NOTE 1

Embedding Climate Resilience into Agriculture Projects

The Africa Climate Resilience Investment Facility (AFRI-RES) Learning Note

1. Why is integrating resilience into the Agriculture Sector so critical to food security?

Agriculture is one of the sectors most vulnerable to climate change, particularly affecting the most vulnerable populations: small-scale producers in low- and middle-income countries. Agriculture is also the largest engine of economic growth in Africa, representing 15 percent of the continent's total gross domestic product (GDP) (World Bank 2021a), and is the principal livelihood for most Africans. Ensuring resilient food security and rural economies is critical to Sub-Saharan Africa's socioeconomic development. The impacts of more frequent extreme weather events such as droughts and floods are felt across the region. Climate change and variability have reduced crop yields and livestock productivity. In the medium term, regional climate models consistently predict fewer days of rainfall and shorter wet spells over 70 percent of the region, coupled with a higher intensity of rainfall on wet days (Trisos et al. 2022). Water availability for food production and other uses is projected to decrease, and competition for resources among populations may intensify. Climate

The Africa Climate Resilience Investment Facility (AFRI-RES) is a partnership between the Africa Union, African Development Bank, the United Nations Economic Commission for Africa (UNECA), and the World Bank Group, established with support from the Nordic Development Fund (NDF). The partnership seeks to assist governments, planners, and private developers in integrating climate resilience in project planning and design, thereby attracting funding from both development and climate finance sources.

This note summarizes lessons and practices deployed in embedding climate resilience into the design of projects that received catalytic funds from AFRI-RES. It draws from application of the Resilience Booster Tool to specific projects, as relevant, Compendium Volume on Climate Resilient Investment in Sub-Saharan Africa (World Bank (2023a) and Guidance, Standards, and Good Practice Notes developed under the program.

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change has reduced total agricultural productivity growth in Africa by 34 percent since 1961, more than in any other region (Trisos et al. 2022). Africa's agriculture is especially vulnerable to future climate change in part because 90–95 percent of African food production is rainfed. A recent meta-analysis of 56 studies indicates that compared to 1995–2005, economic welfare in the agriculture sector is projected to decline in Sub-Saharan Africa by 5 percent for 2°C global warming and 10 percent for 3°C global warming scenarios (Trisos et al. 2022). Climate change already affects pest and disease vectors that harm crops and animals, as demonstrated by the higher probability of major locust outbreaks, such as in the Horn of Africa in 2020 (Trisos et al. 2022).

Other factors interact with climate change to exacerbate the food security crisis, including the degradation of the natural resource base needed for food production, such as water, soil, and vegetation cover. In West Africa, for example, while the area covered by crops doubled between 1975 and 2013, vast areas of forest, savanna, and woodland were lost or fragmented. More than one-third of the region's dense forest cover has been cleared since 1975 for farms and settlements. In savanna and steppe landscapes, bare, sandy areas increased by 47 percent as drought and unsustainable land use practices degraded vegetative cover (World Bank 2022b). Soil erosion is widespread, mainly caused by recurring droughts, deforestation, and unsustainable agricultural practices such as intensive tillage. For this reason, integrated land management solutions are essential in addition to targeted climate-smart agricultural technologies to increase the climate resilience of food production.

Another factor harming agriculture is that the region's poorly integrated food markets cannot accommodate large yearly fluctuations in food crop production, such as those resulting from climate impacts, by directing surplus food to areas with shortages. In West Africa, commodities imported from outside the region account for about 80–90 percent of all food traded by volume; yet intraregional trade has stagnated for several decades at 10–20 percent (World Bank 2022b). A spending shift to agricultural research and development (R&D) and improved extension services could result in higher returns to poverty alleviation and greater resilience to climate change. These projects could focus on supporting climate-resilient crop varieties, with market studies on how to make these commercially viable in the region, and developing local climate forecasting and early warning system capacities, including for tailored agricultural forecasting.

