change pose to global food systems.⁴³ Risks from insects are reflected in the NDCs of several countries.

5.2.2 Areas for improvement

Clear measures and targets for addressing food loss and waste remain an area for improvement as only 11 NDCs and South Sudan in its NAP include measures to reduce food waste and food loss⁵.

The World Resources Institute finds that the value of food lost in grains alone each year in sub-Saharan Africa is estimated to be \$USD 4 billion, more than the value of the total food aid received in sub-Saharan Africa over the past decade and equal to the annual value of cereal imports.⁴⁴

Sierra Leone mentions food loss and plans to develop technologies and tools for reducing it by improving value chains in its NDC. **South Sudan** states in its NDC that it plans to conduct a feasibility study for the development and adoption of digital solutions to enable farmers' access to information through agricultural hubs, in order to optimize resource use and contribute to waste reduction. **Cabo Verde** in its NDC also details plans to adopt a national strategy on organic waste at the municipal level by 2024. This plan emphasizes compost as a waste reduction technique and a resource for agricultural inputs that aligns with circular economy, regenerative agriculture, and agroecology principles. As mentioned earlier, **South Sudan** in its NAP describe plans to improve food processing to enhance value of agricultural value chains (through making pasta, biscuits and bread). This measure is explicitly working to reduce post-harvest food waste.

Sierra Leone will review approaches to integrated pest management.

Comoros specifically voices concerns around livestock-borne diseases and it plans to establish an effective early warning and response system throughout the country for the emergence of new bovine or caprine diseases. **Rwanda** aims to strengthen disease prevention, through improved capacity for surveillance and control in its crops post-harvest. **Togo** plans to strengthen research in the phytosanitary field, explicitly through developing low-cost bio pesticides and strengthening biological monitoring and controls. With respect to NAPs, **Burkina Faso** states plans to support locust monitoring and control measures, while also improving ecological monitoring overall.

Four countries, 8% of NDCs, include measures to change consumption patterns, through nutrition guidelines, dietary public awareness initiatives, and promoting the consumption of local foods. Kenya is the only country to include dietary measure in its NAP.

A growing body of research has demonstrated over the past several years that transitioning caloric intake from animal-sourced foods to plant-based foods would have mitigation and adaptation benefits.⁴⁵ However, this transition generally focused on food systems in rich countries and may erase the nuance of the African context where smallholder production dominates. Food system 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.⁴⁶ The more urgent need in the African context is nutrition and food security for the 282 million people in Africa who are undernourished.⁴⁷ The International Food Policy Research Institute emphasizes that because undernourishment and micronutrient deficiency are increasing globally, all countries should adopt national food-based dietary guidelines that are practical, culturally appropriate, and context- and population-specific.

⁵ This finding does not include waste management techniques if the interventions do not explicitly consider food waste or food loss.

Four countries address dietary changes in their NDCs. **Liberia** plans to develop national dietary guidelines to support climate-resilient, food secure livelihoods by 2025. Similarly, **Eswatini** states that it aims to promote healthy eating and healthy lifestyles in line with adaptation needs. **Malawi** reports its encouragement of nutrition-sensitive practices, nutrition assessments, counselling, and support services linked to livelihoods targeting

adolescents, adults, and children while promoting dietary diversity. **Cabo Verde** states its plans to protect local fish consumption and domestic small-scale fisheries over exportation and large-scale international fisheries. **In its NAP, Kenya** aims to promote new food habits that are in line with agricultural sector climate adaptations, though it does not include further details on what those dietary habits will be.

5.3 Governance enablers for food systems adaptation

A transition to resilient and adaptive food systems must go beyond a narrow focus of increasing crop yields, which fails to adequately take into consideration the fact that food insecurity today is not necessarily a consequence of yields being too low or of global supplies being unable to meet demand, but rather of structural inequities in the food systems.⁴⁸ Food system adaptation plans under the NDCs and NAPs have immense potential to address this by increasing food sovereignty.⁴⁹ Investment in innovation, research and development initiatives, participatory governance, and equity considerations must complement and further the implementation of adaptation measures.

5.3.1 Positive Trends

79% of NDCs and eight NAPs contain specific quantified costs of implementing adaptation measures.

