SCIENCE FOR A FOOD-SECURE FUTURE

Enhancing Sustainable Land Management and Climate-Resilient Agri-food Systems in Côte d'Ivoire (LARACI) Funding Proposal

Annex 2: Feasibility Study

2 June 2026

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Contents

List of Acronyms

AAA	Adaptation of African Agriculture (AAA) Initiative
AE	Accredited Entity
AfDB	African Development Bank
AfricaRice	Africa Rice Center
AMA	Accreditation Master Agreement
ANADER	National Agency for Rural Development
ASAP	Adaptation for Smallholder Agriculture Programme
BAU	Business as Usual
CAADP	Comprehensive Africa Agriculture Development Programme
CBSD	Cassava brown streak virus disease
CCAFS	CGIAR Research Program on Climate Change, Agriculture, and Food Security
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture
CIS	Climate Information Services
CMD	Cassava Mosaic virus Disease
CSA	Climate-Smart Agriculture
CSAIP	Climate-Smart Agriculture Investment Plan
EE	Executing Entity
FAA	Funded Activity Agreement
FAO	Food and Agriculture Organization of the United Nations
FIRCA	Fonds Interprofessionnel pour la Recherche et le Conseil Agricoles
GDP	Gross domestic product
GGGI	Global Green Growth Institute
GHG	Greenhouse Gas

ICT	Information and Communication Technology
IFAD	International Fund for Agricultural Development
IGREENFIN I	Inclusive Green Financing Initiative
IITA	International Institute of Tropical Agriculture
IPCC	Intergovernmental Panel on Climate Change
MINADER PV	Ministry of Agriculture, Rural Development and Food Production
MINETE	Ministry of Environment and Ecological Transition
MMT	Million Metric Tons
NAP	National Adaptation Plan
NDA	National Designated Authority
NDC	Nationally Determined Contributions
NGO	Non-Governmental Organization
PDC2V	The Food Value Chains Development Project
PDO	Proposed Development Outcomes
PIDACC/NB	Programme for Integrated Development and Adaptation to Climate Change in the Niger Basin
PNACC	National Climate Change Adaptation Plan
PNIA	National Agricultural Investment Programme
PREMOPEF	The Project to Improve the Livelihoods of Smallholders and Women in the N'Zi Region
PROMIRE	Promoting zero-deforestation cocoa production for reducing emissions in Côte d'Ivoire
RCP	Representative Concentration Pathway
REDD	Reducing emissions from deforestation and forest degradation in developing countries
SME	Small and Medium-sized enterprises
SNDR	National Rice Development Strategy
SRI	System of Rice Intensification
UNFCCC	United Nations Framework Convention on Climate Change

WCA	West and Central Africa
WFP	World Food Programme
WMO	World Meteorological Organization

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Executive Summary

Although Côte d'Ivoire contributes minimally to global GHG emissions, it remains highly vulnerable to climate change-related hazards, including droughts, floods, fluctuations in annual rainfall, and increasing coastal erosion. Climate projections indicate that by 2050, the country will face the combined effects of rising temperatures (between +1.3 and +2.3°C), increased frequency of extreme weather events, and changes in rainfall patterns (ranging from -2% to +5%). These climate change impacts are and will continue to pose significant challenges to Côte d'Ivoire's sustainable development objectives.

Economic growth and climate are deeply interconnected in Côte d'Ivoire. Without appropriate adaptation measures, climate change could undermine the hard-earned progress of recent decades, potentially pushing millions of Ivorians into poverty. According to the Intergovernmental Panel on Climate Change (IPCC), Africa's GDP could decline by 2-4% by 2040 and by 10-25% by 2100 due to climate change.[1] For Côte d'Ivoire, this translates to an estimated economic loss of XOF 380 to 770 billion (approximately USD 672 to 1,361 million, based on an exchange rate of 1 USD = 565.45 XOF as of August, 2025).

In Côte d'Ivoire, climate change is significantly affecting agriculture. Rising temperatures, erratic rainfall, and extreme weather events are disrupting crop yields and water availability. These changes make farming more unpredictable, particularly for small-scale farmers, and increase the spread of pests and diseases. The long-term impact threatens food security, drives up food and commodity prices, and puts immense pressure on the country's economy. Alongside these climate-induced challenges, the country is also considered one of the most vulnerable to climate change, ranking 139 out of 187 countries on the ND-GAIN Index[2] mainly due to its economic structure, and its lack of adaptive capacity to respond to the adverse effects of a changing climate.

The project aims to catalyze a paradigm shift towards climate-smart agriculture (CSA) in Côte d'Ivoire, while lowering the carbon footprint of the agriculture sector. This will result in enhanced food and nutrition security for farming communities under current and projected climate change conditions. The project will directly benefit 147,000 farmers and indirectly reach an additional 441,000 people, improving the resilience and livelihoods of a total of 588,000 individuals. The intervention will bring 110,600 hectares of land under improved low-emission and climate-resilient management practices. The project promotes a portfolio of CSA technologies and practices tailored to the country's main food value chains, particularly rice, cassava, and yam. These include soil fertility management, sustainable crop practices (System of Rice Intensification, cassava-legume intercropping, drought-tolerant varieties), efficient plant arrangement and climate-smart staking, as well as climate information services and early warning systems. Post-harvest improvements such as improved husking, parboiling, and storage will reduce losses and enhance value chain profitability. Over its implementation period, the project

[1] IPCC 2024. Synthesis report of the IPCC sixth assessment report (AR6).

[2] Notre Dame Global Adaptation Initiative Country Index (ND-GAIN). (2025). University of Notre Dame.

is expected to reduce 3.7 million tons of CO_2eq, of which 2.9 million tons stem from improved rice production practices. By increasing productivity and value addition, the project will contribute both to climate resilience and to enhanced food security by reducing the exposure of farmers to climate variability. The design assumes continued political commitment, effective institutional coordination, and sustained access to concessional finance. Key risks include political or macroeconomic instability, limited institutional and technical capacity for large-scale CSA dissemination, and potential challenges in ensuring equitable access for women and youth. These risks will be managed through capacity strengthening, inclusive governance mechanisms, and strategic partnerships.

This project aligns with the Government of Côte d'Ivoire's ambition to combine the vision of economic emergence with the implementation of its low-carbon strategy, and supports several priorities identified in the country's Nationally Determined Contributions (NDC) and National Agricultural Investment Plan II (2017-2025).

The project is structured around three components, the first with a national-level focus on system-wide and institutional barriers, while the second and third comprise on-the-ground action to bring concrete adaptation and mitigation impact focusing on the central regions of N'Zi, Moronou, Iffou, La Mé, and Gbêkê. The national-level component will provide essential climate information, build institutional capacity, and develop an enabling environment that supports the scaling of context-specific climate-smart solutions, addressing climate-induced risks while driving a transition to low-emission development. In doing so, this component supports the two regional (field) level components in: (2) reducing GHG emissions and enhancing carbon sequestration, as well as (3) developing/enhancing resilient and low-emissions value chains to support sustainable agri-food systems adapted to climate change challenges. The project focuses on mitigating climate-induced risks and reducing emissions within the high-priority rice, cassava, and yam value chains—commodities that offer both climate resilience and critical importance to food security.

The proposed CSA approaches involve investing in agriculture in ways that take climate change into account and promote climate resilience, enhance agricultural productivity and sustainability, while simultaneously reducing GHG emissions. The LARACI project aims to enable a sustainable transformation that will have both short- and long-term benefits in the region while being scalable and replicable in other regions facing similar agricultural challenges. The aims of the project will be achieved through the development of collaborative partnerships with government agencies to institutionalize CSA practices, capacity building for smallholder farmers and national institutions, improving the enabling environment for investments through policy recommendations and financing mechanisms, and scaling up long-term solutions. This will ensure rural communities can adapt and build resilience to climate shocks and stresses, increase agricultural productivity and value chain profitability for improved food security and incomes, while also reducing GHG emissions.

1 Introduction

1.1 Objective and scope of the feasibility assessment

This feasibility assessment has been conducted to evaluate the viability, relevance, and transformative potential of the proposed LARACI project, a climate-smart agriculture (CSA) intervention designed to enhance climate resilience, and low-emission development in Côte d'Ivoire while generating co-benefits for food security. In line with the country's commitments under its Nationally Determined Contributions (NDCs) and National Agricultural Investment Plan II (PNIA II), the assessment provides a comprehensive analysis of the project's potential to support climate adaptation and mitigation in the agriculture of key crops while delivering sustainable benefits to vulnerable farming communities. The feasibility study identifies the climate risks and systemic challenges facing the agri-food sector, especially in the rice, cassava, and yam value chains, and explores practical CSA solutions to address these. It supports the design of a targeted intervention that can deliver results at both national and subnational levels across five climate-vulnerable regions. The study also assesses the project's technical, financial, environmental, and institutional feasibility, ensuring alignment with the investment criteria and results framework of the Green Climate Fund (GCF).

1.2 Structure of the assessment report

The report is organized into eight main sections and annexes:

Section 1: *Introduction* and document outline.

Section 2: *Country profile* provides an overview of Côte d'Ivoire's socioeconomic context, agricultural systems, and food security landscape.

Section 3: *Climate change in Côte d'Ivoire* presents historical trends, projections, and the observed and anticipated impacts of climate change on agriculture, alongside relevant national climate policies and programs.

Section 4: *Rationale for the LARACI project* outlines the rationale for the CSA approach, geographic focus, prioritized value chains, and core adaptation and mitigation strategies, including how the project aligns with national development priorities.

Section 5: *Regulatory, policy and institutional analysis* examines the enabling environment, institutional readiness, and policy frameworks relevant to CSA deployment.

Section 6: *Project design* details the project objectives, theory of change, supported technologies, implementation arrangements, and the logic behind proposed interventions.

Section 7: *Technical assessment* reviews the technical, financial, environmental, and gender aspects of the project, including sustainability and exit strategies.

Section 8: *Conclusions and Recommendations* summarizes key findings and strategic recommendations for project implementation and investment readiness.

Each section builds upon the preceding analysis to establish the case for GCF investment and country ownership, while identifying pathways for long-term sustainability and replication.

2 Country profile

Côte d'Ivoire is located in West Africa along the Gulf of Guinea, spans an area of 322,462 km² and has borders with Mali and Burkina Faso in the north, Ghana in the east, and Guinea and Liberia in the west. Its diverse topography includes plains in the southern region, plateaus in the center, and mountains in the northern and western areas. The climate varies across the country, with an equatorial climate along the southern coast, tropical conditions in the center, and semiarid climate in the north. Côte d'Ivoire is divided into four agroclimatic zones: the Zone Nord, Zone Centre, Zone Sud-Intérieur, and Zone Littoral, each with distinct rainfall patterns and agricultural potential. In alignment with these zones, Côte d'Ivoire has also established several agropoles, which are regional agricultural growth hubs designed to boost value chains, improve productivity, and promote agro-industrial transformation based on local ecological conditions. These agropoles serve as strategic anchors for climate-smart agricultural development, aligning climate-smart practices with regional strengths in crop and livestock production.

The country's climate features three main seasons: warm and dry (November to March), hot and dry (March to May), and hot and wet (June to October). Rainfall varies across regions, with the southern and coastal areas receiving the most precipitation, up to 1,600 mm annually and the Zone Nord (Northern Zone) receiving between 1,000 to 1,400 mm every year. The Northern Zone experiences one rainy season, while the other zones see multiple rainy seasons, supporting various agricultural activities. These seasonal variations create opportunities for multiple crop cycles in some regions, making agriculture a vital sector for the Ivorian economy. Currently, farmers in Côte d'Ivoire depend on cocoa for 74 percent of their income. However, cocoa production has been a major cause of deforestation over the last decades, particularly in the central regions. Since 1960, Côte d'Ivoire has seen a dramatic decline in its forest cover, with national forest cover reducing from 16 million ha in 1960 to 2 million ha in 2018[3]. The pace of deforestation has been particularly severe since 1986, with rates reaching around 2.8% annually.[4] This loss has not only caused an increase in GHG emissions, but has also resulted in landscape changes, biodiversity loss, soil depletion, and pollution of water resources. This devastating environmental impact has increased the country's vulnerability to climate change, threatening the agricultural economy and the livelihoods of millions of smallholder farmers. This has resulted in farmers, specifically in the old cocoa belt region, looking for alternative livelihood options and more diversified production.

As climate change intensifies, there is an increasing need for solutions that support both the immediate needs of farmers and the long-term goals of sustainability and resilience. Key approaches include diversified cropping systems, agroforestry, sustainable land management, and more efficient water use.

[3] UN REDD Côte d'Ivoire, 2019. Rapport final Programme national.

[4] EU REDD Facility

2.1 Agriculture in Côte d'Ivoire

Agriculture is a cornerstone of Côte d'Ivoire's economy, accounting for nearly 20% of the nation's GDP and approximately 80% of export earnings.[5] However, the sector has been facing a number of challenges from climate hazards which is particularly worrying for the 48% of the population that are currently employed in the sector. Agriculture plays a key role in supporting both economic growth and rural livelihoods, with significant contributions from the cultivation of cash crops, such as cocoa, coffee, rubber, and palm oil, as well as food crops, including maize, yam, and cassava which are currently under threat.

Côte d'Ivoire has 17 million hectares of cultivable land[4], which represents about 53% of its total area, and an estimated 430,685 hectares of irrigable land. However, the sector is limited by several challenges, including high deforestation, soil erosion, land tenure insecurity, weather variability, and climate change, which limits agricultural productivity and hinders efforts to enhance food security.

Côte d'Ivoire's agricultural sector is based on a mix of annual and perennial crop-based systems. The food crop-based systems include key annual crops such as yam, rice, plantain, cassava, and maize, which are vital for domestic consumption. Yam is mainly cultivated in the northern regions, while rice is grown in rainfed, lowland, and irrigated systems throughout the country. Rainfed rice cultivation is the most widespread, particularly in the north, west, and west-central regions, whereas flooded and irrigated rice cultivation occurs in specific areas such as the north-western plains. [6] Plantain is produced primarily for local markets and is often grown alongside cocoa and coffee. Cassava production covers a significant portion of the country's land area and is predominantly grown by smallholders in the forest region in the central, eastern and southern parts of the country. Maize is mainly grown in the northern regions.

Perennial crops such as cocoa, cashew nuts, coffee, rubber, and palm oil also play a major role in the country's agricultural landscape. These crops contribute significantly to the country's GDP, with cocoa alone accounting for about 15%[7]. Cashew production has grown by 40% from 2009 to 2013, establishing Côte d'Ivoire as the world's second-largest producer of cashew[8].

The food crops, including yam, rice, plantain, cassava, and maize, serve as staples for the population and are integral to the Ivorian diet. These crops not only support rural livelihoods but also contribute to food security, providing energy and nutrition for the population. However, challenges such as price volatility and fluctuating market conditions impact the stability of income for farmers and the agricultural sector overall.

The southern regions of Côte d'Ivoire, where most agricultural activity takes place, are well-suited for commercial farming due to favorable climate and abundant rainfall. Key cash crops like cocoa, coffee, rubber, and palm oil are grown in this region, supported by a steady flow of labor from

[5] Food and Agriculture Organization of the United Nations. (2023). *Côte d'Ivoire Ninth Economic Update*. https://openknowledge.fao.org/server/api/core/bitstreams/bd54b741-84d5-421b-b987-236c7a7a0a1a/content

[6] Rice for Africa. 2012. *Côte d'Ivoire*. Available at https://riceforafrica.net/wp-content/uploads/2021/09/Cote_dIvoire_en.pdf

[7] BAD, 2020. Initiative de financement à long terme en Côte d'Ivoire Rapport du diagnostic pays / Septembre 2019

[8] Ibidem

internal and external migrants. However, weak value chain integration limits local processing and keeps the country reliant on raw commodity exports, exposing farmers to global price volatility and income uncertainty.

Among the key food crops, yams, cassava, rice, and maize hold particular importance in the country's agricultural system.

Yam contributes about 4.7% of GDP and provides significant nutritional value, second only to rice. It is the primary staple crop for 60% of the population and is a significant source of income. Primarily cultivated in the central and northern regions, yam holds deep cultural and dietary significance and remains the most important tuber crop in the country. Produced mainly by smallholder farmers, yam contributes significantly to household food security and rural incomes. However, yields are increasingly challenged by soil degradation, pests, post-harvest losses, and climate variability.

Rice is cultivated through various systems, including rainfed, lowland, and irrigated methods, and contributes to 1.72% of the country's GDP. Currently, the country's production covers only 54% of national rice demand, with the remainder being imported at a cost of 0.58 million USD annually[9]. The demand for rice is projected to grow, driven by population growth and urbanization. To meet this demand, the Ivorian Government has implemented the *National Rice Development Strategy* (SNDR), which underscores the importance of enhancing productivity and ensuring sustainable cultivation practices aiming for rice self-sufficiency by 2030. The rice value chain faces several challenges, including limited access to inputs, high transportation costs, and minimal financing options for farmers. However, the increasing popularity of rice, combined with government efforts to improve local production, offers a promising path toward closing the supply-demand gap in the future.

Cassava plays a critical role in food security and is the second most important food crop after yam. However, its production has been declining due to poor yields and limited shelf life. It is predominantly produced for household consumption by smallholders, who stand for 85% of production. Despite this, cassava remains an essential part of the national diet, with growing demand for processed products like *attieke* and *gari* in urban areas and export markets. In 2021, Côte d'Ivoire ranked 13th globally in cassava consumption, with an estimated 2.46 million metric tons consumed.[10] Improving existing production would not only help bolster yields but would also offer potential for job creation, particularly for women involved in its production, processing, and marketing.

Maize, widely cultivated across northern, central, and western regions of Côte d'Ivoire, is the country's third most important cereal crop after rice and millet. It plays a dual role in both food and feed systems, with rising demand driven by urban consumption and the poultry industry. While maize is produced by smallholders, its yield remains relatively low due to limited access to improved seed varieties, fertilizers, and mechanized farming tools. Despite these constraints, maize remains a staple in many Ivorian households, consumed fresh or processed into flour. In

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[9] Ibid.

recent years, the growing agri-food industry and animal feed sector have increased demand for maize, creating opportunities for value chain development

Côte d'Ivoire’s food crop sub-sector faces several challenges, including low yields, limited access to modern farming inputs, and inadequate infrastructure. Over 90% of farmers in Côte d'Ivoire are smallholders, typically cultivating less than 4 hectares of land per 7.1 household members[11]. Additionally, farmers face relatively high post-harvest losses - estimated at 40% for major staples and up to 50% for tubers and bananas. Moreover, post-harvest losses for cereals can sometimes be up to 16% of the harvest[12] These losses are indicative of the inefficiencies in the food production value chain, which is poorly organized. Yet, despite these obstacles, the food crop sub-sector has demonstrated resilience in recent years, enabling the country to become self-sufficient in most key staples, with the notable exceptions of wheat, rice, and dairy.

Côte d'Ivoire's agricultural sector is also affected by environmental and natural resource management challenges. Shifting cultivation, slash-and-burn practices, and bushfires remain common in many regions, contributing to soil degradation, deforestation, and loss of biodiversity[13]. These practices are particularly prevalent in the northern and central parts of the country, where cocoa farming is dominant, and the expansion of agricultural land has been accompanied by a corresponding decrease in forest cover.

The agricultural sector also suffers from limited mechanization, and low adoption of modern farming techniques. While there are significant opportunities to modernize agriculture, particularly through the introduction of better irrigation practices, soil conservation techniques, and improved crop varieties, the sector’s slow pace of development is hindering its ability to increase productivity and compete on the global market. Additionally, there is limited investment in rural infrastructure, particularly in road networks and storage facilities. Finally, limited access to markets continues to restrict the ability of farmers to increase their incomes across the country.

2.2 Country food security and nutrition context

Food and nutrition security in Côte d’Ivoire is closely tied to the performance of the agricultural sector, which is under increasing pressure from declining crop yields, climate-related shocks, and structural challenges. In regions such as N’Zi, Moronou, Iffou, La Mé, and Gbêkê - key agricultural zones in the central and southeastern parts of the country - farmers are grappling with reduced soil fertility, erratic rainfall, and limited access to modern inputs and services. These regions, despite their strong potential for staple crop production like rice, cassava, and yam, continue to experience high levels of rural poverty, significantly surpassing poverty rates in urban areas and contributing to widening income disparities. With a rapidly growing population and increasing vulnerability to climate change, ensuring food and nutrition security in these regions has become an urgent national priority. Targeted investments in climate-smart agriculture and rural

[11] National Census (REEA), 2015

[12] Climate-Smart Agriculture in Côte d’Ivoire (2018), FAO

[13] DJE. K.B. 2014. Document de stratégie du Programme National Changement Climatique (2015-2020). 84 pages + Annexes

development are essential to reverse declining productivity and build resilience in these critical zones.