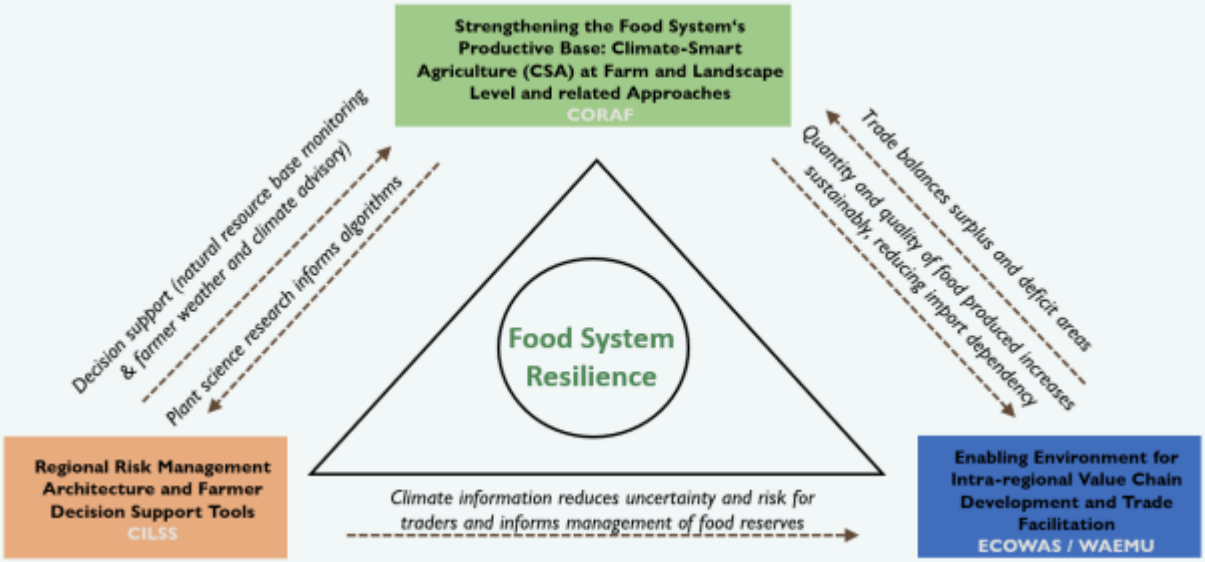
Integration of Climate Resilience into the Agricultural Sector

Three mutually reinforcing areas of intervention can enhance food system resilience in Sub-Saharan Africa. Embodying perspectives from the Next Generation Africa Climate Business Plan (World Bank 2023b), the three intervention areas are (a) sustaining the productive base of the food system by investing in climate-smart agriculture (CSA) at the farm and landscape level; (b) promoting an enabling environment for national and intraregional value chain development and trade, and integrating climate resilience measures; and (c) building national and regional capacity to manage agricultural risk. Figure 1 illustrates how these three priority areas are interconnected and mutually reinforcing in achieving food system resilience in West Africa. A similar scheme can be applied at the national or regional levels in other African regions.

Climate-Smart Agriculture and Integrated Farm and Landscape Management

At the landscape level, the region needs to move toward an integrated CSA approach to manage competing demands for land, water, and other

Figure 1. Intervention Areas to Achieve Food Security Resilience.



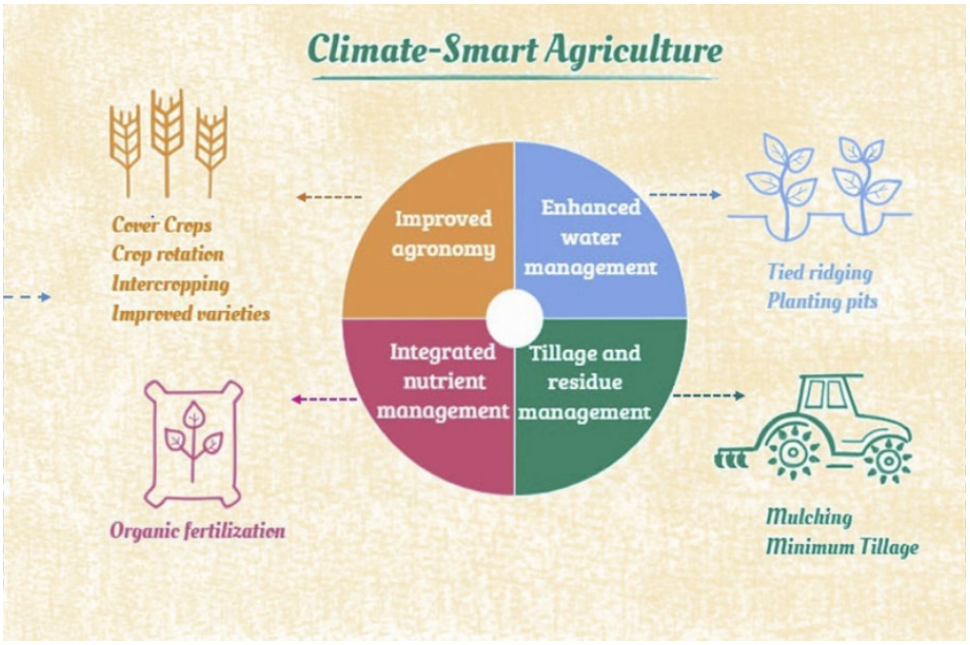
Source: World Bank 2022b.