The annual cost of implementing all adaptation measures in these NDCs is about USD 71 billion.⁶ While it is unclear how much of this is specifically for food systems adaptation, the Climate Policy Initiative estimates that adaptation finance in Africa is needed mainly in agriculture (25%), water (17%), infrastructure and buildings (12%), disaster prevention and preparedness (10%),

and health (8%) – most of which are relevant for food systems.⁵⁰ NDCs are a good source for donors and investors to ensure that finance they provide is aligned with the priorities of the host countries. NDCs play an essential role in directing finance, but very few NDCs clearly mention planned measures for adaptation in food systems. Clearly articulated finance needs in NDCs and NAPs for adaptation enable climate finance funding agencies and international partners to expedite the allocation of funds to African countries for the implementation of these adaptation interventions. 65 % of the UNFCCC Parties that have submitted a Long Term Low-Emission Development Strategy have emphasized challenges relating to finance, including safeguarding sound and balanced public finance and access to new sources of finance.⁵¹

At the moment, USD 11.37 billion⁵² in climate finance as estimated by Climate Policy Initiative is channeled for adaptation measures in Africa which falls short of USD 71 billion costs estimated in the NDCs.

72% of NDCs and all 12 NAPs include early warning or early action systems, including vulnerability assessments relevant to the agriculture and food sector.

⁶ This is total adaptation costs estimated in the most recent NDCs of 41 countries in Africa based on the analysis of NDCs for this paper. South Africa alone has an estimated USD 26 billion costs for adaptation under their NDC.

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.⁵³ **Congo's** NDC aims to develop and integrate climate information and agro-meteorological early warning systems. Congo also plans to implement climate risk, hazard and vulnerability assessments that identify landslide risks using monitoring technologies and other geohazard assessments. The **Democratic Republic of Congo's** NDC describes its plan to improve people's access to multi-hazard early warning systems, disaster risk information, and assessments; establish partnerships with meteorological services related to rural women's early warning needs and droughts; identify preventative solutions to agricultural landslides; and develop intervention schemes for the implementation of the early warning system for women in food crop agriculture. **Cameroon** in its NAP states plans to implement a national climate alert system (including drought management plans, flood and storm alerts) as well as a seasonal forecast and early warning system information that is easily available to allow stakeholders to better plan agricultural operations.

38% of NDCs and ten NAPs include research and development on drought-resistant or climate-resistant crops.

The International Food Policy Research Institute 2021 report finds that investments in R&D for innovation in agri-food systems can give returns of up to 10 times and hence contribute more to reducing poverty and hunger than other development investments.⁵⁴

Guinea Bissau's NDC describes plans to include research on more resistant varieties and obtaining for its population cheap access to seeds that are better adapted to a changing climate. In its NDC, **Liberia** includes aims to establish a national research institution focusing on new Climate-Smart seed varieties and improving livestock breeding by 2030, while increasing funding for research on adaptive forest management solutions by 2025. **Cameroon** describes in its NAP plans to support and popularise research into the crop varieties best adapted to the climatic conditions of the different agro-ecological zones, and to crop diseases. Similarly, **Cabo Verde** states in its NDC that it plans to invest in agricultural research and develop locally appropriate,

low-tech, low-energy, low-cost adaptation practices, while developing local plant and animal varieties, including short-cycle and drought-resistant crops, to increase food quantity and nutritional quality. **Sierra Leone** in its NAP includes plans to provide adequate support to the Sierra Leone Agricultural Research Institute as well as Njala University to develop appropriate crop varieties and production practices that will enhance resilience to adverse weather conditions as well as to develop regional links and collaborations to fund and promote plant breeding programmes.

In total, 43% of NDCs consider some form of crop, livestock, or climate insurance. Burkina Faso, Chad, Kenya and South Sudan also include some form of insurance in their NAPs.