Climate change is already having a detrimental effect on agricultural production in Côte d'Ivoire, with rising temperatures, erratic rainfall, and more extreme weather events lowering yields. These changes are expected to continue, further exacerbating food insecurity for poor rural farmers and the entire agricultural sector. Côte d'Ivoire's Global Hunger Index was 20.6 in 2024 classified as "serious" and ranking it 89th out of 127 countries.[14] While the situation has improved over the last decade, 9.6% of the population are still considered undernourished. The highest rates of food insecurity are found in agricultural and female-headed households.[15] Climate shocks, unsustainable farming practices, environmental degradation, and high post-harvest losses all contribute to the ongoing food insecurity challenges.

Malnutrition remains a persistent issue, especially among children under five. Stunting affects 23.4% of children under five and 8.1% are considered wasted.[11] Moreover, vulnerable groups such as pregnant and lactating women, children, and people living with HIV are disproportionately affected. The Government has given high priority to improving nutrition countrywide which is demonstrated through its commitment to the UN's Decade of Action on Nutrition and the establishment of the National Nutrition Council in 2016.

The COVID-19 pandemic further exacerbated food insecurity and malnutrition within the country as containment measures impacted livelihood, especially in marginal communities. While 94% of households in Abidjan reported an acceptable level of food consumption,[16] the economic downturn significantly affected food access in other areas, highlighting the urgent need for improved resilience to climate and economic shocks.[17]

[14] Global Hunger Index, 2024

[15] Jonathan, N., 2021. Explaining the Gender Gap in Food Security in Côte d'Ivoire.

[16] COVID-19 Food Security Baseline Assessment in Abidjan, WFP 2020

[17] Economic impacts of COVID-19 in Côte d´Ivoire, IPA 2020

3 Climate change in Côte d'Ivoire

3.1 Baseline climate in Côte d'Ivoire

Côte d’Ivoire spans various climatic zones with savannah climate in the north and tropical climate conditions in the south. The country is typically divided into three main agro-ecological zones based on climate, vegetation, and land use patterns:

- **The Northern Zone** consists largely of savannah and lies within the sub-Sahelian climatic zone. It is characterized by a single rainy season (May to October) and a pronounced dry season. Average annual rainfall in this region ranges from 1,000 to 1,200 mm, with mean temperatures between 26°C and 28°C. The landscape is dominated by grasslands and scattered trees, suitable for cotton, cashew, and livestock farming.
- **The Central Zone** (also referred to as the transitional or forest-savannah zone) experiences a mix of savannah and degraded forest. It has a bi-modal rainfall regime, with a short dry season in August separating two rainy seasons (March–July and September–November). Annual rainfall ranges from 1,200 to 1,600 mm, and average temperatures hover around 26°C. This zone is important for food crops such as yam, cassava, and maize.
- **The Southern Zone,** which includes the forested regions and coastal areas, is characterized by a humid tropical climate and dense vegetation. This region benefits from abundant rainfall (1,600 to over 2,200 mm annually), particularly in the southwest where the evergreen forests are located. Temperatures are relatively stable throughout the year (25–27°C). The coastal and forested areas support cocoa, palm oil, rubber, and other cash crops, making them economically significant for export earnings.

Côte d’Ivoire’s rainy season differs from north to south. In the north, there is a unimodal precipitation regime with a single rainy season from March to October, whereas the south has two rainy seasons lasting from March to July and from October to November.

3.2 Observed climate change in Côte d'Ivoire

Climate change is already being observed in Côte d'Ivoire, with warmer temperatures, increased rainfall variability, and more extreme weather events posing significant challenges to agriculture. Temperatures are on the rise, particularly in the dry season, and research has shown that mean temperatures increased by 1.6°C throughout the country during the period 1960-2010.[18]

Studies by SODEXAM[19] have demonstrated that rainfall patterns have already become more intense, resulting in more frequent seasonal floods and droughts and the late onset and early ends of seasonal rains. Inter-annual fluctuations are significant, with shorter rainy seasons, and

[18] Dje. K.B. 2014. Document de stratégie du Program national Changement climatique (2010-2020); and MINSEDD, 2017. Troisième Communication Nationale (TNC) à la convention cadre des nations Unies sur les Changements Climatiques.

[19] SODEXAM, 2022. Étude des besoins et stratégie de développement des services climatiques dans le domaine de l’agriculture en Côte d’Ivoire. LIVRABLE N°4/14 – V7, 233p.

longer and more frequent dry spells. Delays in the onset of the rainy season vary from one to two weeks depending on location.[20] In the central region targeted by this project, the length of the rainy season has reduced by between 10 to 28 days. This can be compared to 10 to 20 days in the north, 20 to 30 days in the inner south, and 10 to 27 days in the littoral. The annual rainfall has declined by an average 6% over the whole Ivorian territory, with notable decreases by 13% in Sassandra (south-west) and 11% in Adiaké (south-east) during the period of 1971-2000 in comparison to 1961-1990. Between 1940 and 2010, rainfall declined by as much as 28.9% in Abidjan and 23.5% in Soubré, while decreasing less in the forest zones of Gagnoa and Abengourou.

Changes in rainfall patterns are also resulting in heavy rains at times that lead to flash flooding and more frequent landslides. There were approximately 30 floods throughout the country between 2000 and 2015, with an average of three floods per year[21] resulting in the destruction of homes and property, as well as many deaths. Storms are also becoming stronger as demonstrated by reports of local tornadoes and more intense thunderstorms.

3.3 Projected climate change in Côte d'Ivoire

Current climate trends for Côte d'Ivoire suggest that the observed situation in the country will worsen over time, with some areas experiencing more adverse conditions than others. More specifically, temperatures are predicted to continue to rise and current projections show an increase of about 1.3°C by 2030, 1.8°C by 2050, and 2.1°C by 2070, compared to 1960 (Figure 1)[22]. Moreover, temperatures are likely to increase more in the north, east, and central regions than in the southern and western regions. Under the Representative Concentration Pathway (RCP) 4.5 scenario, temperatures could rise by 3°C over most of the country by 2100.[23]

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[20] DJE, 2014 (n 8)

[21] Konate, D.; Didi, S.R.; Dje, K.B.; Diedhiou, A.; Kouassi, K.L.; Kamagate, B.; Paturel, J.-E.; Coulibaly, H.S.J.-P.; Kouadio, C.A.K.; Coulibaly, T.J.H. Observed Changes in Rainfall and Characteristics of Extreme Events in Côte d'Ivoire (West Africa). Hydrology 2023, 10, 104. https:// doi.org/10.3390/hydrology10050104

[22] FAO; ICRISAT; CIAT. 2018. Climate-Smart Agriculture in Côte d'Ivoire. CSA Country Profiles for Africa Series. 23p

[23] FAO; ICRISAT; CIAT. 2018. (n=22)

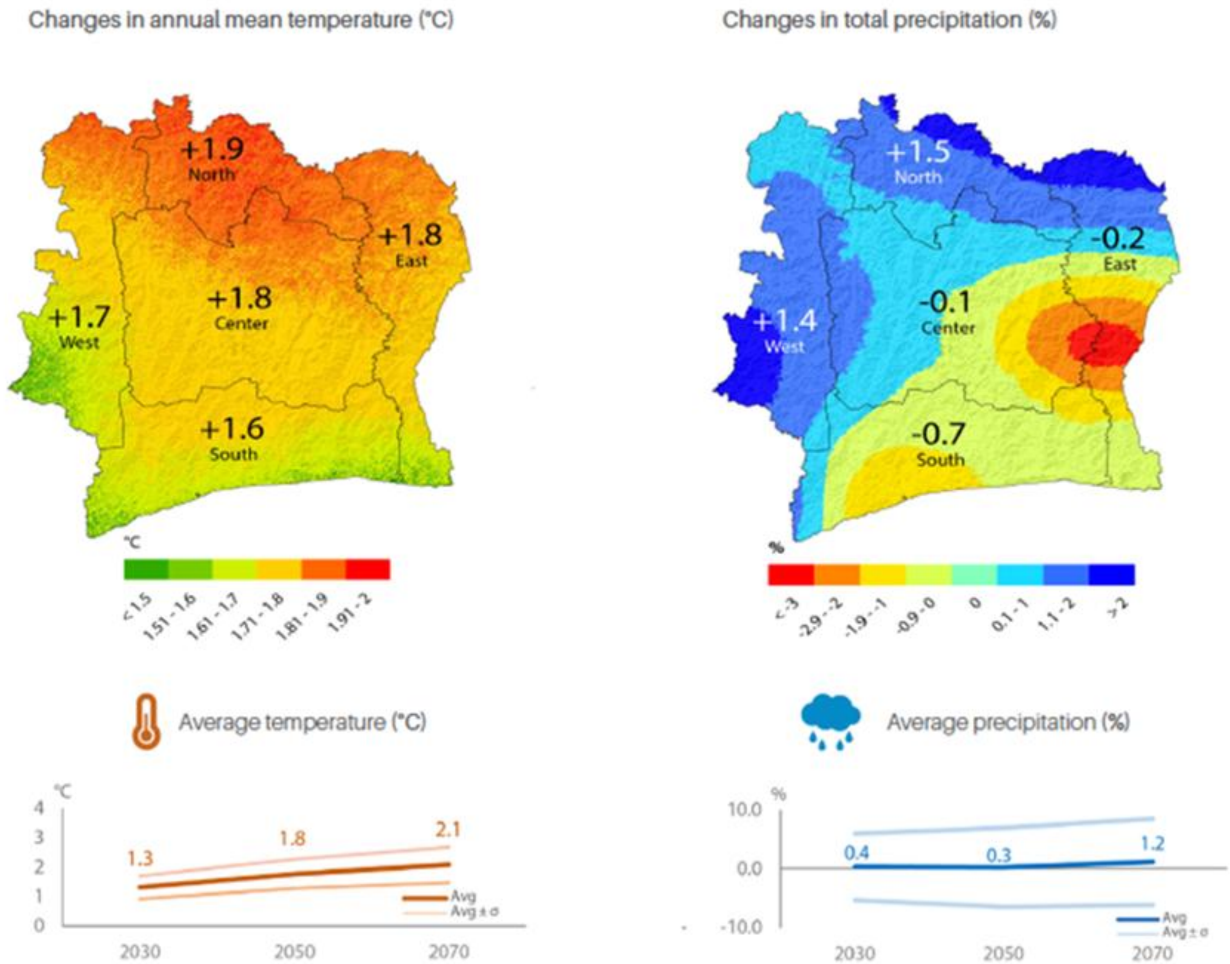

FIGURE 1 PROJECTED CHANGES IN AVERAGE TEMPERATURE AND PRECIPITATION IN CÔTE D'IVOIRE BY 2050[24]

In terms of rainfall, projections according to Côte d'Ivoire's Third National Communication indicate that average annual precipitation could decrease by 3% between 2031- 2040 and by 7% by the end of the century. The highest decrease would be in the northern and western regions (Figure 1).[25] Linear regression analyses and Pearson correlation coefficients between rainfall in agro-climatic zones and cash crop production indicate that rainfall in Agro-Climatic Zone 2, which includes Gagnoa and Abengourou, shows the strongest correlations with cash crop yields in Côte d'Ivoire. Additionally, the production of all cereals (maize, sorghum, millet, fonio), with the exception of rice, is significantly and negatively correlated with potential evapotranspiration in Korhogo, located in the northern zone of the country. Seasonal rainfall patterns will continue to change, with the rainy season durations being contracted. Daily precipitation patterns will also

[24] FAO; ICRISAT; CIAT. 2018.

[25] FAO, 2018. *Climate-Smart Agriculture in Côte d'Ivoire,* CA1322EN/1/08.18 http://www.fao.org/3/ca1322en/CA1322EN.pdf

be affected by variability. For example, based on the RCP 4.5 scenario, by 2100 it is likely that the daily precipitation will decrease by about 8% during the months of April to July.[26]

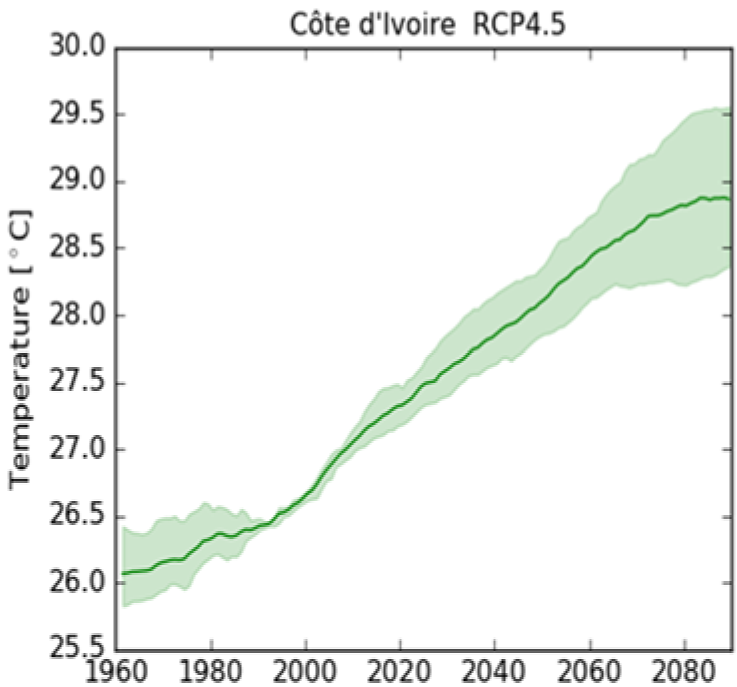

FIGURE 2 PAST AND PROJECTED TEMPERATURES IN CÔTE D'IVOIRE.

THE LINE REPRESENTS THE ENSEMBLE MEAN WHILE THE SHADED AREA REPRESENTS THE MODEL SPREAD. THE PROJECTIONS ARE BASED ON THE RCP4.5 SCENARIO.[27]

3.4 Climate change and variability in the project intervention zone

3.4.1 Temperature

Côte d'Ivoire's climate is shaped by its position within the humid tropical belt of West Africa and the seasonal movement of the Inter-Tropical Convergence Zone (ITCZ). The country exhibits a pronounced north–south climatic gradient. Southern zones, including parts of La Mé and Moronou, experience a humid forest climate with bimodal rainfall (major and minor rainy seasons), while central and northern areas such as Gbêkê and Iffou experience a transition toward a more unimodal rainfall regime typical of the forest–savanna transition zone. N'Zi lies within this intermediate zone.[28]

[26] MINSEDD, 2017. Troisième Communication Nationale (TNC) à la convention cadre des nations Unies sur les Changements Climatiques.

[27] Climate Analytics, 2020. Annual report 2019

[28] World Bank Climate Change Knowledge Portal

Annual mean maximum temperatures across Gbêkê, Iffou, N'Zi, Moronou, and La Mé range between approximately 28°C and 33°C. A clear north–south gradient is observed (Figure 3):

- Gbêkê and Iffou record the warmest average maximum temperatures (30–33ºC), reflecting their more inland and transitional agroecological conditions.
- N'Zi and Moronou exhibit intermediate temperature ranges (29–31ºC).
- La Mé, influenced by southern forest and higher humidity conditions, records relatively lower annual maximum averages (28–30ºC).

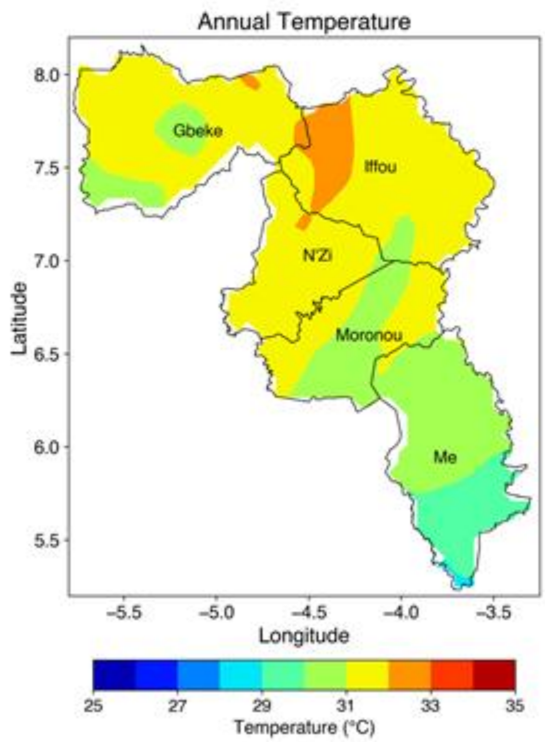

FIGURE 3: SPATIAL DISTRIBUTION OF ANNUAL MAXIMUM TEMPERATURES. SOURCE: CGIAR AFRICA AGRICULTURE ADAPTATION ATLAS (AAAA)

This spatial gradient is important because it determines baseline heat exposure for crops and agricultural labor.

Relative to the 1995–2014 baseline, substantial warming is projected under both emissions pathways (Table 1). Under SSP2-4.5, maximum temperatures are projected to increase by approximately 1.96ºC in Gbêkê, 1.72ºC in Iffou, 1.65ºC in N'Zi, 2.03ºC in Moronou, and 2.51ºC in La Mé. Under the high-emissions scenario (SSP5-8.5), the projected increases are even greater, reaching about 2.89ºC in Gbêkê, 2.72ºC in Iffou, 1.86ºC in N'Zi, 2.65ºC in Moronou, and 3.41ºC in La Mé. These projections suggest pronounced mid-century warming across all regions.[29]

[29] Africa Agriculture Adaptation Atlas available at: https://adaptationatlas.github.io/atlas_notebooksV1/notebooks/heatstressProducers/notebook.html

TABLE 1: PROJECTED MEAN TEMPERATURE INCREASE (°C) BY MID-CENTURY (2041–2060) RELATIVE TO THE BASELINE PERIOD (1995–2014) UNDER SSP2-4.5 AND SSP5-8.5 SCENARIOS ACROSS THE PROJECT INTERVENTION REGIONS.

Region	SSP2-4.5	SSP5-8.5
Gbêkê	+1.96°C	+2.89°C
Iffou	+1.72°C	+2.72°C
N'Zi	+1.65°C	+1.86°C
Moronou	+2.03°C	+2.65°C
La Mé	+2.51°C	+3.41°C

3.4.1.1 Heat stress for crops (NTx35)

To capture frequency of extreme heat, NTx35 was calculated as the number of days per year with daily maximum temperatures exceeding 35ºC, a threshold associated with significant heat stress for many crops. Figure 4 presents the spatial distribution of NTx35 for the baseline period and mid-century projections (2041–2060) under SSP2-4.5 and SSP5-8.5, along with the projected changes in days. During the baseline period, most intervention regions experience relatively low to moderate exposure to extreme heat, generally below 10 days per the main season (March - July), indicating limited but locally relevant heat stress. Slightly higher frequencies are observed in parts of Gbêkê and Iffou compared to the southern region of La Mé, where the number of days above 35ºC remains comparatively lower.

By mid-century under SSP2-4.5, the number of hot days increases across all five regions. The strongest increases are observed in Gbêkê, Iffou, and N'Zi, where anomalies range approximately between 6 and 12 additional days per the main season. Moronou shows moderate increases, while La Mé records smaller but still noticeable changes, particularly in its northern areas. Under SSP5-8.5, the increase in NTx35 is more pronounced and spatially widespread. Northern and central regions, especially Gbêkê and Iffou experience the largest intensification, with projected increases approaching or exceeding 10–15 additional hot days per the main season in some areas. Although La Mé remains relatively less exposed compared to the northern regions, it still shows clear increases relative to the baseline.