natural resources (see figure 2). Traditional sectoral approaches to agricultural productivity, water, and land management have never systematically adopted an integrated ecosystem development vision. This failure has contributed to the disruption or even collapse of functional ecosystems, with a loss of ecosystem goods and services, and it explains why traditional approaches are ill-prepared to meet the challenges of land degradation, biodiversity conservation, and food production. The complex linkages among the natural capital components can be managed only through integrated approaches applied at the landscape level. For example, conserving natural forested areas adjacent to cultivated fields helps with evapotranspiration, water conservation and filtration, wind protection, and pest mitigation. In the context of a changing climate, a landscape view of productive activities and natural resources will also lead to better risk management (see figure 3). Thus, opportunities for income diversification and risk pooling between stakeholders become more visible, feasible, and likely to lead to the triple win of increased productivity, climate adaptation, and climate mitigation.

Integrating Resilience along Agricultural Value Chains

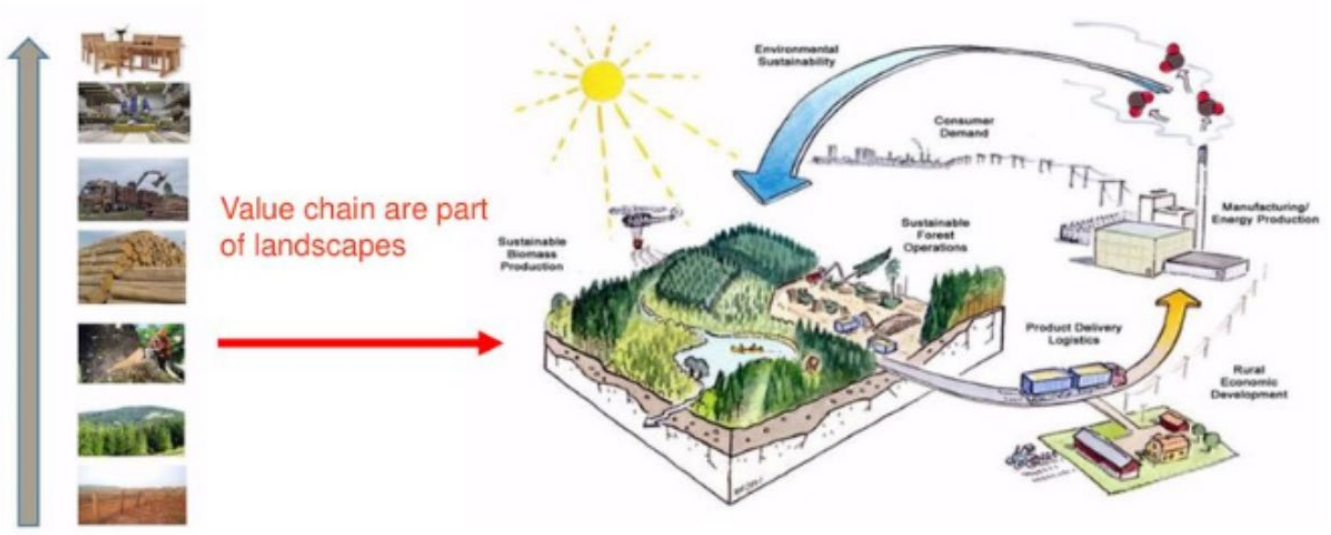
It is critical to adopt end-to-end integration of climate resilience into the value chain perspective, effectively connecting smallholders to agricultural value chains while addressing the rising urban demand for higher-value and more processed agricultural products amid a changing climate. Actions to strengthen the agriculture value chain include (a) value addition, aggregation, and certification of agriculture products, including applying and certifying climate-smart approaches, and use of climate-resilient storage and distribution infrastructure; (b) financial instruments to leverage the private sector participation and incentivize investment in climate-friendly approaches; (c) e-commerce logistical approaches to agricultural commercialization, market access, and trade, which result in system resilience; (d) market information systems empowered by information and communication technology to facilitate regional trade and promote climate-positive actions integrated into the agricultural value chain;

Figure 2. Climate-Smart Agricultural Techniques.