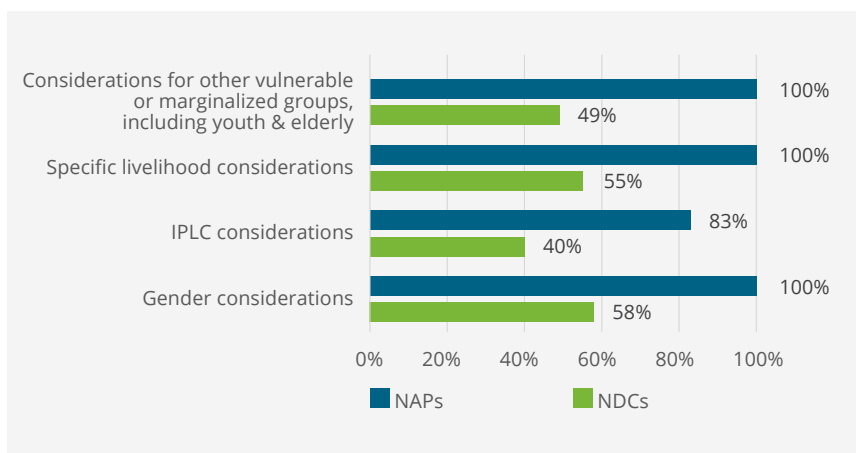
With increased research and development, access to improved crop varieties is still limited among smallholder farmers due to high prices and risk adversity.⁵⁵ Financial insurance mechanisms can help expedite improved crop variety adoption and implementation. These types of food system-related insurance 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. **South Sudan's** NDC describes plans for a feasibility study for an index-based livestock insurance system to protect livestock keepers and pastoralists in drought-prone regions by providing monetary support to them in times of predicted livestock mortality in times of drought and severe fodder shortages. This is also included in South Sudan's NAP. **Kenya**, in its NAP, mentions different kinds of insurance policies, that could be implemented to strengthen and expand social protection, including general insurance mechanisms against climate hazards, livestock insurance, and index-based weather insurance.

55% of NDCs and all 12 NAPs consider livelihoods and food security as part of adaptation plans.

Food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food. Indigenous Peoples,

small-scale food producers, and low-income households are particularly impacted by food insecurity. Vulnerable groups, including women, children, low-income households, indigenous groups, or other minority groups, are at a higher risk of food insecurity and associated malnutrition and livelihood loss.⁵⁶ Governments should ensure any policy action for food is holistic in a way that safeguards food security and sustainable development, as enshrined in the Preamble and Article 2.1 of the Paris Agreement.

Figure 6. Equity considerations in adaptation measures



58% of the NDCs and all NAPs consider gender explicitly in their adaptation measures. Half of NDCs and all NAPs consider vulnerable or marginalized groups, including the youth and elderly.

Current projections estimate that climate change will cause a 2-4% annual loss in GDP in Africa by 2040, and women and marginalized populations will disproportionately feel these impacts. Women currently only receive 7% of all agriculture extension services and less than 10% of the credit offered to smallholder farmers in Africa.⁵⁷ Explicit gender-responsive adaptation interventions are crucial to ensure equitable adaptation.

Liberia states in its NDC that it plans to implement its “Women in Agriculture” program of four training sessions per year (with at least 45 women trained per year). These trainings aim to support the implementation of climate-resilient agricultural and livestock practices and increase women’s access to agricultural inputs and labour-saving devices by 2025. **Madagascar**, in its NAP, states that it will promote the creation of occupations that are less dependent on natural resources while also acknowledging gendered implications within food-system livelihoods. Specifically for the agriculture-livestock-fisheries sector, **Madagascar** states that it supports women in strengthening their capacities and skills, while simultaneously noting and considering the power relations that affect their choices (particularly relationships within families and communities) and differentiated responsibilities in agricultural activities, land ownership policies, social norms, etc.) that condition women’s lifestyles.

Cameroon describes in its NAP plans to train government officials and managers on the effects of climate change on vulnerable groups and tools to improve the capacities of these populations; to develop specific plans to support indigenous peoples in the event of a disaster. **Cabo Verde**, in its NDC, includes aims to develop a gender analysis of women and men in the blue economy to promote entrepreneurship and develop jobs for the young, and by 2025, it aims to adopt a public agricultural financing and credit program to promote regenerative, circular agricultural systems, with special incentives for women and youth to participate.



5.3.2 Areas for Improvement

Only five countries' NDCs include plans for R&D funding allocation and prioritization of local and traditional wild crops. Central African Republic, Kenya, Madagascar and Sudan include considerations of local, indigenous, or traditional crops in their NAPs.