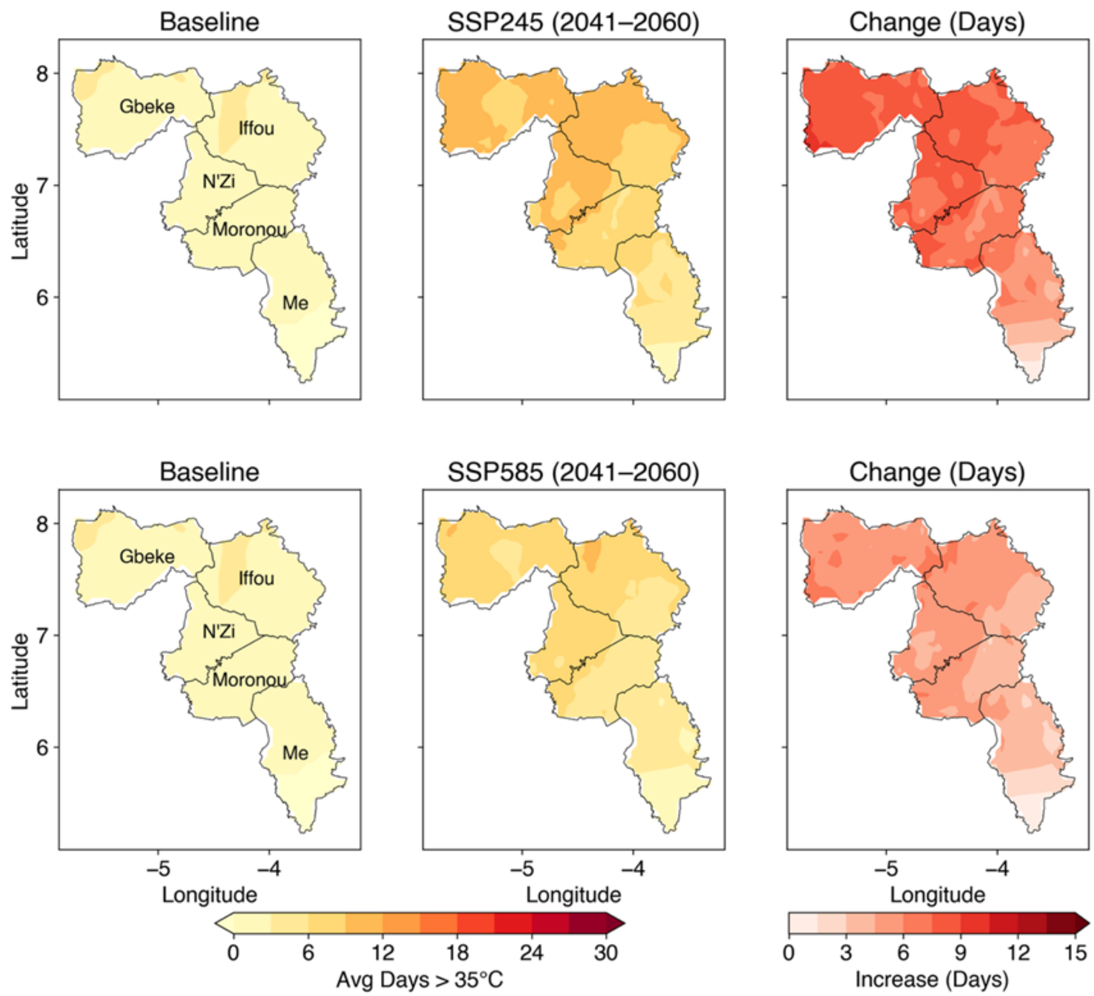

FIGURE 4: BASELINE (1995-2014) AND PROJECTED CROP HEAT STRESS LEVELS (NTX35) INDICATING AREAS VULNERABLE TO HIGH-TEMPERATURE STRESS. SOURCE: CGIAR AFRICA AGRICULTURE ADAPTATION ATLAS (AAAA)

Overall, the projected rise in the number of days exceeding 35ºC suggests a substantial escalation in heat stress risk across Côte d'Ivoire by mid-century, particularly in Gbêkê, Iffou, and N'Zi. Such increases are likely to heighten crop vulnerability, especially during sensitive growth stages, and could significantly affect rice, yam, and cassava productivity under future warming scenarios.

3.4.2 Rainfall

Rainfall across Gbêkê, Iffou, N'Zi, Moronou, and La Mé shows a strong north–south gradient, with higher totals concentrated in the southern parts of the study area. During the baseline period, annual rainfall ranges from approximately 500–700 mm in the northern regions of Gbêkê and Iffou, increases to about 700–900 mm in N'Zi and Moronou, and exceeds 900–1,000 mm in the southern region of La Mé. This spatial distribution reflects progressively wetter conditions toward the southern forest zone (Figure 5).

Mid-century projections (2041–2060) indicate contrasting regional responses under the two emissions scenarios. Under SSP2-4.5, rainfall changes are relatively modest and spatially mixed. Northern regions, particularly Gbêkê and Iffou show slight increases in total rainfall, while parts of N'Zi and Moronou exhibit minor declines. The southern region of La Mé shows little overall change, with localized decreases in some areas. Overall anomalies under SSP2-4.5 generally remain within ±20 mm, suggesting limited but spatially variable shifts in rainfall totals.[30]

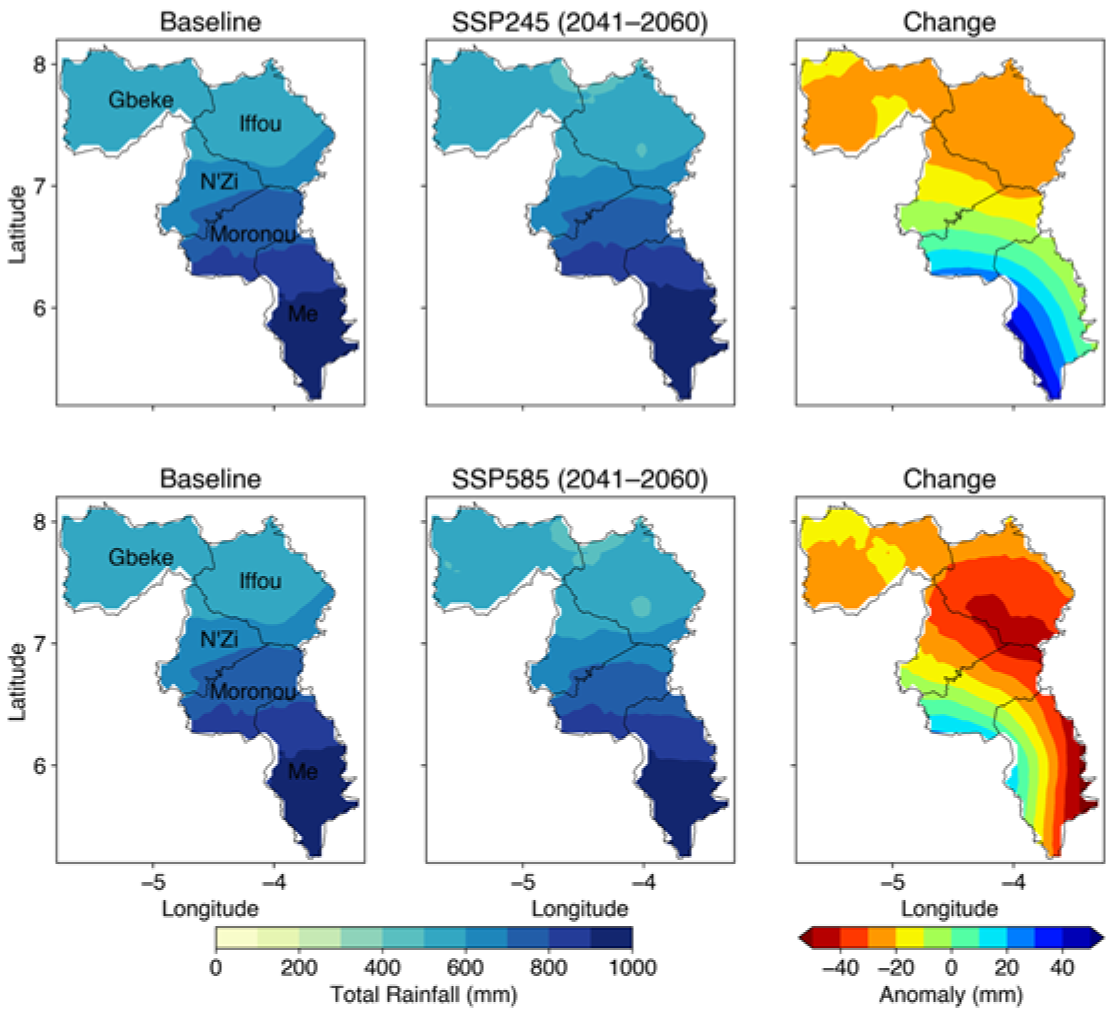

FIGURE 5: MEAN TOTAL RAINFALL PATTERNS DURING MAIN SEASON (MARCH TO JULY). SOURCE: CGIAR AFRICA AGRICULTURE ADAPTATION ATLAS (AAAA)

Under the high-emissions scenario (SSP5-8.5), projected changes become more pronounced and spatially differentiated. Iffou and central N'Zi show notable rainfall increases, with positive anomalies reaching approximately 20–40 mm in some areas. In contrast, Moronou and especially La Mé display substantial declines, with negative anomalies approaching −40 mm in southern

[30] SODEXAM

parts of La Mé. Gbêkê shows moderate increases, but the overall pattern under SSP5-8.5 highlights a strengthening of rainfall contrasts across the region.

These projections suggest that while some northern and central areas may experience moderate increases in rainfall, southern zones particularly La Mé could face declining precipitation under high-emission conditions. Such spatial divergence is critical for agricultural planning, as increased rainfall in some areas may enhance water availability, whereas reductions elsewhere could intensify drought risk and compound heat-related stress. The contrasting responses between SSP2-4.5 and SSP5-8.5 further emphasize the importance of considering multiple emission pathways in adaptation strategies, given that rainfall changes are unlikely to be uniform across regions.

3.4.2.1 Drought stress

Soil water stress is a key factor influencing crop growth and agricultural productivity, particularly in regions with limited or unpredictable water availability. To capture this dimension of risk, the number of dry days (NDD) was assessed and interpreted using four stress categories: No significant stress (<15 days), Moderate (15–20 days), Severe (20–25 days), and Extreme (>25 days). As shown in the baseline map, dry-day exposure is already spatially uneven: Gbêkê and Iffou exhibit the highest baseline dry-day totals, with large areas falling in the severe (20–25 days) class and pockets approaching extreme (>25 days) conditions. N'Zi and Moronou generally sit in the moderate to severe range, while La Mé shows the lowest baseline dry-day burden, largely remaining under 15 days (no significant stress), especially toward the southern end of the region.

Mid-century projections (2041–2060) indicate that dry days increase across all regions under both scenarios, intensifying soil water stress. Under SSP2-4.5, the projected increases are +5.03 days (Gbêkê), +2.81 days (Iffou), +3.07 days (N'Zi), +4.75 days (Moronou), and +9.31 days (La Mé). Under SSP5-8.5, changes are very similar in magnitude +5.05 days (Gbêkê), +2.95 days (Iffou), +3.19 days (N'Zi), +4.87 days (Moronou), and +9.38 days (La Mé) but reinforce the same pattern of widespread drying. In practical terms, these increases are most likely to push Gbêkê and Iffou more frequently into the extreme category, given their already high baseline dry-day totals, while N'Zi and Moronou are likely to shift further toward severe conditions in many areas. Although La Mé begins with comparatively low baseline dryness, its much larger projected increase (around +9 days) suggests a meaningful transition from no significant stress toward moderate and in some places potentially severe dry-day exposure by mid-century. Overall, the projected rise in dry days points to heightened soil moisture limitations across the study area, with particularly strong implications for water-sensitive crop stages such as establishment, flowering, and tuber bulking.

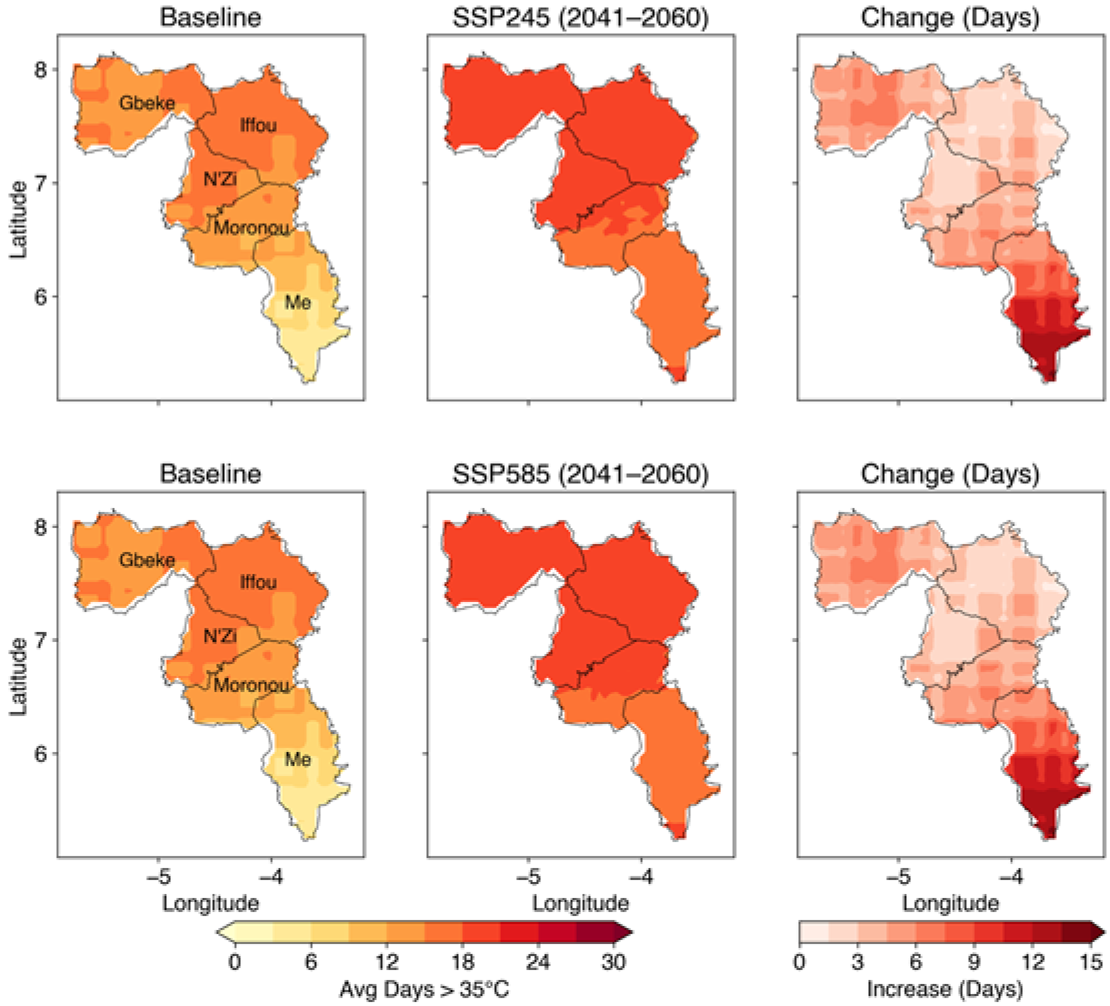

FIGURE 6: SPATIAL DISTRIBUTION OF THE ANNUAL NUMBER OF DRY DAYS (NDD) DURING THE BASELINE PERIOD AND PROJECTED MID-CENTURY CHANGES (2041–2060) UNDER SSP2-4.5 AND SSP5-8.5. SOURCE: CGIAR AFRICA AGRICULTURE ADAPTATION ATLAS (AAAA)

3.5 Impact of climate change on the agri-food sector

Agriculture is a pivotal part of the economy in Côte d'Ivoire, and the country is one of the world's top exporters of cocoa, palm oil, banana, and cashews. Agriculture accounts for nearly 20% of the nation's GDP and approximately 80% of export earnings and provides employment for around 48% of the population. Moreover, in rural areas, where just under half of the population lives, more than 75% of people are engaged in agriculture.

The agricultural sector in Côte d'Ivoire is already facing severe challenges due to climate change, which threatens the stability and productivity of the country's agrifood systems. According to the World Bank, climate change is expected to be the most significant driver of agricultural disruption in the coming decades, with crop production at risk of declining by up to 16% by 2050 if current trends continue.[31] The impacts of climate change are already evident in the country, with rising temperatures, shifting precipitation patterns, and extreme weather events such as droughts and floods increasingly affecting agricultural productivity. Moreover, the increasing temperatures and changing precipitation patterns are facilitating the spread of pests and diseases.[32]

The vulnerability of Côte d'Ivoire's agricultural systems is compounded by the fact that a significant proportion of farming relies on rainfed agriculture, with only about 0.2% of the country's cropland irrigated.[33] The use of irrigation in the country is limited due to low levels of mechanization and limited public investments. There is an estimated 430,685 ha of national crop land suitable for irrigation, yet only around 8% of this area is irrigated.[34] This leaves farmers highly exposed to climate-related risks, including water scarcity, which has already led to substantial declines in crop yields, threatening future food security and exacerbating poverty in rural areas.

The central regions of Côte d'Ivoire, known as the "old cocoa belt", have been significantly impacted by both climate change and unsustainable agricultural practices. The rapid expansion of cocoa farms in these regions has resulted in a high amount of deforestation, which has led to land degradation, loss of biodiversity, and soil depletion. This continued cycle of environmental degradation has caused the land to lose its ability to retain water, prevent erosion, and regulate temperatures, making these areas more vulnerable to further climate shocks. The situation is further exacerbated by the limited diversity of crops in these regions. Furthermore, deforestation and the over-exploitation of soil have reduced the ability of the land and biomass to absorb carbon, contributing to GHG emissions.

The climate risks are particularly concerning in the N'Zi, Moronou, Iffou, La Mé, and Gbêkê regions, where the climate is predicted to shift from humid to semi-humid or even semi-arid by 2100.[35] These changes threaten traditional crop systems like cocoa, which have supported rural economies in these areas for generations. The country now has an urgent need for climate-resilient agricultural practices that focus on more resilient crops to help to reduce farmers' exposure to climate variability, strengthen food security over the long term, alleviate poverty, and restore environmental health. As climate change worsens, there is a growing demand for solutions that not only address the immediate needs of farmers but also promote long-term sustainability and climate resilience. These solutions include more diversified cropping systems, agroforestry practices, sustainable land management, and improved water use efficiency.

Beyond the direct impacts on crop yields, the increased frequency of droughts, floods, heatwaves, and water stress poses a significant threat to rural communities who are already

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[31] World Bank, 2023: *Country Climate and Development Report: Côte d'Ivoire*: https://openknowledge.worldbank.org/server/api/core/bitstreams/79b4732d-63a6-41ea-bfff-75f656a826f5/content

[32] SODEXAM (n 9)

[33] World Bank, Coat of Arms of Ivory Coast, Initiative for the adaptation of African agriculture, International Center for Tropical Agriculture (CIAT), Climate Change, Agriculture and Food Security Research Program (CCAFS), 2019: *Climate-smart Agriculture Investment Plan for Côte d'Ivoire (CSAIP)*; documents1.worldbank.org/curated/en/181591575308113164/pdf/Climate-Smart-Agriculture-Investment-Plan-for-Cote-d-Ivoire.pdf

[34] FAO, "Adapting Irrigation to Climate Change (AICCA): Côte d'Ivoire." Online available: http://www.fao.org/in-action/aicca/country-activities/cote-divoire/background/en

[35] Asaph Yahot et al 2023: « Impacts du changement climatique sur les régimes climatiques futurs en Afrique de l'Ouest : Cas du bassin versant du N'Zi (Bandama, Côte d'Ivoire) », *Bulletin de l'association de géographes français*, 100-1 | 2023, DOI : https://doi.org/10.4000/bagf.10813

more vulnerable due to limited access to resources. More frequent extreme weather events such as flash floods and droughts are leading to crop destruction, soil erosion, and infrastructure damage. These groups also face challenges in obtaining finance, information, and adaptive technologies, making it harder for them to cope with climate impacts. These events highlight the vulnerability of the agricultural sector and the urgent need for adaptation measures to protect both people and crops from the worsening effects of climate change.

According to the UNFCCC[36], the adverse impacts of drought, floods, and extreme rainfall are often felt more acutely by women than men. In Côte d'Ivoire, women have comparatively lower access to resources, inputs and technologies such as water for irrigation, fertilizer, seeds of improved varieties, agricultural and climate-smart agricultural processing practices, and innovations in general. This is primarily due to systemic gender discrimination and societal expectations surrounding gender roles. In Côte d'Ivoire, women are particularly vulnerable to the negative effects of climate change because these sociocultural factors constrain their ownership of productive resources (notably land). Their ability to adapt is constrained by economic disparities and limited access to finance, and the lack of control on labor worsened by unequal distribution of domestic labor. Moreover, due to illiteracy, women often face significant barriers to accessing capacity building programs and agricultural information and extension services, leaving them more susceptible to climate-related shocks[37] which negatively impacts the agricultural sector by hindering its ability to develop and adapt.[38]

However, the UNFCCC report[39] also highlights that climate change can often present opportunities for women in agriculture and other industries whose livelihoods are improved when the climate smart technologies/practices specifically address their constraints Furthermore, the impacts of climate change can challenge traditional gender roles which helps create space for women to engage more actively in leadership and decision-making processes. Additionally, inclusive governance, supported by international organizations and national governments, has been shown to lead to the development of effective climate resilience policies. By integrating women and marginalized groups into decision-making, such governance can foster long-lasting improvements in social equity and gender equality, ultimately contributing to stronger, more resilient communities.

Climate change is also increasingly affecting the post-harvest phase of staple crops such as rice, cassava, and yam in Côte d'Ivoire, leading to substantial losses in food quantity, quality, and economic value. Rising temperatures, unpredictable rainfall, and higher humidity levels disrupt harvest and drying periods, resulting in increased spoilage, mold growth, and fermentation, especially for rice. Root and tuber crops like cassava and yam, which are already prone to rapid deterioration after harvest, are particularly vulnerable to heat-induced physiological damage, rot, and microbial infestations when storage conditions are poor or harvests are delayed due to

[36] UNFCCC, 2022. Dimensions and examples of the gender-differentiated impacts of climate change, the role of women as agents of change and opportunities for women. UNFCCC Synthesis report, Bonn, 20p.

[37] Ibid

[38] World Bank, 2023 (n 28)

[39] UNFCC, 2022 (n 27)

erratic weather. These challenges are further exacerbated by weak infrastructure and limited access to timely post-harvest information. Lack of upgraded extension offices that are equipped with ICT tools, result in reduced dissemination of agro-advisories such as real-time weather alerts, optimal harvest timing, and climate-resilient storage techniques.