Source: Branca and Pirelli 2010.

Figure 3. Resilient Value Chains and Integrated Landscape Management Links.



Value chain thinking **Landscape thinking**

Source: Dekker 2018.

and (e) capacity building and awareness for value chain actors on use of climate-resilient approaches. In watershed management projects, the value chain extends to the water capture, storage, and input end to ensure water security for agricultural production under a changing climate (see figure 3).

Strengthening national and regional institutional capacity to provide demand-driven risk forecasting digital services and financial risk mitigating instruments

Risk forecasting and risk management mechanisms can increase resilience in the agriculture sector. Providing hydrometeorological and early warning systems information to farmers and pastoralists allow for planning and decision-making based on risk probabilities. Agricultural insurance as a risk management mechanism can contribute to increased productivity in agriculture and other related sectors by (a) managing climate-related risks; (b) improving access to credit for farmers and small and medium enterprises; and (c) contributing to macroeconomic stability. The following examples show how food crisis prevention and management in Sub-Saharan Africa are implemented optimally at a regional level to mitigate, diversify, and transfer production risks and allow for economies of scale. Because agriculture relies on regionally shared natural resources, cross-border coordination can reverse resource degradation. Most land and water degradation and their impacts—water scarcity, floods, droughts, soil fertility loss, erosion, and sedimentation—occur in transboundary valleys and watersheds and cannot be addressed effectively without coordinated interventions between upstream and downstream riparian countries or regions. Supply-side challenges of climate change are manifested in agro-ecosystems, which are not circumscribed by national or regional borders. Promoting interregional trade allows food to better flow from surplus to food deficit areas, which will balance fluctuations in national production and create opportunities for economies of scale. Returns to R&D increase with scale, but financial and human resources in individual countries are extremely limited. Regional cross-border collaboration to provide hydromet and early warning information generates positive spillovers. Countries with less capacity learn from leaders to build effective climate hazard and flood/drought forecasting capacity and advisory services.

Action Areas for Integrating Climate Resilience into the Agricultural Sector		
Area of Intervention	**Purpose**	**Examples of Actions**
Climate-Smart Agriculture and Integrated Farm/ Landscape Management	Maintain or increase crop productivity during drought periods	Use of drought-resistant crops
	Agricultural water retention, management, irrigation, and storage techniques	Construction of water storage/retention structures like charco dams, wells, floodable field sections; systems for irrigation and drainage; watershed management and monitoring measures; development of water infrastructure for livestock.
	Prevention of soil erosion due to increased wind, strong precipitation, and increased evatotranspiration	Planting trees for shade and wind protection; agroforestry can also provide complementary marketable crops
		Use of soil-conservation techniques like no-till agriculture, manure incorporation in the soil, replenishment of soil nutrients
	Livestock resilience investments	Investments in improved breeds, feed/fodder production for livestock, infrastructure for managing livestock waste, livestock production facilities and shelters, providing water and shade for the animals, and health and veterinary service facilities.
Integrating Resilience along Agricultural Value Chains	Increase value/income and resilience for agricultural products through processing/marketing and use of organic/environmentally friendly crops and agricultural techniques; use of resilient storage and processing facilities	Value addition, aggregation, and certification of agriculture products
		Use of resilient storage facilities, materials for the safe storage of crops, processing facilities related to agricultural, livestock and fisheries products, and local processing machinery for all the agricultural products noted above
		Use of financial instruments to leverage private sector participation
	Facilitating and promoting commercialization of agricultural products through climate-friendly digital tools.	Use of e-commerce logistic approaches to agricultural commercialization, market access, and trade
		Use of information and communication technology (ICT)-empowered market information systems to facilitate regional trade
Strengthening national and regional institutional capacity to provide demand-driven risk-forecasting digital services and financial risk-mitigating instruments.	Planning and decision making according to climatic vulnerabilities	Hydro-met and early warning information to farmers and pastoralists
	Risk managing mechanism and improving access to credit for farmers and small and medium enterprizes (SMEs)	Agricultural insurance
	Improving flow from surplus to food deficit areas balancing fluctuations in national production while creating opportunities for economies of scale, thus increasing system resilience	Promotion of interregional trade