Neglected and underutilized crops are typically native to the environments in which they are grown, they require fewer external inputs than conventional crops, and can thrive in land considered unsuitable for other purposes, making them an important part of adaptation strategies.⁵⁸ Countries that are considering wild crops in their NDCs include **Eswatini**, which aims to improve the conservation of genetic resources, specifically indigenous trees, and **Burundi**, which explicitly states that it will enhance and promote indigenous, medicinal, and nutritional plants, and prioritize the production and distribution of those respective seeds. **Sudan**, in its NAP, states plans to plant indigenous species including seyal and tundu trees among other native species (*Ziziphus spina Christi*, *Acacia tortilis* and *Capparis decidua*).

40% of NDCs and ten NAPs consider Indigenous Peoples and Local Communities (IPLCs). Only three countries have land tenure measures in their NDCs and Madagascar, Cameroon, Burkina Faso are the only two countries that include land tenure in their NAPs.

Strengthening land rights and resources for IPLCs is essential for the survival, sovereignty, and cultural heritage of these communities. Indigenous stewardship of ecosystems has significant climate mitigation and adaptation benefits as well, including increasing agrobiodiversity and ecosystem services.⁵⁹ Addressing land tenure issues can mitigate risks for IPLCs and other vulnerable populations, and can encourage adoption of different land management techniques, like agroforestry or agroecology.⁶⁰ IPLCs should be included at every stage of the food system value chain.

Cameroon, in its NAP, includes aims to strengthen and develop local mechanisms for securing the land use and ownership rights of different stakeholder groups, including vulnerable groups and minorities, specifically Indigenous peoples and rural women. In its NAP, **Central African Republic** describes plans to inventory traditional and Indigenous knowledge and practices relevant to adaptation in the country and it is working to design and implement a methodology for vulnerability assessments, especially for young people, people with disabilities, and displaced people. In its NDC, **the Democratic Republic of Congo** includes aims to work with local communities and indigenous peoples to generate forest resource development projects, value the traditional knowledge linked to the conservation of ecosystems, and involve IPLCs in negotiations with logging and mining companies.

53% of NDCs refer to Monitoring, Reporting and Verification (MRV) plans that are under development or have unclear implementation status. Seven of the NAPs state that the respective MRV systems are also under development or unclear.



30% of countries' NDCs have general MRV plans for NDC implementation and 4% have adaptation-specific MRV plans. 15% of countries' NDCs make no mention of an MRV plan. Measuring the progress and the impacts of NDCs is one of the key components under the Paris Agreement, and important for determining progress regarding the Global Stock Take and Global Goal on Adaptation.



A group of people, including children, are shown from a low angle, holding hands and pouring small grains or seeds into a central point. The scene is set outdoors under a clear blue sky. The people are wearing colorful clothing, and the overall atmosphere is one of community and shared resources. The text "ANNEX 1. NDC ASSESSMENT FRAMEWORK" is overlaid on the image in white, bold, sans-serif font.

**ANNEX 1. NDC ASSESSMENT
FRAMEWORK**



Researchers for this paper developed the below assessment framework based on literature to capture relevant information on food systems adaptation each country's NDC, and NAP where applicable. While researchers aimed to take a holistic assessment approach to the entire food system, there are nuances and caveats that this framework may not capture. Below are examples of how this framework was used to capture qualitative and quantitative data in this research.



Part 1:

Country	Finance	Ecosystem in country	Pre-Production		Production													
					R & D		Terrestrial: Agriculture Also includes Fertilizer use, and irrigation considerations			Terrestrial: Livestock	Inter-connected systems		Marine: Not applicable if country is land-locked			Freshwater		
					drought-resistant/ climate-resilient crops	indigenous, NUS, traditional, or wild crops	Soil conservation	Crop diversification	Sustainable forest management	Research, breed- ing practices, welfare and management	Agroecology, agroforestry, climate-smart agriculture or livestock	Grassland considerations	Fishing and sustainable aquaculture	Protection, conservation, restoration including mangroves	Coastal gover- nance and vulnerability assessments	Fishing and sustainable aquaculture	Restoration	Fisheries governance and freshwater vulnerability assessments
 <p>CENTRAL AFRICAN REPUBLIC'S NDC</p>	Yes, USD 443.87 million for adaptation	Yes	Establish and make functional by 2030 a food crisis prevention system associated with climate variability and change (early warning system including an information system)	Develop by 2030 food crop varieties adapted to water stress and /or temperature in the central and northern regions of CAR	Support the NTFP sector to diversify the food supply... Increase the production of NTFPs for food (shea, wild pepper, etc.)	promote agri- forestry systems for sustainable soil management	Development of sustainable, intensive and diversified agriculture, and promotion of management action sustainable land use that includes youth, women and indigenous people	Regulation of artisanal timber and wood energy exploitation and measures to reduce pressure on resources; Reduce slash-and-burn cultivation practices by 60% by 2030. Ensure reforestation of degraded areas through urban, peri-urban and community forestry;	By 2030, improve the level of sedentarisation of transhumant herders and reduce the risks associated with climate variability and change, by increasing the area of fodder crops in forested areas and ensuring monitoring zootechnical and veterinary adaptation.	Promotion of agroforestry to reduce climate risks and diversify economic options... CAR's forest and grassland ecosystems remain a significant carbon sink, with an estimated sequestration capacity of 728,896 GgeCO ₂ .		Country is land-locked			No measures			
 <p>MAURITIUS' NDC</p>	Yes, USD 4.5 billion	Country has coastal areas								Develop and promote climate smart agriculture practices		Development and implementation of sustainable fishing management plans, Establish an integrated framework for the management of fisheries founded on the Blue Economy concept, which includes coastal zone management and marine biodiversity conservation						
													Foster an integrated approach combining the goals and targets for the fisheries sector with the coastal zone management sector, and additionally also with the marine biodiversity sector.					
													Resilient artisanal fishery with policy on marine co-management of resources and measures for off-lagoon fishing					

Country	Finance	Ecosystem in country	Pre-Production			Production											
Keywords	Specific to Adaptation	Is given country land-locked?	Early warning or early action system	R & D		Terrestrial: Agriculture Also includes Fertilizer use, and irrigation considerations			Terrestrial: Livestock	Inter-connected systems		Marine: Not applicable if country is land-locked			Freshwater		
				drought-resistant/ climate-resilient crops	indigenous, NUS, traditional, or wild crops	Soil conservation	Crop diversification	Sustainable forest management	Research, breeding practices, welfare and management	Agroecology, agroforestry, climate-smart agriculture or livestock	Grassland considerations	Fishing and sustainable aquaculture	Protection, conservation, restoration including mangroves	Coastal governance and vulnerability assessments	Fishing and sustainable aquaculture	Restoration	Fisheries governance and freshwater vulnerability assessments
SOUTH SUDAN'S NDC 		Yes, country is landlocked	Establish early warning systems (including community capacity building)					Develop a breeding policy with the aim of improving local breeds of livestock and improving management of resources for haymaking.		South Sudan will promote agroforestry, which will not only help sequester carbon but will also provide other benefits such as reduced soil erosion and enhanced agricultural productivity by maintaining soil fertility.					Enhance climate-resilient fish production. Develop an action plan to implement the National Aquaculture Development Strategy.	Restore and sustainably manage fish habitats, especially wetlands such as the Sudd swamps and Nile basin	
LIBERIA'S NDC 	Yes	Country is not landlocked	Strengthen agricultural climate services and early warning systems by 2025.	Establish a national research institution focusing on new climate smart seed varieties and improving livestock breeding by 2030. Increase funding for research on adaptive forest management solutions by 2025			irrigation systems, increased soil fertility.	Develop incentives and programs to promote crop and livestock diversification, climate resilient seeds, water harvesting, establishment of 5 seed/gene bank					Develop training, capacity building, and strategic communications plans for coastal managers and communities to implement coastal adaptation actions, especially by increasing support for education and training on climate risks and adaptation solutions for vulnerable groups.	Establish 2 Marine Protected Areas by 2030 and 4 co-managed fishery areas in coastal and aquatic ecosystems associated with fish production in coordination with fishery communities by 2030	Identify endangered and vulnerable fish species, map the areas valuable for their protection, and work with fishery communities to create multiple-use conservation areas. Support alternative fishery livelihoods by developing the foundational structures and extension services needed to increase aquaculture production and reduce the impact on marine fisheries, including through provision of 25 aquaculture kits to smallholder fishers by 2025		

Part 2:

Country	Post-Production				Consumption		Governance, Equity, and Co-Benefits Considerations							
	Insurance	Processing		Transportation	Storage	Food Waste and Loss	Changing consumption demand-side	Gender	IPLCs and Equity Considerations			MRVs	Co-Benefits	
Keywords	Climate in general, livestock, or crop	Surveillance, monitoring and pest detection	Food preservation, drying	Specific to food-systems	Silos, cold storage, refrigeration		Dietary guidelines, public awareness campaigns/ nutritional labelling	Specific to food or General	Livelihood considerations	IPLCs considered? Other vulnerable groups considered?	Community management and land tenure	Status	Food Security	Other benefits, including mitigation
<p>CENTRAL AFRICAN REPUBLIC'S NDC</p> 								Specific to adaptation measures: Information, Training, Installation propagation nurseries and of processing units; setting up the establishment of collection depots and storage for NTFP marketing, with the goal of 50% of women head of households		By 2030, 50% of indigenous communities initially targeted have seen their adaptability to climate change reinforced		In-development: "The proposed MRV system covers mitigation, adaptation, and finance."	food/crop diversification mentioned as a measure to prevent food insecurity	Livelihood diversification: "diversify economic options" and "supporting vulnerable households"
<p>MAURITIUS' NDC</p> 		Development of an integrated strategy and policy to foster adoption of integrated Pest and Disease Management (IPDM) practices including the review of policy and regulatory framework to facilitate the upscaling of IPDM technology and regulate the use and disposal of pesticides						All climate change adaptation projects are designed to integrate gender The Climate Change Act 2020 also makes provisions to commission studies on climate change, taking into consideration, inter alia gender issues	special efforts are being made by the National Women's Entrepreneur Council through several entrepreneurial projects to empower women to address gender-related poverty	IPLCS: A particular attention was also given to vulnerable groups, especially in the Outer Islands.... Empowerment of persons with disabilities, elderly persons and local communities to enhance their quality of life.		Unclear		

Country	Post-Production				Consumption		Governance, Equity, and Co-Benefits Considerations							
Keywords	Insurance	Processing		Transportation	Storage	Food Waste and Loss	Changing consumption demand-side	Gender	IPLCs and Equity Considerations			MRVs	Co-Benefits	
	Climate in general, livestock, or crop	Surveillance, monitoring and pest detection	Food preservation, drying	Specific to food-systems	Silos, cold storage, refrigeration		Dietary guidelines, public awareness campaigns/ nutritional labelling	Specific to food or General	Livelihood considerations	IPLCs considered? Other vulnerable groups considered?	Community management and land tenure	Status	Food Security	Other benefits, including mitigation
SOUTH SUDAN'S NDC 	South Sudan will introduce an index-based livestock insurance system to protect livestock keepers and pastoralists in drought-prone and arid regions by providing monetary support to them for predicted livestock mortality in times of drought and severe shortages of fodder	Implement control measures for crop pests and diseases to prevent crop loss.		Establish adequate transport and cold-storage solutions to reduce post-harvest losses.		Within NDC, post-harvest measures specifically aim to reduce post-harvest loss					Promote community-based watershed management ... promotion of community-based forest management in South Sudan will contribute to a more diverse employment base.			
LIBERIA'S NDC 	Establish or strengthen crop and livestock insurance systems by 2025.		Develop facilities and climate smart technologies to promote postharvest and value addition practices. Establish five (5) artisanal fish landing and processing centers in the Mesurado basin by 2025. Increase capacity building of women involved in marketing & smoking of fish		Development of small-scale composting of market waste to reduce food waste. Implement frequent organic waste segregate collection, distributing food waste caddies (reduces odors, pest and insects from rapidly degrading material)	Develop national dietary guidelines to support climate-resilient, food secure livelihoods by 2025	Roll out a "Women in Agriculture" program with 4 training sessions per year (with at least 45 women trained per year) to support implementation of climate-resilient agricultural and livestock practices and increase women's access to agricultural inputs and labor-saving devices by 2025.	Develop alternative livelihoods programs with forest dependent people in 5 forested counties to ensure a just transition from forest extractive models for local communities, including development of models and markets for non-timber forest products and for sustainable eco-tourism by 2030. (Linked to Mitigation target).			Liberia's national MRV system is a single entity driven system solely implemented by the Environment Protection Agency. The national MRV system also contains a set of measuring and monitoring tools and protocols for measurement, verification, and reporting. In the case of forest measurement for example, the following exists: Forest Reference Emissions Level (FREL); National Forest Monitoring System (NFMS); and National Forest Inventory and Living Standard Measurement System (NFI & LSMS)		Ecosystem conservation	

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