While the demand for yam is expected to double in the next 30 years, its productivity has been declining due to factors such as soil degradation and climate change.[40] The effects of climate change have made yam cultivation, already a fragile production system, even more unstable. Projections indicate that without improvements in productivity, meeting the growing demand will require significantly expanding cultivation areas, exacerbating deforestation and environmental degradation. The main challenges to yam production include changing temperatures and water stress. Temperature variations impact yam growth and development and can also impact the timing of planting and harvesting which can impact crop yield. Additionally, yam requires a well-distributed and consistent water supply so changing precipitation patterns and increased frequency of droughts can significantly impact production. There are untapped opportunities to catalyze agribusiness toward meeting the demand for yam products and improving youth employment outlook. Yields average about 5.5 tons/ha, compared to potential yields which can increase by up to 40% with the use of CSA technologies. Compounding challenges include the labor-intensity of planting and harvesting, the long crop cycle, poor seed multiplication ratio, and the significant variability of nutritional value, yield, texture, and perishability post-harvest affected by soil quality and climatic factors.

Rice is another essential crop in Côte d'Ivoire, forming a significant and increasing part of the national diet. It is grown in Côte d'Ivoire through three production systems—rainfed, lowland, and irrigated. Traditionally, rice production has been concentrated in lowland floodplains, accounting for 48% of harvested areas, with upland rain-fed cultivation also significant. However, climate change poses substantial challenges to these traditional practices. Decreased and more erratic rainfall have led to water shortages, particularly affecting highland and plateau regions, resulting in reduced yields and a shift to a single cropping season annually[41.] This is illustrated by the reduction in rice production that occurred due to poor rainfall during the 2016-2017 growing season.

This led to a 27% drop in rice production[42], and many households were forced to reduce their food intake, with 72% reporting that they ate fewer meals. In addition to these socio-economic impacts, rice production systems contribute to climate change through significant greenhouse gas (GHG) emissions, particularly methane from flooded paddy fields. However, despite the urgent need for both climate adaptation and mitigation, the uptake of climate-smart practices remains low. This is largely due to barriers such as limited access to timely climate information,

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[40] https://nph.onlinelibrary.wiley.com/doi/10.1002/ppp3.10459

[41] https://www.fao.org/in-action/aicca/news/detail-events/en/c/878311/

[42] World Bank, Coat of Arms of Ivory Coast, Initiative for the adaptation of African agriculture, International Center for Tropical Agriculture (CIAT), Climate Change, Agriculture and Food Security Research Program (CCAFS), 2019: *Climate-smart Agriculture Investment Plan for Cote d'Ivoire (CSAIP)*; documents1.worldbank.org/curated/en/181591575308113164/pdf/Climate-Smart-Agriculture-Investment-Plan-for-Cote-d-Ivoire.pdf

insufficient extension services, and the high initial cost of adopting improved technologies, such as alternate wetting and drying or improved seed varieties, that could make rice cultivation more resilient and sustainable

Cassava (Manihot esculenta Crantz) is another vital staple crop in Côte d'Ivoire, playing a significant role in the nation's food security and economy. Studies indicate that increased temperatures can enhance the fecundity and development rate of cassava pests, such as the whitefly, potentially leading to greater infestations. Conversely, other research suggests that cassava may benefit from elevated CO_2 levels, with potential yield increases projected under certain climate scenarios. However, such benefits are contingent upon effective pest and disease management, which could be compromised by a lack of climate information. While its production is widespread, supply is currently decreasing due to decreasing yield and diminishing planted area[43]. We have performed a financial analysis (See Annex 3) during this study which demonstrates a limited Net Present Value of Cassava farms under business as usual (BAU) within projected climate conditions. Such limited returns partially explain the reducing interest of smallholders in the cultivation of the crop and therefore the diminishing planted areas despite the growing demand. Moving away from these BAU scenarios and unlocking the potential of cassava through adoption of climate smart technologies that can improve both yields and economic returns of smallholders is of high priority for the Ivorian Government.

3.6 Climate policies and programs

Côte d'Ivoire has introduced several policies and programs aimed at adapting to and mitigating the impacts of climate change. The country ratified the Paris Agreement in 2016 and submitted their first Nationally Determined Contribution (NDC) the same year, and then a Revised NDC in 2022. Other climate strategies include the National Action Plan (NAP) which is currently being finalized and the Climate-Smart Agriculture Investment Plan (CSAIP) (2019).

3.6.1 NDC

In the revised NDC (2022), the country commits to an unconditional target of decreasing economy-wide emissions by 30.41% and a target of 98.95% reduction in emissions by 2030 conditional on receiving international support. The revised NDC contains adaptation targets for the agriculture, forestry and other land use, water, and coastal sectors. The mitigation actions are estimated to cost USD 10 billion and a further USD 12 billion is required to implement the required adaptation actions.[44] The NDC integrates considerations for green jobs, gender, local authorities, and short-lived climate pollutants. The implementation is supported by an investment plan to mobilize climate finance, along with partnerships and monitoring frameworks.

[43] World Bank, Coat of Arms of Ivory Coast, Initiative for the adaptation of African agriculture, International Center for Tropical Agriculture (CIAT), Climate Change, Agriculture and Food Security Research Program (CCAFS), 2019: *Climate-smart Agriculture Investment Plan for Cote d'Ivoire (CSAIP)*; documents1.worldbank.org/curated/en/181591575308113164/pdf/Climate-Smart-Agriculture-Investment-Plan-for-Cote-d-Ivoire.pdf

[44] UNDP, 2023

3.6.2 NAP

The country's updated NAP is currently under completion and aims to integrate climate adaptation strategies into national development planning, focusing on sectors including agriculture, water resources, health, and coastal zones. Several adaptation options have been identified for the agricultural sector, including agroforestry, CSA, meteorological information systems, development and access to seeds of improved varieties, and soil fertility.

3.6.3 CSAIP

Côte d'Ivoire has developed a Climate-Smart Agriculture Investment Plan (CSAIP) to enhance the resilience and sustainability of its agricultural sector in the face of climate change. This initiative aligns with the country's commitments under the Paris Agreement and its NDC.

The CSAIP is a strategic framework that has been developed with support from the Adaptation of African Agriculture (AAA) Initiative and the World Bank, with technical assistance from the CGIAR Research Program on Climate Change, Agriculture, and Food Security (CCAFS). The CSAIP's framework aims to integrate climate-smart agricultural practices to improve productivity, build resilience to climate change and, as appropriate, reduce greenhouse gas emissions in the agriculture sector.

The CSAIP was developed through a participatory approach and encourages collaboration among government bodies, agricultural stakeholders, and international partners. This helps to ensure that the interventions are tailored to suit local needs and helps develop support for the interventions among key local stakeholders. The plan identified 12 key investments and actions that will help the sector adapt to climate change, benefiting over 2.2 million people.

These 12 key investments focus on:

- Maize development
- Cassava production
- The Abidjan market
- Agrometeorological systems
- The mango value chain
- Rainfed rice
- Agricultural finance services
- The livestock sector
- Yam production and processing
- Cocoa
- Soil fertility
- Agricultural extension

The 12 key investment areas all have equal priority in the CSAIP and have been categorized in Table 2 based on zone.

TABLE 2: CSAIP INVESTMENTS BY ZONE AS PRESENTED IN THE CSAIP[45].

NORTHERN SAVANNAH	**CENTRAL ZONE**	**SOUTHERN FOREST ZONE**	**NATIONAL LEVEL**
Maize development	Cassava production	Abidjan market	Agrometeorological system
Mango value chain	Rainfed rice	Cassava production	Agricultural finance services
Livestock sector	Yam production & processing	Cocoa	Soil fertility
Yam production & processing			Agricultural extension

[45] World Bank, Coat of Arms of Ivory Coast, Initiative for the adaptation of African agriculture, International Center for Tropical Agriculture (CIAT), Climate Change, Agriculture and Food Security Research Program (CCAFS), 2019: *Climate-smart Agriculture Investment Plan for Cote d'Ivoire (CSAIP)*; documents1.worldbank.org/curated/en/181591575308113164/pdf/Climate-Smart-Agriculture-Investment-Plan-for-Cote-d-Ivoire.pdf

4 Rationale for the LARACI project

Côte d'Ivoire is facing increasing climate-related challenges that threaten agricultural productivity, food security, and livelihoods, especially in the central regions. Farmers are already contending with reduced crop yields, soil degradation, and decreased ecosystem productivity, which are only expected to increase moving forward. Diversifying production and focusing on crops that are more climate resilient, such as rice, cassava, and yam, could help increase the resilience of agricultural value chains, improve food security, reduce GHG emissions, and contribute to positive environmental impacts.

The LARACI project seeks to address critical climate change impacts on Côte d'Ivoire's agrifood sector by promoting Climate-Smart Agriculture (CSA) practices that enhance climate-resilience, reduce emissions, and improve the productivity of key value chains. By focusing on the challenges of climate risks and the vulnerabilities associated with the prevailing land degradation and deforestation affecting rice, cassava, and yam production, the project will foster sustainable agricultural practices that support both adaptation and mitigation objectives. Through the integration of innovative technologies, improved financial services, and capacity-building efforts, the project will strengthen the resilience of smallholder farmers and contribute to a low-carbon, climate-resilient agrifood system in Côte d'Ivoire.

4.1 Climate-smart agriculture

Climate-Smart Agriculture (CSA) is an integrated approach designed to help communities adapt to climate risks, build resilience, and enhance food security while promoting sustainable, low-carbon development. Rooted in three core pillars (enhancing resilience, increasing agricultural productivity, and reducing greenhouse gas emissions) CSA promotes a range of practices, from improved soil, water, and pest management to the use of climate advisory services, access to credit, and post-harvest innovations. The LARACI project aims to apply CSA technologies across agricultural value chains to address adaptation, mitigation, and food security in synergy. By incorporating sustainable methods such as crop diversification, water management, and agroforestry, CSA supports the transition toward climate-resilient, low-carbon and environmentally sustainable agrifood systems, particularly in vulnerable rural communities.

In Côte d'Ivoire, CSA is essential given the country's reliance on rainfed farming and the increasing threats posed by climate change. Rising temperatures, erratic rainfall, and extreme weather events are already affecting crop yields, threatening key value chains, and deepening rural poverty. Without adaptation, staple crops such as rice, yam, and cassava face significant risks, making it critical to explore and implement CSA solutions.

Currently, most investments in the country are dealing with the issues of adaptation, mitigation, and food security separately under different projects. As a result, the trade-offs and synergies that need to be considered together to effectively address the multi-dimensional challenges faced by the producers and value chain actors in a climate context are not effectively captured or factored into programming, which hinders progress and misses the opportunity for systems transformation. Moreover, CSA adoption remains limited due to several barriers including restricted access to climate information, and high initial implementation costs. These constraints and barriers are reviewed in more detail in section 6.2.

Currently, the banana-cocoa integrated system appears to be the most widely implemented CSA practice in Côte d’Ivoire, covering approximately 13% of agricultural land. Its relatively broader adoption has been facilitated by low technological requirements, active private sector involvement, and multiple benefits, including food production, income diversification, and enhanced overall system resilience.[46]

Although adoption remains limited, examples of currently implemented CSA practices across the country include:

1. **Alley cropping**: This technique involves planting food, forage, or specialty crops between rows of trees. In Côte d'Ivoire, it is commonly practiced in the Guinea savannah zones in the north of the country, where crops like groundnut and maize are planted alongside leguminous trees such as *Gliricidia sepium*, which help improve soil fertility.
2. **Use of organic manure**: Organic manure, which mostly comes from poultry, is widely used in cereal-based systems and cocoa plantations across the country. This helps improve soil health and sustainable farming practices.
3. **Use of weather information**: Initiatives like METAGRI, launched in 2008 by the World Meteorological Organization and the Spanish State Agency for Meteorology, have helped to provide farmers' initial access to climate information but the scope was limited to seasonal information. This has enabled farmers in the target regions to understand the usefulness of weather forecasts for making more informed planting decisions. The METAGRI project also noted in its terminal evaluation report that regular provision of agrometeorological information would help farmers to manage the risks associated with increased climate variability, a gap which LARACI aims to address.
4. **Water control through irrigation**: Various irrigation techniques are being adopted across the country to ensure better water availability, especially during droughts. Sprinkler systems are commonly used in areas such as the alluvial plains, which are known best for vegetables, rice, pineapples, and bananas, and in the sugar-producing regions. The most prominent irrigation methods in the country, however, include the equipping of inland valley bottoms and the promotion of drip irrigation for vegetable gardens, helping to diversify diets, improve food security, generate income, and increase resilience to climate change.
5. **Anti-erosion measures**: A range of erosion control practices are being implemented, such as planting grass around drains to prevent erosion in banana fields. Additionally, techniques like terraces, contour ridges, and erosion control strips have been tested in areas like Adiopodoumé and Bouaké, showing significant reductions in soil loss and runoff compared to control plots.

[46] Climate Smart Agriculture in Cote d’Ivoire, FAO

6. **Cocoa-banana association**: This temporary association practice involves planting cocoa alongside banana trees, allowing the cocoa to benefit from the shade provided by the bananas during its early stages of growth. This practice has proven to be effective, especially during periods of prolonged dry spells, contributing to better yields and resilience.

These CSA practices offer a pathway to improving environmental sustainability while enhancing farmers' productivity, resilience, and income in the face of climate change.

Enhancing CSA practices across the country could help support the industry while mitigating the impacts of change. On the economic front, CSA practices support farmers' resilience by diversifying crops, focusing on more resilient ones, thus reducing farmers’ exposure to climate change, which in turn improves future food security. For instance, the cocoa-banana association allows for greater production stability during dry spells, as the banana trees provide shade for cocoa plants which helps to promote their growth. Additionally, CSA practices can provide farmers with new income-generating opportunities by diversifying the range of crops grown and by facilitating access to more sustainable markets for climate-resilient products. With better access to climate information and capacity-building programs, farmers can make informed decisions about planting times, crop types, and irrigation, leading to higher yields and more predictable income streams. Overall, CSA offers a pathway for improving both environmental sustainability and economic resilience in Côte d'Ivoire's agriculture sector.

4.2 Project location

The central regions of N’Zi, Moronou, Iffou, La Mé, and Gbêkê (Figure 7) were prioritized by national stakeholders as the preferred project intervention zone because in recent years, climatic disturbances in these regions have had major consequences on agricultural production. Moreover, research has shown that the climate in this region is expected to transition from a humid climate to a semi-humid or even semi-arid climate between 2050 and 2100[47].

[47] Asaph Yahot et al 2023: « Impacts du changement climatique sur les régimes climatiques futurs en Afrique de l’Ouest : Cas du bassin versant du N’Zi (Bandama, Côte d’Ivoire) », *Bulletin de l’association de géographes français*, 100-1 | 2023, DOI : https://doi.org/10.4000/bagf.10813

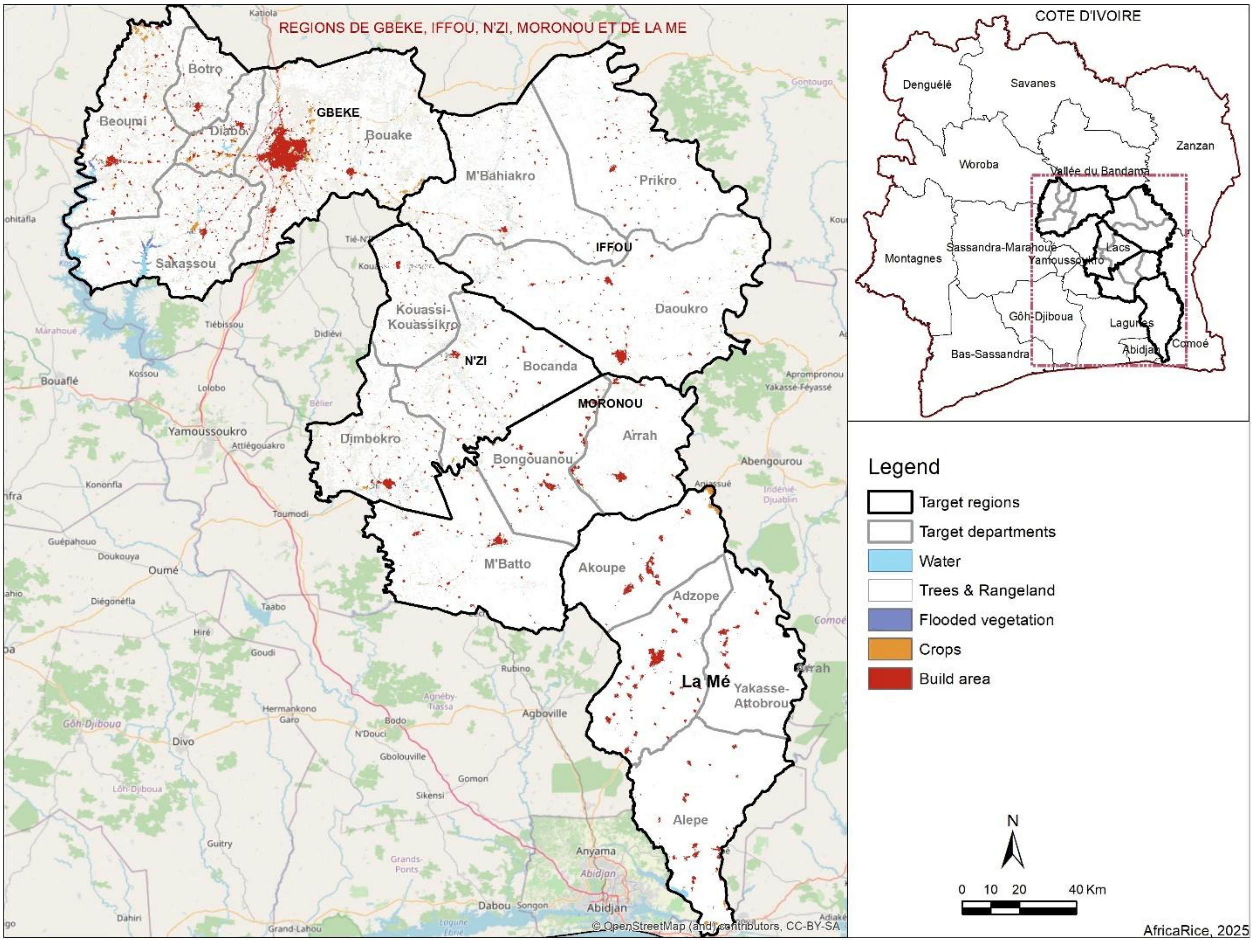

FIGURE 7: MAP OF THE TARGETED REGIONS

The region, commonly called the old "cocoa belt", is watered by the N'Zi river whose plains are suitable for rice cultivation, as well as many other agricultural crops such as yams, cassava, corn, plantains, and peanuts as well as market gardening and fruit crops.

The central regions of Côte d'Ivoire have become particularly vulnerable to climate change due to the historical over-exploitation of forests and the rapid expansion of cropland. Cocoa farming, which provides 74% of farmers' income in the country, has been a significant driver of deforestation, especially in the targeted areas. As a result, national forest cover has declined sharply, from 16 million hectares in 1960 to just 2 million hectares in 2018.[48] This loss of forest has led to significant changes in the landscape, including biodiversity loss, soil degradation, water pollution, and a diminished ability of the land to sequester carbon. The overuse of soil for agricultural production has further resulted in fertility loss, erosion, and a rise in greenhouse gas emissions, with the agriculture sector becoming a major contributor to the country's emissions.[49] These environmental impacts have made the agricultural landscape more susceptible to climate change, intensifying its effects while simultaneously contributing to the acceleration of climate

[48] UN REDD Cote d'Ivoire, 2019. *Rapport final Programme national*.

[49] NDC Cote d'Ivoire, 2022: Contributions Déterminées au niveau National. Version révisée. Mars 2022.

change itself. Given the destructive consequences of cocoa production on both the environment and local communities,[50] farmers and national stakeholders in the region are seeking more climate-resilient alternatives that can improve long-term food and nutrition security, boost livelihoods, and reduce GHG emissions and the overall environmental footprint of agricultural practices.[51]

4.3 Value chain prioritization

Côte d'Ivoire's agricultural landscape is diverse, with many crops contributing to the local diet and economy. The LARACI project will focus on three priority value chains: yam, cassava, and rice. These were identified as particularly important to address and reduce climate risks of the agrifood system in the targeted central regions. Their priority was based on the analysis of the CSAIP[52] and confirmed by stakeholder consultation. Several factors were taken into account in this selection, considering both the immediate and long-term impacts of climate change on the overall agrifood system productivity and sustainability, food security, economic development, environmental sustainability, and social welfare; while also considering the potential for mitigation of emissions from the agrifood sector.

The three value chains are a central priority for food security due to their importance in the Ivorian diet. At the same time, they have potential to be relatively climate-resilient with appropriate CSA measures and have a strong mitigation potential. Yam and cassava together account for 35% of the daily calorie intake for Ivorians whereas rice accounts for 61% of cereal intake. Additionally, rice represents 45% of all cereals grown. Table 3 outlines the criteria applied to evaluate the potential impact of each value chain, with specific weightings assigned to reflect their relative potential to ensure the success of the intervention.