2. How are agriculture sector projects integrating climate resilience into their design?

This section describes projects[1] supported by the AFRI-RES fund. Some also used the Resilience Booster tool to aid in their project design. The Resilience Booster is an interactive, step-by-step tool for development practitioners to embed climate resilience into project designs by using a set of resilience attributes. It helps teams to think through, specify, and design project activities that build resilience by integrating resilience attributes. We report the results of the application of the Resilience Booster at the end of the project description if available.[2]

Ghana Cocoa Sector Development Project

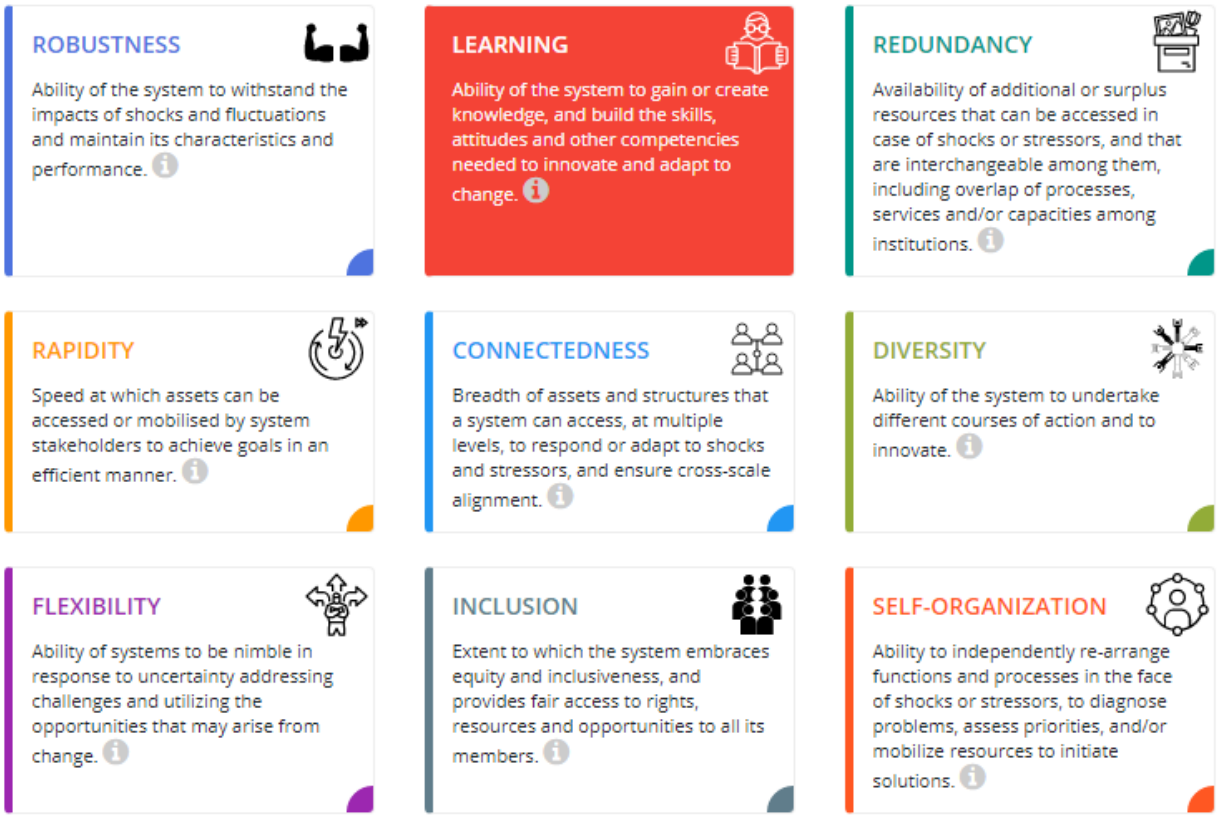
The Ghana Cocoa Sector Development Project seeks to improve cocoa farmers' livelihoods while ensuring the environmental and social sustainability of cocoa-based production systems. In It will adapt crops to a changing climate through CSA, integrated land management, and agri-climate forecasting services. In Ghana, average annual and decadal precipitation since the 1960s has been declining, while temperatures have been increasing in the cocoa growing areas. The project engages in activities to **increase the climate resilience of the smallholder farmers** engaged in cocoa cultivation for their livelihoods. It implements climate change desk monitoring deforestation and the greening of the cocoa landscape through **remote sensing technology** for (a) detecting land use changes and (b) measuring the carbon footprint and **impact of climate change**. The project will provide **advisory services** targeting disease (including climate-sensitive) surveillance and early detection, management, and reporting; the adoption of climate-smart practices on replanted areas; improved soil fertility management; and other good agricultural practices, including the reestablishment of optimum-shade cultivation practices for cocoa agroforestry.

The project will pilot and scale up, if successful, a payment for environmental services scheme to encourage farmers to keep shade trees on their farm. Separately, the project will support **market-oriented diversification** into (a) profitable alternative tree crops that are resilient to climate change in locations not suitable for cocoa; or (b) off-farm, climate-resilient income opportunities along innovating financial models. The latter activities will be in areas such as green enterprises (postharvest quality management, organic cocoa and cocoa byproduct value chain development), agroforestry, and high-value, shade-loving crops, such as ginger and alligator pepper. The project will **finance climate-proof infrastructure** to improve communities' living conditions and access to market and services, such as access roads, transport equipment, storage facilities, power and green energy, and water supply.
Applying the Resilience Booster tool suggests that adopting climate-smart practices such as optimum-shade cultivation practices and advisory and early warning systems increases the robustness of the system. Market-oriented, climate-resilient diversification of activities will ensure **robustness**. Improving skills and increasing income of the communities result in **adaptive** actions. And developing green enterprises will result in a **transformative** change regarding resilience (see figure 4 for explanation of Resilience tool attributes).

1 Cameroon Valorization of Investments in the Valley of the Benue Project, Ethiopia Lowlands Livelihood Resilience Project, Guinea Commercial Agriculture Development Project, Nigeria Livestock Productivity and Resilience Support Project, and the West Africa Food Resilience Program.

2 See also Rigaud, Arora, and Singh (2023).

Figure 4. Resilience Booster Tool Attributes.



Source: World Bank AFRI-RES webpage, https://resiliencetool.worldbank.org/#/home.

Guinea Commercial Agriculture Development Project

The Guinea Commercial Agriculture Development Project is a primary example of climate action being integrated along the production and market chain. In Guinea, the potential for accelerating the development of commercial **agriculture as a critical engine of growth** requires a comprehensive **public-private partnership**. The government will need to invest heavily in infrastructure and make continued reforms. These efforts will enable investors to deliver the capital, expertise, knowledge of markets, and credit for inputs, technology, logistics, and commercialization to modernize agriculture. Guinea's rising average temperatures and diminishing annual rainfall increase the **risks related to agricultural productivity, water scarcity, and storage losses** if no proper storage facilities. Increased incidence of pests (including insects) and disease outbreaks are expected, too. A predicted more intense rainy season would increase flooding, harming crops and roads, which are mainly unpaved, reducing the mobility of produce and goods, increasing travel times, and raising transport costs.

The Guinea Commercial Agriculture Development Project is committed to integrating climate actions into its investments along the value chain. These include (a) **adapting rural roads** to all-weather use to counteract the adverse effects of flooding and precipitation; (b) building **resilient market infrastructure**, particularly storage facilities designed for climate adaptation (with cooling facilities to

adapt to increased temperatures) and mitigation (with energy-efficient equipment and efficient waste management systems); (c) ensuring a **sustainable financing mechanism** to maintain improved road and market infrastructure for **long-term resilience**, including covering the costs of repairing damage caused by climate change; (d) mainstreaming **climate resilience in the private investments** to be supported under the program, such as through the adoption of CSA practices, climate-resilient technology, and energy efficient equipment; (e) working with value chain actors to improve their understanding of climate change and its impact on commercial agriculture; and (f) building **capacity to use tools and techniques** for designing and implementing adaptation and mitigation approaches.