TABLE 3: CRITERIA FOR VALUE CHAIN EVALUATION

CRITERIA	**EXPLANATION/GUIDING QUESTIONS**	**WEIGHT**
Adaptation needs	Is the commodity affected by the impact of climate change such as rainfall variability and temperature extremes?	20%
Mitigation potential	Is there a significant mitigation potential associated with the adoption of CSA technologies along the value chain?	20%

[50] Kalischek, N., Lang, N., Renier, C. *et al.* 2023. Cocoa plantations are associated with deforestation in Côte d'Ivoire and Ghana. *Nat Food* 4, 384–393 (2023). https://doi.org/10.1038/s43016-023-00751-8.

[51] WB, 2021. *Sustaining High, Inclusive, and Resilient Growth Post COVID-19. A World Bank Group Input to the 2030 Development Strategy*; Washington DC, 77p: https://documents1.worldbank.org/curated/en/232621635224063141/pdf/Main-Report.pdf

[52] World Bank, Coat of Arms of Ivory Coast, Initiative for the adaptation of African agriculture, International Center for Tropical Agriculture (CIAT), Climate Change, Agriculture and Food Security Research Program (CCAFS), 2019: *Climate-smart Agriculture Investment Plan for Cote d'Ivoire (CSAIP)*; documents1.worldbank.org/curated/en/181591575308113164/pdf/Climate-Smart-Agriculture-Investment-Plan-for-Cote-d-Ivoire.pdf

Relative climate resilience	How resilient is the crop to climate hazards, and local and climate-induced pests and diseases compared to other crops? Are CSA technologies available that have potential to address adaptation needs?	10%
Food and nutrition security contribution	Is the commodity a key part of the local diet and widely consumed? Does it provide essential calories, nutrients, and minerals?	20%
Cultural importance	How significant is the crop culturally and how does its production align with existing farming practice?	10%
Economic importance for the region	Is there a stable growing market for the crop inside the country and in the region?	10%
Social and gender impacts	Is the value chain associated with potential job opportunities including for women and youth involved?	10%

The value chains associated with the most commonly grown crops in the targeted region were considered in the analysis: rice, yam, maize, millet, sorghum, cassava, and banana. For each criterion outlined above, the value chains were evaluated on a scale of 1 to 5, where 1 represents the lowest score (e.g., minimal contribution to food security) and 5 represents the highest score (e.g., major staple crop with widespread consumption). After scoring each value chain, the weighted scores were calculated by multiplying the score for each criterion by the corresponding weight. The total score for each value chain was obtained by summing up these weighted scores. Table 4 below summarizes the result of the value chain scoring and prioritization exercise.

TABLE 4: SCORING OF EACH VALUE CHAIN IN RELATION TO THE CRITERIA

CROP	FOOD SECURITY CONTRIBUTION (20%)	ADAPTATION NEEDS (20%)	RELATIVE CLIMATE RESILIENCE (10%)	MITIGATION POTENTIAL (20%)	CULTURAL IMPORTANCE (10%)	ECONOMIC IMPORTANCE (10%)	SOCIAL AND GENDER IMPACT (10%)	TOTAL SCORE
Rice	5 (1.0)	4 (0.8)	4 (0.4)	5 (1.0)	3 (0.3)	5 (0.5)	4 (0.4)	4.4
Cassava	5 (1.0)	5 (1.0)	5 (0.5)	4 (0.8)	4 (0.4)	4 (0.4)	5 (0.5)	4.6
Yam	4 (0.8)	4 (0.8)	5 (0.5)	3 (0.6)	5 (0.5)	3 (0.3)	4 (0.4)	3.9
Maize	5 (1.0)	4 (0.8)	4 (0.4)	3 (0.6)	3 (0.3)	4 (0.4)	3 (0.3)	3.8
Millet	4 (0.8)	4 (0.8)	3 (0.3)	3 (0.6)	3 (0.3)	4 (0.4)	3 (0.3)	3.5
Sorghum	3 (0.6)	4 (0.8)	4 (0.4)	3 (0.6)	3 (0.3)	4 (0.4)	3 (0.3)	3.4
Banana	5 (1.0)	3 (0.6)	3 (0.3)	2 (0.4)	4 (0.4)	4 (0.4)	4 (0.4)	3.4

Cassava emerged as the highest scoring value chain, with a total score of 4.6. It scored high across all criteria, particularly in adaptation needs, relative climate resilience, and social and gender impacts, making it a highly suitable value chain for the LARACI project. Cassava is considered a relatively climate resilient crop, particularly to drought and changing temperatures. CSA technologies can further enhance its resilience and productivity, particularly for smallholder farmers, making it a strong choice for food security. Moreover, it has a wide cultural significance which is important for local livelihoods. Along with its adaptation potential, there is also capacity to reduce GHG emissions through the increased yields and additional biomass that will sequestrate CO2 when CSA technologies are adopted.

Rice followed closely with a total score of 4.4, noting the high scores for food security contribution and economic importance. Rice is a staple crop and has a strong market within the country, making it an essential crop for the project. Additionally, it shows good potential for CSA adoption and could have a positive economic impact. Moreover, rice systems generally have a high emission footprint and incorporating CSA practices into its cultivation in the area could help offset methane and nitrous oxide emissions associated with permanent flooding and the use of synthetic fertilizers, respectively.

Yam scored 3.9, showing strong potential in terms of cultural importance and relative climate resilience. While it does not perform as strongly as rice in terms of mitigation potential, its cultural significance and role in the local diet make it a valuable crop for the region.

The other crops, such as maize, millet, sorghum, and banana, were still important but ranked lower overall due to lower scores in key criteria like mitigation potential or economic importance for the region. However, they may still be considered for other projects in specific regions or contexts based on more detailed local assessments.

4.4 Value Chain Risk Assessment

Building on the climate hazard profile (warming, higher evapotranspiration, more erratic rainfall, and localized flood risk), this section assesses how drought, extreme heat, extreme wet seasons/flooding, and rainfall variability can disrupt each stage of priority commodity value chains from input provision to production, post-harvest/processing, and marketing and how risks can cascade across the system.

Critically, the hazards described are not projections alone. Historical production data for cassava and yam in Côte d'Ivoire document recurrent, climate-driven shocks of precisely this type. Figure 8 presents national cassava and yam production trends from 1961 to 2024, overlaid with annual rainfall and documented climate shock years.

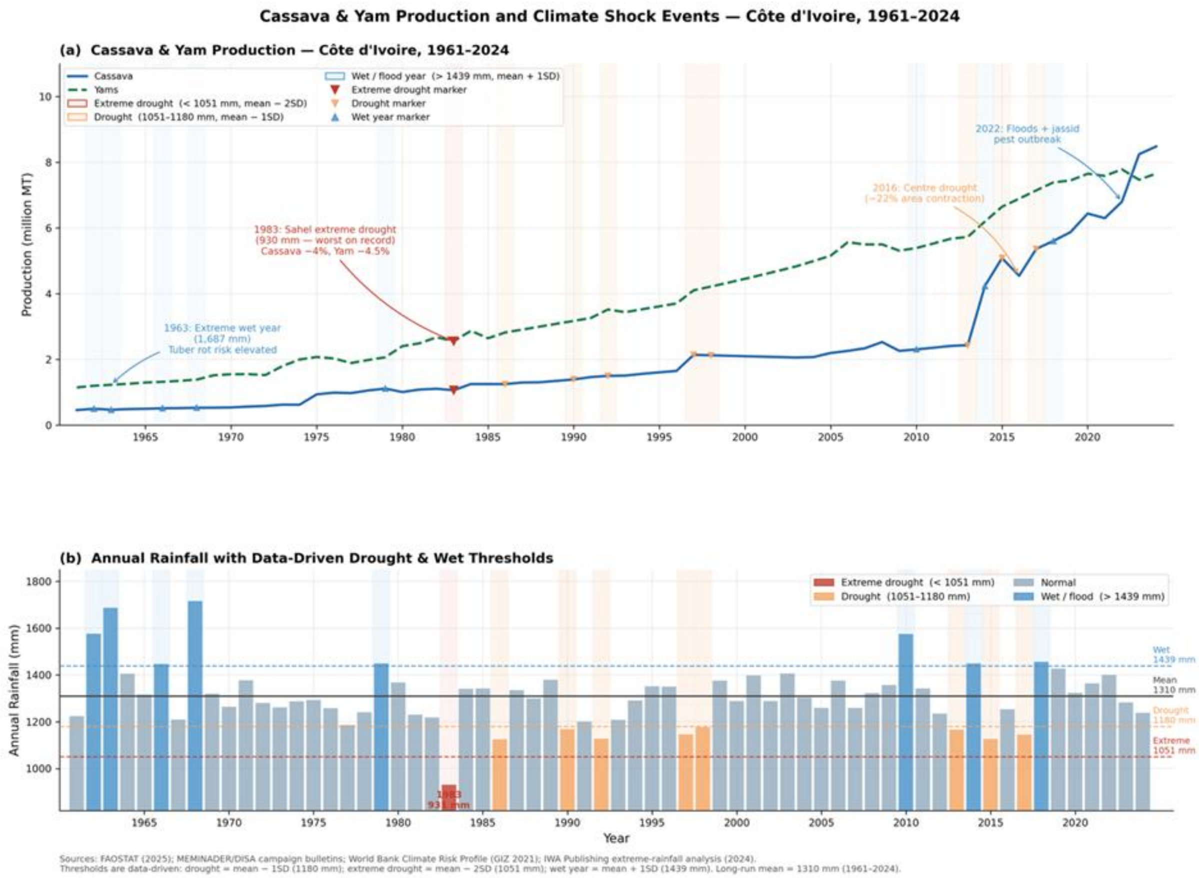

FIGURE 8: HISTORICAL PRODUCTION DATA FOR CASSAVA AND YAMS FOR CÔTE D'IVOIRE FROM 1961 TO 2024, OVERLAID WITH ANNUAL RAINFALL.

The earliest and most severe episode remains the 1982–83 Sahel drought, during which the northern and southern parts of Côte d'Ivoire experienced a structural transition to drier conditions, with documented cut-offs in rainfall regimes in 1982 and 1983 respectively[53]. Cassava area expanded sharply as households pressed the crop into service as a famine reserve a response well documented across the West African cassava belt during drought years,[54] yet national production contracted from approximately 1.11 MT in 1982 to 1.06 MT in 1983, a decline of approximately 4.0%, reflecting yield depression as field management broke down under rapid area expansion and constrained labor availability, consistent with mechanisms documented by

[53] Konate, D., Didi, S.R., Dje, K.B., Diedhiou, A., Kouassi, K.L., Kamagate, B., Paturel, J.-E., Coulibaly, H.S.J.-P., Kouadio, C.A.K. and Coulibaly, T.J.H. (2023). Observed Changes in Rainfall and Characteristics of Extreme Events in Côte d'Ivoire (West Africa). *Hydrology*, 10(5), 104. DOI: https://doi.org/10.3390/hydrology10050104 Link: https://www.mdpi.com/2306-5338/10/5/104

54 FAO (2004). *A Review of Cassava in Africa with Country Case Studies on Nigeria, Ghana, the United Republic of Tanzania, Uganda and Benin*. Proceedings of the Validation Forum on the Global Cassava Development Strategy, Vol. 2. Food and Agriculture Organization of the United Nations, Rome. No DOI (institutional report). Link: https://www.fao.org/4/a0154e/a0154e00.htm

Nweke et al. (2000)[55] for smallholder cassava systems in Côte d'Ivoire. Yam, highly sensitive to soil moisture deficits during tuber bulking, registered a concurrent and proportionally larger production contraction from approximately 2.68 MT in 1982 to 2.56 MT in 1983, a decline of approximately 4.5%, consistent with the pattern documented across the West African yam belt, where drought-year farm-level yields decline substantially against a water-adequate potential of 22–49 t/ha.[56,57] That yam sustained a steeper proportional loss than cassava under the same drought event is agronomically significant: it reflects cassava's comparative drought tolerance and its ability to delay harvest under moisture stress, properties that make it a more resilient food security crop in drought-prone zones such as Gbêkê and N'Zi and also explains the structural shift in farmer crop portfolios observed in the decades that followed.[58,59]

A second wave of climate stress took hold from the early 1990s through the 2000s. A transition to drier conditions was detected in the central zone of Côte d'Ivoire around 1991, precisely the forest–savanna transition band encompassing Gbêkê, Iffou, and N'Zi, associated with increased dry-spell frequency and reduced rainfall intensity.[60] The 1991–2000 decade recorded the greatest overall decline in total annual precipitation in the country's recent climatic record[61], compressing growing seasons and reducing the reliability of both cassava establishment and yam bulking windows across these intervention regions. Over this same period, national yam production grew only modestly from approximately 3.26 MT in 1991 to 3.71 MT in 2000, a cumulative gain of just 13.7% across a full decade, compared with cassava's 43.4% expansion over the same period from approximately 1.47 MT to 2.10 MT, a divergence that partly reflects yam's greater sensitivity to the rainfall deficits and shortened growing seasons characteristic of this transitional climatic phase. In Gbêkê, where *Dioscorea alata* dominates yam production and cassava cultivation has increasingly displaced southward-retreating forest crops, shortened and less predictable rainfall onset during this period constrained smallholder planting calendars and amplified inter-annual yield variability.[62]

The most recent decade has brought both intensified drought and more damaging flood events. During 2015–16, prolonged agricultural drought with soil moisture deficits extending from May

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55 Nweke, F., Ngoram, K., Dixon, A., Ugwu, B. and Ajobo, O. (2000). *Cassava Production and Processing in Côte d'Ivoire*. COSCA Working Paper No. 23. International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. No DOI (working paper). Link: https://cgspace.cgiar.org/items/4973816f-ec1d-4e56-bc94-89babedbadca

56 Owusu Danquah, E., Danquah, F. O., Frimpong, F., Dankwa, K. O., Weebadde, C. K., Ennin, S. A., Asante, M. O. O., Brempong, M. B., Dwamena, H. A., Addo-Danso, A., Nyamekye, D. R., Akom, M., & Opoku, A. Y. (2022). Sustainable intensification and climate-smart yam production for improved food security in West Africa: A review. *Frontiers in Agronomy, 4*, 858114. https://doi.org/10.3389/fagro.2022.858114

57 Orkwor, G.C., Asiedu, R. and Ekanayeke, I.J., eds. (1998). *Food Yams: Advances in Research*. International Institute of Tropical Agriculture (IITA) and National Root Crops Research Institute (NRCRI), Ibadan, Nigeria. 328 pp. No DOI (book). Available via IITA publications catalogue: Link: https://www.iita.org/iita-publication/food-yams-advances-in-research

58 Nweke et al, n= 55

59 FAO (2004). *A Review of Cassava in Africa with Country Case Studies on Nigeria, Ghana, the United Republic of Tanzania, Uganda and Benin*. Proceedings of the Validation Forum on the Global Cassava Development Strategy, Vol. 2. Food and Agriculture Organization of the United Nations, Rome. No DOI (institutional report). Link: https://www.fao.org/4/a0154e/a0154e00.htm

60 Konate et al, n = 53

61 Obahoundje, S., Akpoti, K., Zwart, S.J., Tilahun, S.A. and Cofie, O. (2025). Implications of changes in water stress and precipitation extremes for cocoa production in Côte d'Ivoire and Ghana. *International Journal of Climatology*, 45(9), e8872. DOI: https://doi.org/10.1002/joc.8872

62 Obahoundje, S., et al, n=61

to September was documented across eastern Côte d'Ivoire, including zones overlapping with the N'Zi and Moronou intervention regions.[63] These are the critical months for yam tuber initiation and bulking in the Centre-East, making the timing of these multi-month deficits maximally disruptive to productivity. Between 2014 and 2016, national cassava production grew from 4.24 MT to 4.55 MT an apparent modest gain of 7.3% at the national level but this aggregate masks a documented 22% contraction in harvested area in 2016 that was only partially offset by improved variety yields, indicating that farm-level exposure in the affected eastern regions was substantially more severe than the national total suggests .[64,65] Yam production over the same 2014–16 period grew from 6.20 MT to 6.90 MT, a gain of 11.3%, but again this national trajectory conceals localized stress in the Centre-East yam belt: field-level studies in Moronou confirm that yam and cassava smallholders in this zone already operate below their technical efficiency frontier, with mean technical efficiency scores of 0.89 and 0.81 respectively, leaving limited buffer capacity to absorb external moisture shocks.[66]

The 2022 season combined above-average torrential rainfall and flooding with a jassid pest outbreak intensified by warm, humid conditions, causing food crop production to fall to approximately 20.4 million tons recovering only partially to 22.5 million tons in 2023.[67] The 2023 El Niño then reversed the hazard type: early rains followed by anomalously low precipitation during the main growing season (April–June) drove soil moisture loss and vegetation stress across Côte d'Ivoire's coastal agricultural belt, including zones relevant to La Mé.[68]

4.4.1 Impacts of climate hazards along cassava value chain

Cassava is a strategic food-security crop with deep domestic processing linkages (notably attiéké, pressed paste, placali, etc.). The Côte d’Ivoire cassava value chain is characterized by a large informal processing segment and quality-sensitive urban markets; product diversification differs by geography (e.g., gari is relatively minor domestically compared to some neighboring countries).[69] Nationally, only approximately 0.2% of cropland is equipped for irrigation, indicating that staple crops, including cassava, depend almost entirely on seasonal rainfall and soil moisture storage rather than managed water systems. This structural reliance on rainfall significantly increases sensitivity to projected increases in dry days and rising temperatures. This matters in

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[63] Obahoundje, S., et al, n=61

[64] MEMINADER/DISA (2023). *Résultats de la Campagne Agricole 2022–2023*. Direction des Statistiques Agricoles, Ministère d'État, Ministère de l'Agriculture et du Développement Rural, Abidjan, Côte d'Ivoire. No DOI (government statistical bulletin). The underlying production data are reproduced and cited via the Ministry of Economy portal: Link: https://www.economie-ivoirienne.ci/en/activites-sectorielles/subsistence-agriculture.html

[65] N'Zué, B., Zohouri, G.P., Diby, L.N., Fondio, L. and Kassin, K.E. (2014). Performances et zones de production du manioc en Côte d'Ivoire. *Journal of Applied Biosciences*, 73, 5999–6008. DOI: https://doi.org/10.4314/jab.v73i1.1

[66] Casimir Tano, J.S. (2024). Mesure de l'efficacité technique des cultivateurs de manioc et d'igname dans la région de Moronou en Côte d'Ivoire. *Revue Marocaine des Sciences Agronomiques et Vétérinaires*, 12(4), 285–293. DOI: https://doi.org/10.5281/zenodo.14576244

[67] MEMINADER/DISA, 2023, n = 64

[68] Kongo, V.O. and Arreyndip, N.A. (2025). The 2023 drought in West Africa and associated vulnerability to food insecurity. *Scientific Reports*, 15, 34959. DOI: https://doi.org/10.1038/s41598-025-18940-9 Link: https://www.nature.com/articles/s41598-025-18940-9

[69] https://www.africarice.org/post/a-balancing-act-in-africa-s-inland-valleys

the intervention zones where projected longer dry-season conditions and more frequent droughts raise the probability of establishment failure (poor sprouting) and reduced root bulking.

TABLE 5*: EFFECT OF CLIMATE HAZARDS ON THE CASSAVA VALUE CHAIN (CÔTE D'IVOIRE)*

Climate hazard	Provision of inputs	On-farm production	Post-harvest & local processing	Product marketing
Drought	Lower availability of quality planting material (stem cuttings) and reduced multiplication capacity; rising prices for stems and labor	Moisture stress reduces root bulking and fresh-root yields; increased pest pressure and higher disease susceptibility; yield instability undermines planning	Roots deteriorate quickly if harvest is delayed; lower dry-matter content reduces conversion rates (less product per ton); water scarcity constrains fermentation, washing, and hygiene in artisanal processing	Reduced and more variable supply raises price volatility; quality downgrades (color, odor, texture) reduce acceptance in urban markets
Extreme heat (crop + labor heat stress)	Higher demand for drought/heat tolerant varieties and advisory services; increased costs for weeding/field operations	Heat stress accelerates evapotranspiration and can shorten effective bulking period; labor productivity drops during peak heat	Faster microbial spoilage and fermentation management challenges; heat affects storage of intermediate products and can increase food safety risk	Transport/market losses increase when products are held longer in hot conditions; greater rejection risk for processed products
Extreme wet seasons / flooding	Delays in stem transport and planting; inputs may be washed away	Waterlogging reduces root development and increases rot; flood damage to fields and rural roads	Higher drying difficulty; increased contamination risk during processing; floodwater can compromise hygiene and increase spoilage	Market access disruptions (road washouts) and supply gluts when delayed harvests coincide; higher losses in transit
Rainfall variability (late onset/early cessation, erratic rain)	Uncertainty in planting windows reduces uptake of improved materials and services	Mixed impacts on yields depending on timing; greater replanting costs after failed establishment	Irregular supply complicates processor scheduling (fermentation/steam cooking batches); increases unit costs	Price volatility and inconsistent quality reduce trader confidence; discourages longer-term supply contracts

Key risk pathways and evidence (cassava)

a) Production and yield fragility remain a concern despite cassava's reputation for tolerance. Côte d'Ivoire's broader staple crop performance has shown low and declining yields in earlier periods; for cassava, one reference point in national diagnostic work reported about 6.6 t/ha average yield (and declining over that historical window).
b) Disease interacts with climate stress. Cassava Mosaic Disease (CMD) is a documented major threat in Côte d'Ivoire production zones (with multiple studies emphasizing incidence/severity and the need for management).[70]
c) Processing and market structure shape climate vulnerability. Cassava products differ in process requirements and market tolerance. For instance, gari is described as a minor product in Côte d'Ivoire (unlike Benin/Nigeria), underscoring how local preferences concentrate risk on other products (e.g., attiéké) that are sensitive to moisture control and hygiene.[71]

Implications for risk management (cassava)

Priority interventions tend to include drought-tolerant planting material, soil moisture conservation (mulching/cover, reduced tillage, contour/bunding where relevant), and climate information services that shift planting windows, which are necessary to avoid climate-driven yield losses under longer dry spells; they are not only yield-enhancement measures.