Cameroon Valorization of Investments in the Valley of the Benue Project

The Cameroon Valorization of Investments in the Valley of the Benue Project focuses on integrating end-to-end climate action into river basin management to ensure water security for agricultural food production. The project aims to enhance **water security and governance** of water resources by **addressing water infrastructure safety** and operations, construction and rehabilitation of irrigation and drainage infrastructure, and support to water users' institutions. The project includes **flood preparedness and transboundary cooperation** in the Benue Valley, which is part of the regionally significant Niger Basin. In addition, it supports technical interventions to increase the **resilience of agricultural food production** through introducing **CSA techniques**. Interventions along the river basin management chain will **build resilience** against several climate risks facing the north of Cameroon, especially **drought, extreme precipitation, and flooding**, which would ultimately affect food production and security in the region.

Ethiopia Lowlands Livelihood Resilience Project

The Ethiopia Lowlands Livelihood Resilience Project (LLRP) applies the sustainable and holistic IGAD Drought Disaster Resilience Sustainable Initiative in its logical design framework to address the root causes and impacts of climate change–induced recurrent droughts and related shocks. Most of the people (14 percent of the total population) in Ethiopia's arid and semiarid lowlands rely on pastoralism and agropastoralism, based on the seasonal movement of livestock and traditional rangeland management, as the most suitable way to use scarce resources. Pastoralists and agropastoralists have been severely affected by the changing climate and frequent droughts. The resulting large-scale livestock mortality and morbidity have caused households to lose assets.

Among the climate resilience activities, the project will collate local knowledge on adaptation, finance adaptive research to enhance resilience, and finance policy action to support adaption goals. The **research** will support the agenda of **drought-tolerant livestock and crop varieties** and research on **livestock and crop management practices to adapt to a changing climate.** It also introduces **innovative pilots** that will deliver **improved information** on, for instance, **market, weather, and conflict**, through mobile phones and contribute to improved decision-making. **Rangeland monitoring through remote sensing** will enhance rangeland management. The project supports improved **access and integration into the market system** to reduce vulnerability of pastoral and agropastoral communities to a changing climate. A readily available livestock market will improve the efficiency of their production system and reduce pressure on rangelands, both of which contribute to enhanced resilience. The project supports **policy reform** toward **sustainable and resilient rangeland management**, and it supports **livelihood diversification** to ensure **climate-resilient alternatives** to livestock management are available to the local communities.

Applying the Resilience Booster tool, the introduction of soil, livestock and crop drought-tolerant and conservation practices will introduce robustness into the system. These changes will lead to increased **absorptive** capacity. Education about **diversified livelihoods** and **rangeland and weather monitoring instruments** will increase the **adaptive** capacity of the system. And the introduction of **policy reforms and watershed management plans** will result in a **transformative** effort in terms of resilience.

Nigeria Livestock Productivity and Resilience Support Project Project

The Nigeria Livestock Productivity and Resilience Support Project will introduce climate resilience measures to livestock systems. It will (a) strengthen **sector policy and institutional foundations** for improved sector **productivity and resilience to climate change** that are tailored to various production systems; (b) improve **value chain performance** for increased smallholder market orientation and private sector investment; and (c) **mitigate farmer-herder conflict** in selected areas, which is mainly **driven by climate change**. A set of activities will support the development and implementation of a **genetic resource management strategy**, with large ruminants as a priority. Aside from traits preferred by producers (increased productivity, early maturity) and markets, **breed improvement and selection will emphasize traits that confer resilience to climate-induced stresses**, enabling livestock performance to improve as the climate changes. Another activity will finance the development of user-friendly, comprehensive **extension training materials**, including digital guides. These materials will cover ruminant production systems and **incorporate approaches for climate change adaptation and mitigation**. Farmer field schools will be supported to facilitate applied research and learning for groups of herders. Additionally, the project will support **improved grazing and rangeland management practices** (individual or community-based) that **increase soil carbon stocks, biodiversity, and reduce erosion**. Improvements in the delivery of animal health services will increase productivity by reducing livestock morbidity and mortality, in turn **improving the resilience of livestock** and livestock-based livelihoods **to climate shocks, including diseases induced by climate change**.