4.4.2 Impacts of climate change hazards along yam value chain

Yam is one of Côte d'Ivoire's most important staple crops and a central livelihood commodity in key producing zones. Recent research-oriented sector material describes yam as the leading non-cereal food crop, with production on the order of 8 million tons (2023), while highlighting disease pressure, competing land uses, and climate change as growing constraints. Yam is especially sensitive because tuber yield depends on sustained moisture during key growth stages. Evidence from West Africa highlights that temporal drought during bulking can push yields down substantially; farmers may experience very low yields (12 t/ha) compared to a potential range of 22–49 t/ha depending on variety, when drought spells and erratic precipitation occur.[72] While this specific quantified range is reported from the West African yam belt context (and not only Côte d'Ivoire), it is directly relevant to the intervention regions because the same rainfall-driven production model (rainfed systems, limited irrigation) dominates.

[70] Toualy, M.N.Y., Akinbade, S., Koutoua, S., Diallo, H., & Kumar, P.L. (2014). Incidence and distribution of cassava mosaic begomoviruses in Côte d'Ivoire. International Journal of Agronomy and Agricultural Research, 4(6), 131-139.

[71] Mendez del Villar, P., Adaye, A., Tran, T., Allagba, K., Bancal, V. 2017. Analyse de la chaîne de Manioc en Côte d'Ivoire. Rapport pour l'Union Européenne, DG-DEVCO. Value Chain Analysis for Development Project (VCA4D CTR 2016/375-804), 150p + annexes.

[72] Frimpong, F., Owusu, D. E., Ennin, S. A., Asumadu, H., Aidoo, A. K., & Maroya, N. (2018). Sustaining yam yields amidst climate threat in the forest–savannah transition zone of Ghana. bioRxiv, 474247.

TABLE 6: *EFFECT OF CLIMATE HAZARDS ON THE YAM VALUE CHAIN*

Climate hazard	Provision of inputs	On-farm production	Post-harvest & local processing	Product marketing
Drought	Scarcity of quality seed yam and planting material; higher costs for mounds/ridges and labor	Moisture stress reduces tuber initiation and bulking; higher nematode/pest pressure; increased variability in size/shape	Smaller tubers dry out faster; reduced storability; higher weight loss	Lower volumes and more grade variability reduce trader margins; higher prices can reduce demand in poorer markets
Extreme heat (crop + labor heat stress)	Increased need for heat/drought-tolerant varieties and advisory support	Heat accelerates soil moisture loss; greater canopy stress and staking challenges; labor productivity declines (mounding, weeding, harvesting)	Heat increases respiration and storage losses; promotes rots when combined with minor injuries	Faster quality deterioration shortens marketing window; more distress sales at farmgate
Extreme wet seasons / flooding	Delays in field preparation and planting; planting material damage	Waterlogging increases tuber rot risk; erosion of mounds; disease outbreaks	Storage rots rise sharply under humid conditions; curing becomes harder	Road/market disruptions; quality downgrading and increased rejection by wholesalers
Rainfall variability	Uncertain planting timing; higher replanting and labor costs	Yield instability (failed establishment or poor bulking); shifting pest/disease calendars	Difficult to time harvest for optimal storability; storage planning uncertainty	Volatile supply drives price swings; discourages aggregation and structured trade

Key risk pathways and evidence (yam)

a) Climate-smart intensification is repeatedly flagged as necessary in West Africa. Synthesis work stresses that yam systems face climate pressure and land degradation dynamics, and that improved soil fertility management and adaptation-oriented practices are essential.[73]

b) Breeding and market requirements intersect with climate risk. Côte d'Ivoire-focused yam research argues for aligning varietal development with market segments and emerging constraints (including climate).[74]

c) Post-harvest losses are structurally important for yam value chains. Yam is highly susceptible to storage losses driven by injuries, poor handling, transport constraints, and inadequate storage infrastructure risk factors that worsen under higher heat/humidity.

Implications for risk management (yam)

The highest-leverage measures typically include: improved seed yam systems, soil moisture conservation and erosion control on mounds/ridges, adaptive planting calendars, and major upgrades in curing/storage (ventilated barns, handling training, better packaging/transport) to reduce climate-amplified rots and shrinkage.

4.4.3 Impacts of climate change hazards along rice value chain

The rice value chain climate risk is acute because (i) rice is sensitive to heat at flowering, (ii) production systems include rainfed lowlands/inland valleys exposed to seasonal flooding, and (iii) quality and competitiveness depend heavily on post-harvest operations (drying, parboiling, milling). AfricaRice reporting on Côte d'Ivoire emphasizes that the country has strong potential but still faces low yields and limited technology adoption, with climate change exacerbating productivity and food security challenges.[75]

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[73] Owusu Danquah E, Danquah FO, Frimpong F, Dankwa KO, Weebadde CK, Ennin SA, Asante MOO, Brempong MB, Dwamena HA, Addo-Danso A, Nyamekye DR, Akom M and Opoku AY (2022) Sustainable Intensification and Climate-Smart Yam Production for Improved Food Security in West Africa: A Review. Front. Agron. 4:858114. doi: 10.3389/fagro.2022.858114

[74] Dilby, N., Mobio, A., Kouassi, H., Kanon, L., Deffan, P., Ehounou, E., Dibi, E., Tran, T., Kouakou, A., Dufour, D., & Mbéguié-A-Mbéguié, D. 2025. Aligning yam market segments with breeding targets in Côte d'Ivoire: A value chain perspective. Market Intelligence Brief Series 25, Montpellier: CGIAR.

[75] Yéo Yassongui, S.; Kouadio, K.S.A.; Elliott, D.; Ouedraogo, M.; Singh, M. (2024) RIICE development in Cote d'Ivoire: AfricaRice report of 2024. Transforming Agrifood Systems in West and Central Africa Initiative (TAFS-WCA). 17 p.

TABLE 7: EFFECTS OF CLIMATE HAZARDS ON THE RICE VALUE CHAIN

Climate hazard	Provision of inputs	On-farm production	Post-harvest & local processing	Product marketing
Drought	Increased demand/cost for drought-tolerant seed and irrigation services	Water stress reduces tillering and grain filling; higher risk of crop failure in rainfed systems; conflicts over water in irrigated perimeters	Lower volumes reduce mill utilization; thin grains break more in milling	Reduced supply increases prices; import substitution becomes harder if quality is inconsistent
Extreme heat (esp. flowering stage + labor heat stress)	Push for heat-tolerant varieties and adjusted calendars	High temperatures can cause spikelet sterility and yield loss; labor constraints during peak heat	Faster grain quality deterioration if delayed drying; increases fissuring and breakage	More broken rice and inconsistent quality reduce competitiveness against imports
Extreme wet seasons / flooding	Delays in input delivery and planting; damage to infrastructure	Flooding/submergence in inland valleys and lowlands; lodging and disease outbreaks	Harvest-time rains raise moisture and mycotoxin/mold risks; drying bottlenecks and higher losses	Road disruptions and higher transaction costs; quality downgrades reduce consumer acceptance
Rainfall variability	Unpredictable service demand (seed, fertilizer, mechanization)	Planting uncertainty and uneven crop establishment; pest/disease timing shifts	Unreliable paddy flows complicate aggregation and scheduling for parboilers/millers	Volatile prices and unstable supply; discourages structured sourcing

Key risk pathways and evidence (rice)

a) Heat risk at flowering is a well-established yield-loss pathway. Controlled studies show substantial fertility reductions as tissue temperatures rise into the mid-30°C range at anthesis, reinforcing the importance of heat-smart calendars and varieties.[76]

[76] SVK Jagadish, PQ Craufurd, TR Wheeler, High temperature stress and spikelet fertility in rice (*Oryza sativa* L.), *Journal of Experimental Botany*, Volume 58, Issue 7, May 2007, Pages 1627–1635, https://doi.org/10.1093/jxb/erm003

b) Inland valley systems face a "too much vs too little water" challenge. AfricaRice communications from Côte d'Ivoire's inland valleys illustrate the operational and agronomic constraints associated with seasonal flooding and water management.[77]
c) Post-harvest upgrades are a major resilience lever. Work on rice post-harvest losses in Sub-Saharan Africa identifies harvesting and handling stages as major loss points and highlights drying/parboiling/milling as critical quality determinants.[78]
d) Technology improvements can raise quality and reduce cost exposure. Côte d'Ivoire evidence on improved parboiling systems finds profitability and energy savings, supporting adaptation that reduces exposure to fuel/energy shocks and improves market acceptance.[79]
e) Targeted initiatives are explicitly focusing on PHL reduction and quality in Côte d'Ivoire. IRRI/JICA collaboration notes the goal of reducing post-harvest losses and improving rice quality through better drying and bankable supply chains[80].

Implications for risk management (rice)

Rice resilience investments are typically highest-return when they: (i) protect flowering from peak heat (varieties + planting dates), (ii) improve water control (bunds, drainage, small-scale irrigation reliability), and (iii) remove post-harvest bottlenecks (mechanized/efficient drying, improved parboiling, moisture testing, storage, and milling calibration).

4.5 Adapting to climate change through project interventions

This project will focus on three key value chains: cassava, yam, and rice.

According to Côte d'Ivoire's CSAIP, the climate change-induced yield decline for rice is less pronounced than for other crops like maize, millet, and groundnuts (see Table 8). This indicates that rice could be key to adaptation strategies in Côte d'Ivoire, thanks to its relative climate resilience. Rice can thrive in a range of environments, from rainfed uplands to irrigated lowlands. With proper water management, rice can withstand both cold and heat stress, making it inherently more resilient to climate change than other important cereals in the country, such as maize. From 2007 to 2021, the area under rice production grew by over 64%, and it is expected to increase further by 2025 due to its high priority for national food security (see Table 8). However, the expansion of rice production also comes with an increasing greenhouse gas

[77] https://www.africarice.org/post/a-balancing-act-in-africa-s-inland-valleys?

[78] Ndindeng, S.A., Candia, A., Mapiemfu, D.L., Rakotomalala, V., Danbaba, N., Kulwa, K., Houssou, P., Mohammed, S., Jarju, O.M., Coulibaly, S.S. and Baidoo, E.A., 2021. Valuation of rice postharvest losses in Sub-Saharan Africa and its mitigation strategies. *Rice Science, 28*(3), pp.212-216.

[79] Kanon, A. L., Aboudou, R., Depieu, M. E., Arouna, A., & Ndindeng, S. A. (2025). Rice Value Chain Upgrading in Côte d'Ivoire: The Role of the Improved GEM System for Rice Parboiling. *Proceedings*, *118*(1), 9. https://doi.org/10.3390/proceedings2025118009

[80] https://www.cgiar.org/news-events/news/collaboration-between-irri-nong-lam-university-and-jica-to-reduce-postharvest-losses-and-increase-rice-quality-in-africa?

footprint. It is crucial that this growth integrates climate-smart technologies and practices, like those developed by CGIAR (

Table 9), to offset these emissions. Similarly, roots and tubers like yams and cassava show resilient yield projections, contributing significantly to food security. Projections indicate a slight increase in yam and cassava cultivation relative to a no-climate-change scenario (see Table 8). Additionally, cassava is expected to have growing commercial potential, with export quantities projected to be 29% higher by 2050 than they would be without climate change.

These three value chains demonstrate some resilience to climate change compared to other crops such as cocoa and coffee. Yet each of the three value chains still exhibit climate vulnerability as explained for each crop below and CSA investment in their production has strong potential to help significantly improve growth and yields to adapt to climate risks. This could go a long way towards safeguarding food security in the country under the projected climate change. The below outlines the key climate risks and proposed adaptation strategies laid out by the LARACI project related to each of the three value chains:

4.5.1 Cassava

Risks: While cassava is generally resilient to water stress and temperature fluctuations, it faces increasing threats from pests and diseases due to climate change. The crop is particularly vulnerable to the more frequent outbreaks of pests and diseases such as Cassava Mosaic Disease (CMD) and mites, along with changes in temperature extremes. Higher temperatures disrupt the plant's physiological processes, leading to reduced tuber formation and lower yields. As a result, the suitability of cassava for croplands in Côte d'Ivoire is projected to decline by 5 to 10%.

Adaptation and mitigation strategies: The technologies to improve cassava yield and resilience will focus on cassava-legume intercropping, optimum-planting and harvesting times, site specific fertilizer recommendation rates, and climate resilient, high yielding cassava varieties. Cassava-legume intercropping increases land use efficiency, improves nutrient use efficiency, and helps combat and soil fertility depletion, while diversifying farmers' income. The use of AKILIMO, an agronomic advisory service, will ensure site-specific advice for fertilizer recommendations to help support sustainable intensification, while also providing advice for the optimal planting and harvesting time to ensure good crop establishment and/or harvest when dry matter content is high which may result in higher produce prices. Improved varieties form the basis for counteracting climate change induced decline of yields and ensure efficient use of inputs like fertilizer via site specific recommendations that ensure the use of agronomically and economically suitable amounts.

4.5.2 Yam

Risks: Climate change has significant effects on yam production, impacting both yield and quality. Yam is sensitive to temperature variations, which influence growth and development. Rising temperatures alter planting and harvesting schedules, disrupt tuber formation, and reduce overall yield. The crop also requires a consistent and well-distributed water supply, making it vulnerable to water stress caused by more frequent droughts and altered precipitation patterns. Changes in temperature and humidity promote the spread of pests and diseases, further damaging crops and reducing yields. Additionally, due to yam's high soil nutrient demands, many farmers rely on slash-and-burn practices before planting.

Adaptation and mitigation strategies: The project promotes a climate-resilient yam production package centered on four key technologies. First, improved yam seed systems will expand access to high-quality planting material through rapid multiplication techniques such as SAH, minisetts, and leaf bud cuttings. These methods boost seed availability, reduce disease spread, and accelerate adoption of climate-resilient varieties. Second, efficient plant arrangements will replace traditional mounding with ridge planting, increasing planting density from 4,000–6,000 to over 10,000 plants per hectare. This improves land and input use efficiency and enables higher tuber output per hectare, contributing to improving food security. Third, climate-smart staking using *Gliricidia sepium* will address soil fertility, erosion control, and deforestation. *Gliricidia* provides live or cut stakes for yam vines while improving soil nitrogen, structure, and moisture retention through mulching. Its integration reduces pressure on natural forests and enhances climate mitigation. Lastly, the project will promote yam genotypes or varieties that have a high nutrient uptake capacity and/or use efficiency to maximize the use of natural soil nutrients and enhance yield. These nutrient-efficient yam varieties are identified and selected through participatory methods and help to maintain yields under low-input conditions.

4.5.3 Rice

Risks: Although rice is relatively less vulnerable than other major cereals in Côte d'Ivoire, it is still highly susceptible to climate change. Climate change threatens to reduce Ivorian rice yields by 5-25%.[81]. The country's rice yields are at 2.8 tons per hectare, which is much lower than the world average of 4.8 tons per hectare. Any further decline in yield due to climate change will significantly impact national food security. Rice is sensitive to temperature fluctuations, with increased heat potentially accelerating its growth cycle, leading to lower yields. Warmer temperatures can also affect grain quality and increase the risk of heat stress during critical growth stages. As a result, inland valleys in WCA, which are key rice-growing regions, are expected to lose over 20% of their suitability for rice cultivation due to these temperature shifts.[82] In addition, changes in temperature and humidity will increase the prevalence of pests and diseases, such as rice blast and rice yellow mottle virus, which can severely reduce yields. Regarding mitigation, rice production holds substantial potential for reducing greenhouse gas emissions, particularly methane emissions from permanent flooding and nitrous oxide emissions from synthetic fertilizers. After livestock, rice production is the second-largest source of methane emissions in the agriculture sector in Africa.

Adaptation and mitigation strategies: The project incorporates a variety of climate-smart technologies to address key adaptation and mitigation challenges in rice cultivation. The project will implement RiceAdvice, a digital tool which provides location-specific recommendations on varieties, crop calendars, and integrated use of fertilizers and soil management to tackle growing season changes and inappropriate farming practices. The Smart-Valleys management system will also be promoted to improve water control in inland valleys, addressing drought, flooding, and soil erosion. The project will also promote the System of Rice Intensification (SRI) to help address

[81] World Bank Group. (2019). *Côte d'Ivoire Climate-Smart Agriculture Investment Plan*. Washington, DC: World Bank. https://hdl.handle.net/10986/32745

[82] Akpoti, K., Groen, T. A., Dossou-Yovo, E., Kabo-Bah, A., & Zwart, S. J. (2022). Climate change-induced reduction in agricultural land suitability of West Africa's inland valley landscapes. *Global Food and Nutrition Security*.

water scarcity and decreased soil fertility. The package uses young seedlings, organic matter, and efficient irrigation to increase yields with limited inputs to improve soil health and increase efficient water use while also increasing carbon sequestration and lowering GHG emissions. The project will also focus on the combined application of biochar and integrated use of fertilizer to improve soil health and crop resilience, especially under changing climate conditions while also incorporating mid-season drainage to help manage water and reduce iron toxicity, boosting rice yield. Additionally, mid-season drainage will be used to help control water levels. This is a water management technology in which all surface water is removed from the rice field between the mid-and late tillering stage, allowing the soil to dry and re-aerate before being flooded again for reduced iron toxicity effects, increased rice yield and water productivity. Finally, the dissemination of climate information services and early warning systems will help to enhance resilience by informing farmers about drought, flooding, and pest risks, enabling better decision-making.[83]

TABLE 8: PERCENTAGE POINT DIFFERENCE IN YIELD AND AREA OF PRODUCTION WITH DIFFERENT LEVELS OF CLIMATE CHANGE FOR RAINFED CROPS IN CÔTE D'IVOIRE (SHOWN AS PERCENTAGE POINT DIFFERENCES OVER THE BASELINE NO-CC)[84]

	Difference in yield (SSP3)				Difference in area of production (SSP3)			
	RCP 4.5		RCP 8.0		RCP 4.5		RCP 8.5	
	2030	2050	2030	2050	2030	2050	2030	2050
Cassava	-1.2	-3.3	-1.2	-3.2	0.1	0.5	0.1	0.7
Rice	-1.7	-5.9	-2.3	-7.6	0.4	0.9	0.8	1.9
Yam	-0.9	-2.3	-1	-2.4	0.2	0.5	0.1	0.4
Maize	-5.9	-17.2	-7.6	-21.7	-0.1	-0.5	0.2	-0.3
Millet	-1.7	-6.5	-2.4	-9.2	0.1	0.2	0.4	1.1
Groundnut	-3.4	-9.3	-4.6	-12.4	1.2	3.6	2.0	6.1

[83] Diallo, Aboubacar, et al. "Improved uptake of RiceAdvice digital application for increasing farmers' yield and income while reducing environmental impact of rice cultivation in Mali." (2023).