The project will finance investments to improve the quantity and quality of water and rangeland—resources that are critical for **productive pastoral systems with increased climate resilience** and carbon sequestration. It uses **remote sensing technologies** and tools such as the Food and Agriculture Organization feed balance methodology to assess the status of water and feed (including forage and fodder). The information will be disseminated to **guide decisions on improved feed and water management, use, and access**. The project will **finance** the establishment and implementation of an inclusive, **community-driven process for climate-smart, sustainable rangeland and landscape management**. All key users of grazing reserves and water will be involved, which will establish clear conditions for accessing these natural resources and develop sound governance mechanisms to manage them. Support will be available for **constructing and rehabilitating stock routes and water points**, with the goal of improving this network and including areas that offer new rangeland/pasture. Committees will be established and supported to manage investments sustainably. The project will also **finance the development of cultivated pasture, including facilities for irrigation in water-scarce environments**.

The project will support the creation of early warning systems using remote sensing and spatial analysis to forecast forage conditions and water availability. These efforts will help reduce the risk of conflict due to increasing land use and resource scarcity. With the support of the Nigerian Meteorological Agency, pastoralists and the government can take **preemptive action to prevent conflicts**.

Climate change resilience measures will be mainstreamed into the market value chain. They will enhance and modernize the value chain for livestock products, promoting a stronger commercial/market orientation among small and medium producers. These efforts should encourage increased private investment in priority segments of the value chain.

West Africa Food System Resilience Program

West Africa is one of the world's most vulnerable regions due to its climatic, institutional, livelihood, economic, and environmental context. Agriculture contributes 29 percent of the region's GDP and is the principal livelihood for more than 60 percent of West Africans. Because the region is highly exposed to major climate, agricultural, and market risks, the performance of agriculture has historically been volatile, unleashing more frequent and worsening food crises.

The West Africa Food System Resilience Program (FSRP) promotes the adoption of improved technologies leading to increased productivity and to enhance the climate resilience of agricultural production systems. Burkina Faso, Mali, Niger, Togo, Chad, Ghana, and Sierra Leone will receive **demand-driven digital advisory services**, including **agro-advisory and impact-based hydromet/climate information and warning services**. he project will promote their use in agriculture and food crisis prevention, management, and response; digital agriculture; climate-smart, nutrition-sensitive, and gender- and youth-sensitive technologies; and policies to strengthen the regional food input and output markets.

The FSRP improves the production of climate, hydromet, agromet, and impact-based information for use by decision-makers, farmers, pastoralists, and other actors in the food system. Goals include (a) augmenting regional and national hydromet infrastructure and technical capacity to observe and forecast hydromet phenomena and provide demand-driven information services to end users, including impact-based forecasting, warning, and advisory services; (b) streamlining the chain of information across regional, national, and subnational levels to develop cost-effective regional information systems; (c) ensuring maximum leverage of available global and regional products and services across timescales, with emphasis on the subseasonal to seasonal timescale; (d) enhancing cooperation between public and private hydromet and agromet service providers; and (e) supporting targeted capacity building.

The FSRP provides tailored services to better inform the development of agriculture and risk financing instruments (emergency funds, insurance, derivatives, contingency loans). It also supports the timely delivery and use of essential agro-hydromet information to key users, including farmers and pastoralists, by building their capacity, developing multimodal communication channels, and supporting the co-development of services by engaging users. These investments will target the geographical intervention areas under the project and agricultural products from selected value chains. It also will strengthen the financial and institutional sustainability of regional and national institutions providing climate, hydromet, and agromet information.

Other components of the program support regional and national research and agricultural extension support services, as well as the financial and institutional sustainability of regional institutions providing climate, hydromet, and agromet information. The program supports planning and implementation of integrated land management approaches across the region, as well as the preparation and implementation of **regional policies and regulations to increase regional flows of agricultural goods and inputs produced under climate adaptation strategies adopted to increase food security.**

Applying the Resilience Booster tool, the project design increases the system's robustness and absorptive capacity through the application of integrated land management practices across the region. It increases the **adaptive** capacity of the system through its support for the development of **climate, hydromet, and agromet information systems.** It is **transformative** through its support for the **development of regional institutions** providing **financial and information services** and by supporting the **legislating of regional policies supporting flows of climate-smart agricultural goods and inputs** across the region.

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