[84] World Bank, Coat of Arms of Ivory Coast, Initiative for the adaptation of African agriculture, International Center for Tropical Agriculture (CIAT), Climate Change, Agriculture and Food Security Research Program (CCAFS), 2019: *Climate-smart Agriculture Investment Plan for Cote d'Ivoire (CSAIP)*; documents1.worldbank.org/curated/en/181591575308113164/pdf/Climate-Smart-Agriculture-Investment-Plan-for-Cote-d-Ivoire.pdf

TABLE 9: EXAMPLES OF CGIAR CSA SOLUTIONS FOR CASSAVA, RICE, AND YAM ALONG THE THREE PILLARS OF CSA

CGIAR CSA SOLUTIONS	PRODUCTIVITY	RESILIENCE	MITIGATION
Cassava: Cassava-legume intercropping - replacing sole cropping by intercropping	Optimizing cassava–legume intercropping increases productivity by allowing both crops to grow on the same land simultaneously. This makes better use of cultivated land, helps maintain soil fertility, and reduces erosion, leading to higher and more sustainable yields.	Improved cassava-legume intercropping addresses climate-related stresses such as drought, soil erosion, and soil fertility depletion.	Improves emissions reduction through improved yields resulting to more carbon sequestration in additional biomass.
Rice: System of Rice Intensification (SRI)	Enhances yield, number of tillers, and quality of rice due to the combined application of organic and mineral fertilizer.	Increases water use efficiency by intermittent water application (reducing permanent flood). Reduces seed requirement and makes nursery management easier. Increased use of organic fertilizers enhances soil fertility.	Increases above and below ground carbon capture and storage. Reduces GHG emissions due to reduced use of synthetic fertilizers. Reduces methane emissions from reduced use of water (shifting from permanent flooding to intermittent flooding).
Yam: Efficient plant arrangements	Shifting from mounds to ridges in yam cultivation increases planting density, allowing more yams to be grown per hectare. This improves land and resource use efficiency, leading to higher overall yields.	Addresses climate change-induced reduction of potential yield.	Increases above- and below-ground carbon capture and storage. Improves emissions reduction through improved yields resulting to more carbon sequestration in additional biomass.
Climate smart staking	Introduction of *Gliricidia sepium* as planted live stakes (including pruning and mulching) in yam systems to improve or maintain soil fertility, control erosion, and improve the performance of the yam crop.	The leguminous tree contributes to improved soil fertility via nitrogen fixation and reduces the risk of climate change related soil erosion via the mulch application from pruning in a crop that is usually characterized by low planting densities.	Increases above- and below-ground carbon capture and storage. Improves emissions reduction through improved yields resulting to more carbon sequestration in additional biomass.

TABLE 10: CLIMATE HAZARD, VALUE CHAIN VULNERABILITY, AND ADAPTATION RESPONSE MATRIX

Region/zone	**Climate Hazard**	**Affected crop/value chain stage**	**Most at risk group**	**CSA package elements selected**	**Expected risk reduction mechanism**
Moronou and La Mé	Drought	• Input provision • Production post-harvest • Marketing	• Rainfed smallholders • Women processors (cassava value chain) • Low-input farmers	• Drought tolerant varieties • Improved seed systems • Cassava–legume intercropping • Smart-Valleys & SRI (rice)	Reduces sensitivity of crops to drought. Exposure to drought is also reduced by improving water control. This maintains yields under moisture stress, stabilizing supply and product quality across the value chain
Gbêkê, Iffou, and central N'Zi	Flooding	• Input provision Production • Post-harvest • Marketing	• Farmers in inland valleys/lowlands • Processors • Traders dependent on rural infrastructure	• Smart-Valley's water management • Mid-season drainage (rice) • Soil and water conservation practices	Reduces exposure by improving water control, limiting flood damage, and maintaining product quality and market access
All project regions	Rainfall variability (erratic onset and cessation)	• Input provision • Production • Post-harvest	• Smallholders without access to CIS • Aggregators and processors	• Climate information services • Advisory tools	Reduces exposure by aligning production and processing decisions with seasonal conditions, stabilizing yields.
All project regions	Temperature variability including extreme heat	• Production • Post-harvest • Marketing	Smallholder farmers • Agricultural laborers • Processors and traders	• Heat-tolerant varieties • Climate advisory services • Improved post-harvest handling and timing	Reduces sensitivity by improving tolerance to heat stress and reducing post-harvest losses through better timing,

					handling, and climate-informed decision-making
All project regions	Climate-driven pest & disease pressure	• Production	• Smallholders with limited pest and disease management capacity	• Climate-resilient varieties • Improved seed systems • Climate information and early warning systems	Reduces sensitivity and exposure by improving resistance and enabling timely, climate-informed pest and disease management
All project regions	Soil degradation & declining fertility (exacerbated by climate change)	• Production	• Low-input farmers • Farmers in degraded landscapes	• Cassava–legume intercropping • Gliricidia-based climate-smart staking • SRI + biochar + integrated soil fertility management	Enhances adaptive capacity by restoring soil health, improving nutrient cycling, and sustaining productivity and product quality under climate stress

4.6 Mitigation of greenhouse gas emissions

The LARACI project is a cross-cutting project addressing climate mitigation alongside adaptation, to reduce the emissions of GHG and enhance carbon sequestration in the agricultural sector. Agriculture is one of the largest contributors to national GHG emissions in Côte d'Ivoire, particularly due to high methane emissions from rice cultivation and nitrous oxide emissions from the use of synthetic fertilizers. For example, rice systems, especially those relying on permanent flooding, contribute significantly to methane emissions.

In addition to high methane emissions, deforestation driven by the conquest of new agricultural lands has led to a dramatic loss in forest cover, from 16 million ha in 1960 to 2 million ha in 2018. This deforestation has reduced land and biomass carbon storage and sequestration, contributing to higher GHG emissions and biodiversity loss. In its updated NDC, submitted in 2022, Côte d'Ivoire committed to reducing its greenhouse gas emissions by 30.41% by 2030 relative to business as usual, or 98.95% with international support. The Global Methane Pledge, launched at COP26 and now gathering 159 participating countries, calls for drastic reductions of global methane emissions by 2030. Through CSA interventions, this project will enable farmers to improve agricultural yields, reducing the pressure to clear new land for agriculture, thereby avoiding deforestation and associated emissions. A conservative approach, however, has been taken in assessing the emissions reduction potential of the project, focusing on increased sequestration by improved yields only for yam and cassava, and including GHG emissions reduction from methane in rice value chain. Table 11 This led to an estimate of approximately 3,808,776 tCO2eq by the end of the project lifespan. Table 11 shows the breakdown of the expected reduction in GHG emissions. The project-level MRV system has been designed to align with Côte d'Ivoire's evolving national GHG inventory framework, with explicit coordination mechanisms with MINETE established from inception to ensure that project-generated mitigation data is progressively integrated into national climate reporting processes (see Annex 22 for full MRV details).

TABLE 11: GHG EMISSION MITIGATION POTENTIAL ASSOCIATED WITH EACH CSA INTERVENTION

		Total emission reduction rice (tCO_2eq)	**Total emission reduction cassava (tCO_2eq)**	**Total emission reduction yam (tCO_2eq)**	**Total (tCO_2eq)**
Total ER for 3 crops	Year 1	55,311	3,615	(46,614)	12,313
	Year 2	82,967	5,423	(25,779)	62,611
	Year 3	110,622	7,231	15,890	133,743
	Year 4	138,278	9,039	36,725	184,041
	Year 5	165,933	10,846	36,725	213,504
	Year 6	165,933	10,846	36,725	213,504
	Year 7	165,933	10,846	36,725	213,504
	Year 8	165,933	10,846	36,725	213,504
	Year 9	165,933	10,846	36,725	213,504
	Year 10	165,933	10,846	36,725	213,504
	Year 11	165,933	10,846	36,725	213,504
	Year 12	165,933	10,846	36,725	213,504
	Year 13	165,933	10,846	36,725	213,504
	Year 14	165,933	10,846	36,725	213,504
	Year 15	165,933	10,846	36,725	213,504
	Year 16	165,933	10,846	36,725	213,504
	Year 17	165,933	10,846	36,725	213,504
	Year 18	165,933	10,846	36,725	213,504
	Year 19	165,933	10,846	36,725	213,504
	Year 20	165,933	10,846	36,725	213,504
Total ER end of project lifespan		3,042,108	198,851	567,817	3,808,776
Total ER mid-term (year 2.5)		193,589	12,654	(64,448)	141,795

Total ER end of project (year 5)	553,111	36,155	16,947	606,212

4.7 Alignment of the proposed project with Côte d'Ivoire's priorities

The LARACI project is closely aligned with Côte d'Ivoire's climate priorities as outlined in its climate policies presented in section 3.5.

This cross-cutting project aims to facilitate the adaptation of the agricultural sector to climate change by incorporating CSA measures that enhance soil fertility, protect fragile ecosystems, and thereby improve food security for vulnerable populations such as smallholder farmers, women, and children. In addition to strengthening resilience, the project also contributes to climate mitigation by promoting practices that increase carbon sequestration and lower GHG emissions. These interventions are designed to reduce vulnerabilities and increase resilience in agricultural systems, in line with the country's broader adaptation and mitigation objectives. Côte d'Ivoire's Revised NDC, which was submitted in 2022, prioritizes the agricultural sector with planned mitigation and adaptation measures. This project directly contributes to at least five of the planned adaptation interventions:

- enhancement of environmental & climate information system and access;
- implementation of climate risk management systems;
- promotion of sustainable soil management techniques;
- building rural farm communities' capacity for climate resilience targeting young and women; and
- promotion and support for climate resilient technologies for agriculture, livestock, and fisheries.

Moreover, the proposed project advances climate-smart agriculture (CSA) in Côte d'Ivoire through targeted interventions such as cassava–legume intercropping to enhance land productivity and soil health, efficient plant arrangements in yam cultivation to increase planting density and optimize resource use, and the promotion of improved seed systems and nutrient-efficient crop varieties. Additionally, the project supports the adoption of the System of Rice Intensification (SRI), a package of practices that improves yields while reducing the use of water, seed, and fertilizers. SRI enhances resilience to water scarcity, irregular rainfall, soil degradation, and pest pressures. Together, these CSA interventions address major climate-related risks and align with Côte d'Ivoire's national adaptation priorities by strengthening the productivity, sustainability, and resilience of smallholder farming systems.

Côte d'Ivoire's commitment to both adaptation and mitigation efforts, as demonstrated by its NDC and draft National Adaptation Plan (NAP), is central to the project's approach. The project addresses several of the NAP's adaptation options identified for the agriculture sector, including agroforestry, CSA, meteorological information systems, development and access to seeds of improved varieties, and soil fertility. By implementing these options, the project will directly contribute to reducing vulnerability and increasing the resilience of several priority sectors of the

NAP such as agriculture, forestry and land use, and water resources. Extensive consultations with key stakeholders during project design - including government agencies, the private sector, civil society, and the intended beneficiaries - have helped to ensure that the project has been developed to reflect national priorities and is positioned for successful implementation.

The project also supports seven out of the twelve investments and actions that were prioritized in Côte d'Ivoire's CSAIP[85]. The main objective of CSAIP is to boost crop resilience and enhance yields, helping more than 2.2 million beneficiaries and their families adapt to climate change. As part of this plan, eight drought-tolerant and/or climate resilient crop and livestock investments were identified as priority for the different regions of Côte d'Ivoire. The project stakeholders have selected the three targeted value chains (rice, cassava, yam) out of the eight prioritized investments due to their significant role in enhancing food and nutrition security in the country, their specific relevance to the targeted regions (in agropole 4), and for complementarity with other investments (such as ongoing GCF projects targeting cocoa). By showcasing how CSAIP can leverage transformative impact on the ground, this project will also enable and unlock further investments identified in the CSAIP in Côte d'Ivoire, as well as serve as an example for other countries that have developed CSAIPs.

The CSAIP identified cassava, rice, and yam as priorities for the central zones and defines the following proposed development outcomes (PDOs) and beneficiary estimates for cassava, rice, and yam:

- **Cassava**: Increase the cassava sector's capacity to practice CSA by providing producers, processors, and extension agents with technical assistance and increased access to improved varieties and up-to-date research. This will benefit 90,000 producers.
- **Rice**: Scale CSA practices applicable to the African context to increase rice productivity and stabilize producer revenues to achieve national rice self-sufficiency, benefitting 68,640 rainfed rice producers.
- **Yam**: Minimize climate risks and increase farm productivity by increasing capacity for climate-smart yam production and strengthening yam processing and markets for improved economic and nutritional resilience, benefiting 70,000 rural agricultural workers.

In addition to its alignment with the country's national policies and plans, the project falls within the framework of the Government's Abidjan Legacy Programme, and the latest GCF Country Investment Programme. The project has been designed in close partnership with FIRCA, MINETE as the national designated authority (NDA), and the MINADER PV as a key line ministry responsible for coordinating agriculture sector projects in the country.

[85] World Bank, Coat of Arms of Ivory Coast, Initiative for the adaptation of African agriculture, International Center for Tropical Agriculture (CIAT), Climate Change, Agriculture and Food Security Research Program (CCAFS), 2019: *Climate-smart Agriculture Investment Plan for Cote d'Ivoire (CSAIP)*; documents1.worldbank.org/curated/en/181591575308113164/pdf/Climate-Smart-Agriculture-Investment-Plan-for-Cote-d-Ivoire.pdf

The Abidjan Legacy Programme was presented by MINEDDTE (now known as MINETE)[86] at the COP15 of the United Nations Convention to Combat Desertification (UNCCD) in Abidjan, 2022. This multi-partner national initiative identifies land restoration as a solution at the forefront of the fight against climate change in Côte d'Ivoire. Moreover, it underscores how the cocoa value chain exemplifies the twin threat of commodities that fuel climate change, while also facing existential risks from it. The goal of the Abidjan Legacy Programme is to ensure that commodity value chains are futureproof, resilient, and inclusive. As such, it promotes a radical transformation of the modes of production and consumption in support of a regenerative transition of productive systems. Special focus is dedicated to value chains with high value opportunities, that are future proof in the sense that they can withstand climate impact. It also prioritizes those value chains that support land restoration to build climate-resilience while contributing to climate change mitigation.

In the absence of the proposed adaptation interventions, the agricultural sector in Côte d'Ivoire is likely to experience further degradation, increased vulnerability to climate risks, and reduced productivity. The main barriers to climate change adaptation in the agriculture sector and particularly in the targeted central region would not be removed in the foreseeable future, leaving this sector and region highly vulnerable to climate risk and the related impact. Moreover, there would be a missed opportunity not building mitigation into this transition by incorporating technologies that aim to increase carbon sequestration and reduce GHG emissions, which would actively reinforce harmful practices such as the overuse of nitrogen-based fertilizers, forest and biodiversity loss, and deteriorating water quality.

4.8 Demand and supply Analysis

4.8.1 Demand and supply analysis of selected crops

As Côte d'Ivoire experiences rapid population growth, urbanization, and economic transformation, the demand for staple crops such as rice, cassava, maize, and yam continues to rise. This demand is driven not only by demographic expansion but also by evolving consumer preferences, increased regional trade, and the growth of agro-processing industries. On the supply side, factors such as climate change, land availability, input accessibility, processing techniques, post-harvest losses, and government policies significantly influence production and supply levels. Despite efforts to boost domestic production, Côte d'Ivoire remains reliant on imports, particularly for rice, to meet national consumption needs.

4.8.1.1 Rice

Rice is a staple for the Ivorian population, with per capita consumption reaching approximately 84 kg annually. Despite significant production efforts, domestic output has not met demand, leading to substantial imports. In 2024, local production was estimated at 1.55 million tons, while consumption ranged between 2.1 to 2.8 million tons. This has resulted in a deficit covered by

[86] Now Ministry of Environment and Ecological Transition (MINETE)

imports primarily from India, Vietnam, Pakistan, and Thailand. To address this gap, the Government launched the Rice Sector Development Strategy (SNDR 2) in 2024, aiming for self-sufficiency by 2026 and positioning Côte d'Ivoire as a major rice exporter by 2030. This strategy involves a USD1.3 billion investment to increase production to 3.2 million tons of milled rice by 2030 through expanding cultivation areas, improving water management, and enhancing yields[87]. Climate change poses significant challenges to rice production in Côte d'Ivoire. Farmers are experiencing changing seasonal patterns and reduced rainfall, leading to water shortages and a reduction from two cropping cycles per year to one, thereby decreasing overall supply.

4.8.1.2 Cassava

Cassava is vital for food security in Côte d'Ivoire, with production reaching 5 million tons in 2018, making the country the 14th largest producer globally. It is integral to the Ivorian diet, and its cultivation supports rural livelihoods, being both a subsistence and a cash crop. High domestic demand for cassava-based products, such as *attiéké* (fermented cassava semolina), sustains robust local markets. Cassava is also identified as a priority sector in the National Export Strategy of Côte d'Ivoire, which aims to enhance its export potential. Government initiatives focus on enhancing cassava production through improved varieties and farming techniques to meet domestic consumption and explore export opportunities. Cassava is generally resilient to climate change; however, it remains vulnerable to pests and diseases exacerbated by changing climatic conditions including African Cassava Mosaic Virus disease (CMD). There is, therefore, a risk that the supply of cassava could decrease in the foreseeable future in Côte d'Ivoire.

4.8.1.3 Yam

Yam holds great cultural importance, especially in traditional ceremonies and festivals, which sustains its continued cultivation. In 2018, Côte d'Ivoire produced approximately 7.2 million tons of yam, making it the third-largest producer globally. This strong production level reflects both high domestic consumption and market demand, explained by its role as a key staple crop in the country. Efforts to improve production focus on addressing challenges like soil fertility and pest management to ensure a reliable supply. Yet, alterations in rainfall patterns and increased temperatures lead to reduced yields in the cultivation of yam. This raises the risk of a reduced domestic supply of yam which could undermine food security, increase prices, reduce farmer incomes, and potentially destabilize markets. It would also raise the country's reliance on food imports, putting further stress on land and biodiversity.

4.8.2 Demand and Supply Analysis for Adaptation Technologies

The increasing effects of climate change on the agricultural sector in Côte d'Ivoire necessitate the adoption of adaptation technologies to enhance resilience and cope with the growing demands for staple crops. Table 12 below summarizes the demand and supply dynamics of such technologies for the three prioritized crops, highlighting ongoing initiatives that have piloted the technologies.

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[87] https://www.reperci.org/what-we-do/products/rice

TABLE 12: A SUMMARY OF THE DEMAND AND SUPPLY DYNAMICS OF ADAPTATION TECHNOLOGIES FOR THE PRIORITIZED CROPS

VALUE CHAIN	ADAPTATION TECHNOLOGY	DEMAND DRIVERS	SUPPLY INITIATIVES	INSTITUTIONS / PROGRAMS WITH RELEVANT EXPERIENCE AND EXPERTISE
Rice	RiceAdvice	Supports climate-informed decision-making for variety selection and integrated use of fertilizers with focus on agro-ecology.	AfricaRice digital extension services, TAAT initiative	AfricaRice
	Smart-Valleys	Enhances water control in inland valleys, reducing drought and flooding risks.	AfricaRice Smart-Valleys Project, regional agricultural programs	AfricaRice
	System of Rice Intensification (SRI)	Improves drought tolerance, reduces input reliance by combining the use of younger seedlings, organic matter, intermittent irrigation, larger spacing for increasing rice yield with limited use of input.	FAO, Cornell International Institute for Food, Agriculture, and Development	SRI-CIIFAD
	Combined Biochar & Nitrogen Fertilizer	Enhances soil health, optimizes nutrient management	Agricultural research institutions, TAAT	CGIAR/IITA TAAT
	Mid-Season Drainage	Improves rice yield and reduces iron toxicity by allowing the soil to dry and re-aerate before being flooded again for reduced iron toxicity effects and increased rice yield.	Research-led pilot projects, AfricaRice water management programs	AfricaRice
	Climate Information Services & Early Warning Systems	Provides climate forecasts, reduces risks of extreme weather impacts.	National meteorological services, regional climate resilience programs	WMO

Cassava	AKILIMO tailored agronomic advisory service-fertilizer recommendation	Site-specific nutrient needs due to declining soil fertility and erratic rainfall.	Digital crop modelling and tailored advice via the AKILIMO and TAAT platforms	IITA/ TAAT
	AKILIMO tailored agronomic advisory service - optimum planting and harvesting time	Site-specific planting and harvesting time due to changing weather patterns.	Digital crop modelling and tailored advice via the AKILIMO and TAAT platforms	IITA/ TAAT
	Cassava-Legume Intercropping	Need for increasing crop yields, improving soil fertility, and diversifying income.	Regional research programs, farmer cooperatives	IITA
	Cassava seed systems	Demand for drought- and pest-resilient high-yielding varieties and better seed availability.	Development and diffusion of improved varieties and rapid multiplication techniques	CGIAR/IITA/ National Breeding Programs
Yam	Identifying yam varieties with high nutrient uptake and/or use efficiency	Need for varieties that perform well under low-input conditions, nutrient-poor soils, and climate variability.	Participatory varietal selection and screening by IITA and partners	IITA
	Efficient plant arrangements	Pressure to increase land-use efficiency and improve resource management due to climate-induced land scarcity.	Promotion of ridge planting to increase density (from 4,000–6,000 to 10,000–10,416 plants/ha)	IITA
	Yam seed systems	Low availability of quality planting material and demand for rapid multiplication of climate-resilient varieties.	Deployment of Semi-Autotrophic Hydroponics (SAH), minisetts, and leaf bud cuttings (LBC) for seed production	IITA
	Climate-Smart Staking	Need for sustainable staking systems, erosion control, and improved soil fertility.	Introduction of live *Gliricidia* staking and “cut-and-carry” mulching systems	IITA

5 Regulatory, policy, institutional, barriers, complementarity and coherence analysis

5.1 Overview of regulatory, policy and institutional frameworks

Côte d'Ivoire has made considerable strides in developing a regulatory, policy, and institutional framework for agricultural transformation, yet several barriers hinder the effective implementation of CSA technologies and practices. The country's agricultural policies are primarily guided by the National Agricultural Investment Programme (PNIA), first launched in 2010 and revised in 2018 to align with the objectives of the second generation of CAADP (Comprehensive Africa Agriculture Development Programme). The Ministry of Agriculture and Rural Development (MINADER PV) oversees agricultural policies, with support from the National Agency for Rural Development (ANADER). Despite this, technological barriers persist due to insufficient modernization efforts. The country's reliance on traditional farming practices exacerbates vulnerabilities to climate change, as evidenced by poor soil tillage techniques that deplete soil nutrients. Limited access to climate-resilient seeds and soil fertility solutions stems from weak distribution networks and insufficient research funding. Moreover, outdated meteorological equipment and gaps in climate data collection—partly a consequence of the civil conflicts from 2002 to 2011—hinder effective climate adaptation. The National Meteorological Directorate, despite receiving assistance from the World Meteorological Organization (WMO), still struggles with limited ICT infrastructure, restricting farmers' access to crucial weather forecasts and extension advisories.

Financial and institutional barriers continue to severely hinder the adoption of CSA in Côte d'Ivoire. Despite some progress, including the expansion of mobile money and the establishment of 46 microfinance institutions (MFIs) and over 12,000 bank agents, access to formal credit remains limited, with only 14% of rural adults able to obtain it, and women even less so. Côte d'Ivoire's financial system is still heavily urban-centered, and rural farmers face high interest rates, short loan durations that do not align with agricultural cycles, and stringent collateral requirements, which are difficult to meet due to widespread land tenure insecurity. The 1998 Rural Land Law and its amendments in 2013 and 2019 aim to formalize ownership, but implementation has been slow, with less than 30% of rural land registered, undermining farmers' ability to use land as collateral. Meanwhile, the steep up-front costs of CSA technologies exceed most smallholders' cash flow capacity. Digital and financial literacy also remain low, particularly among women, further constraining uptake. Although MINADER PV, in collaboration with the Ministry of Economy and Finance, has worked to improve financial inclusion through digital services and microcredit, government-backed subsidies, blended finance, and risk-sharing mechanisms remain inadequate. Development partners such as the World Bank and the African Development Bank (AfDB) have supported financial inclusion efforts. Without more targeted, concessional, and risk-tolerant capital, CSA implementation will remain out of reach for the majority of smallholders.

Gender disparities also present a significant challenge in Côte d'Ivoire's agricultural sector. Women constitute 70% of the agricultural labor force but own only 10% of the land, largely due to socio-cultural barriers and weak enforcement of gender-inclusive policies. Although the National Gender Policy, introduced in 2009 and revised in 2019, emphasizes women's empowerment in economic activities, gender disparities in access to credit, farm inputs, and ICT services remain stark. Land tenure insecurity seriously constrains investment by small-scale producers, especially women and youth. Limited digital literacy among women further exacerbates their exclusion from agricultural advisories and market information, hence increasing their vulnerability to climate shocks and stresses. In response, the Government, with support from development partners, has sought to enhance women's financial inclusion and capacity-building initiatives that extended to supporting their integration in agricultural value chains, building their entrepreneurship and facilitating their access to technologies. However, more needs to be done to ensure gender-responsive CSA policies are fully integrated into national strategies.

Capacity constraints within government institutions also limit the efficiency of CSA implementation. The number of agricultural extension workers has declined over the years, with ANADER struggling to meet the demand for technical support. Moreover, weaknesses in meteorological forecasting expertise hinder the accurate dissemination of climate advisories. To address these issues, investments in knowledge-sharing platforms, continuous education for extension officers, and enhanced forecasting capabilities are imperative to support CSA practices across Côte d'Ivoire.

5.2 Barrier analysis

Several steps have been taken to identify and understand the barriers that prevent the adoption of adaptation and mitigation measures as related to the LARACI project, and outline strategies to overcome them. By examining the physical, financial, institutional, and social barriers, this analysis has provided a clear understanding of the factors preventing effective climate adaptation or mitigation. It is a key element informing the design of targeted interventions, ensuring that the project is appropriately designed to overcome these barriers and achieve its intended outcomes. The barriers identified fall under five categories: technological, financial and institutional, gender, policy and regulation, and capacity.

5.2.1 Technological barriers

Poor cropping systems and soil tillage practices contribute to soil nutrient depletion, erosion, and reduced water retention, ultimately decreasing agricultural resilience. Reliance on rainfed and traditional agricultural practices is proving inadequate in addressing climate change-related challenges, such as frequent droughts, floods, and pest outbreaks. The lack of access to new and innovative technologies hampers efforts to adapt to climate change and mitigate greenhouse gas emissions while maintaining or improving productivity. Additionally, Côte d'Ivoire faces a lack of reliable climate data due to outdated meteorological equipment, poor maintenance, and historical disruptions caused by civil conflicts. Moreover, the available climate information is inadequately translated into actionable advisory for farmers. Addressing these issues requires public-private partnerships to enhance ICT infrastructure and facilitate the dissemination of crucial agricultural information.

5.2.2 Financial and institutional barriers

Mainstreaming CSA depends on financial and institutional support. However, dysfunctional market structures, poor coordination among stakeholders, and ineffective land tenure systems hinder CSA adoption. As evidenced by the Economic and Financial Analysis (Annex 3), agriculture is capital intensive, yet smallholder farmers have limited access to credit and many live in rural areas where interest rates are high and poverty cycles discourage investment in CSA innovations. The lack of affordable farming inputs and equipment also impedes mechanization and market access, reducing cost-effectiveness and profitability. Additionally, the weak land tenure system disincentivizes long-term investments in farming and fosters land-use conflicts. Solutions include sustainable finance mechanisms such as micro-credit schemes, digital financial services, and partnerships with financial institutions to lower interest rates and improve credit access. Strengthening small-, and medium-sized enterprises (SMEs) can also provide necessary financial assets to promote and adopt CSA technologies.

5.2.3 Gender barriers

Despite women constituting about 70% of the agricultural labor force and producing over half of the country's food, significant gender disparities persist in access to training and access to extension, financial resources, land ownership, and farming tools. Women account for only 10% of landowners in Côte d'Ivoire, limiting their ability to invest in and improve agricultural productivity, including adoption of CSA technologies. In relation to climate risks and shocks, women have poor access to localized and up-to-date climate information and low awareness of adaptation practices and innovations. This makes women comparatively more vulnerable to climate hazards (floods, droughts, etc.). Their agricultural productivity is further limited by their access to inputs (improved seeds, fertilizers, secure land rights, finance) and mechanized agricultural equipment, high post-harvest losses due to inadequate storage and processing infrastructure, difficult access to markets, and usage of unsustainable agricultural practices (slash-and-burn, deforestation). Additionally, socio-economic barriers restrict women's access to ICT, further reducing their ability to receive climate-related advisories and market information. Overcoming these challenges requires policies and initiatives aimed at increasing women's access to finance, agricultural training, ICT, and value chain engagement ultimately fostering gender-inclusive climate adaptation strategies.

5.2.4 Policy and regulatory barriers

Producers and agribusinesses face difficulties in leveraging financial services due to unfavorable regulatory environments and rural financial exclusion. Approximately 14% of agricultural producers in Côte d'Ivoire receive formal credit, limiting the ability of those that don't to invest in climate-smart farming practices. The weak microfinance sector, high transaction costs, and lack of targeted financial incentives further exacerbate the issue. Implementing favorable policies for microfinance, reducing transaction costs, and introducing financial incentives such as subsidies and credit facilities can enhance CSA adoption. Public-private partnerships for training and financial support will also be crucial in overcoming regulatory obstacles.

5.2.5 Capacity barriers

The national capacity for climate adaptation remains underdeveloped. The Government's ability to implement climate resilience strategies is still in its early stages, and the shortage of extension officers limits farmers' access to necessary advisory services. Currently, the ratio of farm advisors to agricultural workers is approximately 1:4,800, making effective knowledge dissemination difficult. Additionally, there is no structured continuous education program to keep extension officers updated on CSA innovations. Limited ICT adoption further weakens the effectiveness of agricultural advisories. Furthermore, Côte d'Ivoire's national meteorological agency suffers from inadequate scientific expertise and outdated forecasting tools, limiting its ability to provide accurate and timely climate information. Addressing these gaps requires investment in capacity-building programs, strengthening extension services, and equipping meteorological agencies with modern technologies. Knowledge-sharing initiatives should also be prioritized to enhance collaboration among meteorological and extension services, private sector actors, producer organizations, and financial institutions.

5.3 Complementarity and coherence analysis

Several CSA initiatives are currently underway in Côte d'Ivoire, driven by both government-led strategies and international partnerships. The National Programme for Agricultural Investment (PNIA) and Côte d'Ivoire's National Climate Change Adaptation Plan (PNACC) prioritize CSA integration to enhance food security and resilience. Programs led by the World Bank, FAO, and IFAD, such as the West African CSA Programme and the Adaptation for Smallholder Agriculture Programme (ASAP), focus on strengthening climate resilience, improving access to financing, and promoting sustainable land management. The CGIAR Research Program on Climate Change, Agriculture, and Food Security (CCAFS) (2009-2021) has also been instrumental in testing and scaling CSA technologies, including drought-resistant crops, agroforestry systems, and improved irrigation techniques, and the newly launched Climate Action Science Program aims to transform food, land, and water systems so that they become more climate-resilient, while reducing GHG emissions. LARACI is complementary to these initiatives as it builds on their foundational work while addressing persistent gaps in climate information services, financial de-risking, and policy coherence. By leveraging digital technologies, strengthening agrometeorological networks, and facilitating climate finance through public-private partnerships, LARACI aligns with and enhances existing CSA efforts, ensuring a more integrated and sustainable approach to climate resilience and mitigation in Côte d'Ivoire's agricultural sector.

Project-specific synergies and linkages with LARACI[88]

- FAO: PROMIRE (2021-2026): Zero-Deforestation Cocoa Production. Although PROMIRE primarily focuses on cocoa and REDD+ agroforestry in southern Côte d'Ivoire, its lessons

[88] See details in Appendix 1 of this feasibility assessment

on sustainable land-use models can inform LARACI’s work on soil health and low-carbon agroforestry systems (Component 2). LARACI could use best practices from PROMIRE on soil restoration, adapting them to rice, cassava, and yam-based value chains. PROMIRE and LARACI demonstrate complementarity and coherence, as PROMIRE focuses on cocoa agroforestry and carbon mitigation while LARACI targets different value chains, yet both share best practices on soil health and low-carbon agriculture.

- WFP: Women-Adapt (2023-2028): Enhancing Resilience of Smallholder Women & Youth. Women-Adapt’s focus on community-based adaptation, financial inclusion, and risk preparedness aligns with LARACI’s climate finance and social inclusion goals. LARACI can expand Women-Adapt’s gender-sensitive CSA approaches to a national level (Components 1 and 3). Women-Adapt and LARACI demonstrate complementarity and coherence, as Women-Adapt operates in the Poro region while LARACI has a national scope in its first component and focuses on the central regions of Côte d’Ivoire (N’Zi, Moronou, Iffou, La Mé, and Gbêkê), enabling LARACI to scale gender-sensitive climate-resilient technologies in the targeted region and maintaining distinct geographic and operational focuses. Both projects promote climate-resilient technologies, offering opportunities for knowledge exchange.
- IFAD: IGREENFIN I (2022-2028): Inclusive Green Financing Initiative. IGREENFIN I enhances access to credit and technical assistance for smallholders, farmer cooperatives, and SMEs, closely mirroring LARACI’s Component 1 on financial de-risking. LARACI and IGREENFIN I operate as complementary and mutually reinforcing instruments within Côte d'Ivoire's climate finance ecosystem. LARACI functions as the demand-side readiness instrument, building enabling conditions, institutional capacity, and bankable client base that IGREENFIN I requires to deploy capital at scale. The transition pathway operates through two sequential phases within the LARACI project period. In the early phase, Years 1 to 3, LARACI builds farmer bankability through financial literacy, farm business planning, record keeping, and strengthening of professional producer organizations, and establishes the financial infrastructure, including warehouse receipt systems, index insurance, and climate-integrated credit scoring, that enables formal finance to flow to CSA-adopting farmers. In the scale-up phase, Years 3 to 5, financial institutions that will have built their capacity and de-risked through Output 1.3 begin extending CSA-aligned credit products to investment-ready professional producer organizations, drawing on the pipeline of bankable clients supported during the project. Beyond the project period, the enabling environment established by LARACI creates favorable conditions for continued CSA financing flows through domestic financial institutions and is designed to be compatible with and reinforced by the capital deployment mechanisms of IGREENFIN I where geographic and thematic overlap exists. Given the very low penetration of agricultural lending among smallholders in the target regions, LARACI fills an existing financing gap rather than crowding out private finance or duplicating IGREENFIN I's capital deployment mandate.
- FMO: &Green Fund Investing in Inclusive Agriculture and Protecting Forests (2023-2028). This initiative promotes sustainable commodity production in deforestation-linked

sectors (e.g., cocoa and rubber). Both initiatives demonstrate complementarity and coherence by promoting sustainable agricultural commodity production while reducing deforestation risks. While the &Green Fund initiative primarily focuses on cocoa and forestry-related supply chains, LARACI will maintain coherence by concentrating on land restoration and conservation in rice, cassava, and yam value chains, avoiding direct overlap.

- AfDB: PIDACC/NB (2022-2028): Climate Adaptation in the Niger Basin. PIDACC/NB implements integrated climate resilience actions, including soil restoration and sustainable resource management. LARACI can leverage PIDACC/NB's best practices on natural resource governance and integrate CSA and Climate Information Services (CIS) innovations into the Niger Basin region. Joint capacity-building efforts can enhance adoption of CSA practices.
- Government of Côte d'Ivoire: PDC2V (2021-2027): Livelihood Value Chain Development. This project develops inclusive, competitive food value chains (cassava, aquaculture, horticulture). LARACI can leverage PDC2V's cassava-focused outcomes to scale sustainable productivity improvements (Component 3). Private sector actors engaged in PDC2V will be mobilized to enhance LARACI's investment facilitation efforts.
- Government of Côte d'Ivoire: PREMOPEF (2021-2025): Livelihood Strengthening for Smallholders and Women. PREMOPEF supports food security and resilience-building in the N'Zi region, overlapping with LARACI's intervention zones. LARACI will build on PREMOPEF's gender and social inclusion lens to scale up results across Côte d'Ivoire. Joint knowledge-sharing workshops can enhance climate resilience innovations.

LARACI is complementary to these initiatives as it integrates lessons learned and best practices from their foundational work while either focusing on different geographical areas, different value chains or addressing persistent gaps in climate information services, financial de-risking, and policy coherence. By leveraging digital technologies, strengthening agrometeorological networks, and facilitating climate finance through public-private partnerships, LARACI aligns with and enhances existing CSA efforts, ensuring a more integrated and sustainable approach to climate resilience and mitigation in Côte d'Ivoire's agricultural sector. The table in Appendix 1 summarizes synergies and linkages between ongoing CSA related initiatives in Côte d'Ivoire and LARACI.

6 Project design

6.1 Objectives and timelines

The LARACI project aims to initiate a paradigm shift towards CSA for improved food and nutrition security and income generation for farming communities under existing and projected climate change scenarios, and for a reduced GHG footprint. This will be achieved through improving climate-related risk management, reducing greenhouse gas (GHG) emissions, and promoting climate-smart agricultural (CSA) practices focusing on three key crops: yam, rice, and cassava.

The project's key targets include:

- Strengthening national agrometeorological systems to provide timely climate information and advisory services.
- Enhancing the capacity of extension services to support CSA implementation.
- Increasing access and ability to leverage financial tools to improve access to climate risk mitigation resources.
- Developing integrated systems for sustainable land management and agroforestry.
- Scaling CSA practices to support resilient agri-food systems particularly in key value chains such as rice, cassava, and yam.

The project is designed to be implemented over a five-year period, with specific milestones for each component:

- **Year 1: Launch, foundational frameworks and early implementation**
    - Crosscutting:
        - Finalize institutional arrangements with Executing Entities (EEs) and establish coordination and implementation mechanisms at national and local levels.
    - Component 1
        - Launch climate information system (CIS) upgrades and early dissemination of forecasts to farmers.
        - Begin training extension staff and local actors through accelerated capacity-building programs.
        - Map existing financial actors and instruments and develop the first wave of climate-smart finance tools.
    - Components 2 - 3
        - Identify lead farmers and professional producer organizations in central regions for piloting CSA practices (cassava, yam, rice).
        - Start pilots for climate-smart staking, improved yam arrangements, and cassava-legume intercropping.
        - Establish participatory land preparation and community engagement.
        - Implement quick-win soil and water conservation measures in priority sites.

- Conduct rapid assessments to finalize targeting of beneficiaries and CSA technology suitability by agro-ecological zone.

- **Year 2: Consolidate foundation and expand early results**
  - Component 1:
    - Operationalize digital CIS platforms and scale national advisory dissemination.
    - Institutionalize climate-smart extension curricula and gender-responsive delivery systems.
    - Pilot CSA financial products with selected financial institutions.
  - Components 2 - 3:
    - Expand CSA technology rollout in rice, cassava, and yam zones.
    - Strengthen farmer-based seed systems and introduce improved climate-resilient varieties.
    - Scale soil fertility management and live-staking systems with farmer professional producer organizations.
    - Launch full-scale training of farmers and professional producer organizations in selected areas.
    - Initiate proposed CSA technologies pilots, including yam staking systems and cassava-legume intercropping.
    - Put in place MRV systems and begin tracking early outcomes on adaptation practices and emission reduction through MRV systems.

- **Year 3: Full rollout and systems integration**
  - Component 1:
    - Embed CIS and CSA tools into national agricultural advisory and planning systems.
    - Finalize policy and regulatory adjustments for CSA input approval and use.
    - Scale up financial services for CSA investment (loans, guarantees, insurance).
  - Components 2 - 3:
    - Intensify technology diffusion and farmer field school activities in remaining communes.
    - Monitor yield improvements and adaptation indicators.
    - Support agro-processors and aggregators to adopt CSA post-harvest practices.
    - Scale up CSA extension and input delivery across all target regions and value chains (rice, cassava, yam).
    - Expand access to climate finance instruments and insurance for smallholders.

- **Year 4: Optimization and local institutions strengthening**
  - Component 1:
    - Provide technical assistance for long-term mainstreaming of CSA and climate risk management into national and local budgets.

        - Deepen partnerships with private sector actors to sustain CSA finance and service delivery.
    - Component 2 - 3:
        - Fine-tune CSA packages based on feedback and data.
        - Consolidate value chain linkages and promote inclusive markets for CSA products.
        - Strengthen professional producer organizations to manage CSA assets and provide bundled services to members.
- **Year 5: Evaluation and sustainability transition**
    - Component 1:
        - Conduct national impact assessment and finalize policy integration.
        - Establish permanent CSA knowledge-sharing and coordination platforms.
    - Component 2 - 3:
        - Transition CSA extension and finance systems to local authorities and market actors.
        - Finalize integration of CSA practices into local land use, development plans, and farmer networks.
        - Document and disseminate lessons for national replication and regional scaling.

6.2 Supported technologies

The LARACI project focuses on three value chains: rice, yam, and cassava. For each value chain, different CSA technologies are feasible in Côte d’Ivoire.

6.2.1 Rice

Various climate-smart rice production technologies can be supported in Côte d’Ivoire to enhance productivity, mitigate climate risks, and ensure sustainable agricultural practices. The following technologies have been identified, each addressing key climate-related challenges:

- RiceAdvice: A digital application offering location-specific recommendations on rice varieties, crop calendars, and fertilizer application. It helps farmers adapt to changes in growing season patterns, select suitable varieties, and optimize fertilizer use, improving productivity and sustainability.
- Smart-Valleys: A low-cost, farmer-led, and participatory approach designed to sustainably develop inland valley bottoms for rice-based agriculture. By leveraging farmers’ local knowledge and simple, locally available materials, the approach focuses on constructing basic water-control structures, such as canals and bunds, to improve water management. This process emphasizes careful site selection based on both socio-economic and biophysical factors, followed by the design, layout, and construction of infrastructure. Farmers report key benefits including better water retention, reduced fertilizer loss from flooding, and increased rice yields, all achieved with minimal external input and greater resilience to climate change.

- GEM Parboiling Technique: An energy-efficient rice processing technology that uses rice husk fuel to improve grain quality, reduce emissions, and enhance working conditions for women.
- Alternate wetting and drying (AWD): A water-saving rice irrigation technique where fields are allowed to dry intermittently rather than being continuously flooded. After the field is initially flooded, irrigation is withheld until the water level in the soil drops to a certain threshold (often measured with a field water tube), then re-flooded. This cycle repeats throughout the growing season, except during critical growth stages like flowering. This technology reduces water use and methane emissions, while maintaining or improving yields.
- System of Rice Intensification (SRI): A package of technologies that integrates younger seedlings, organic matter, intermittent irrigation, and optimized plant spacing. It enhances drought tolerance, improves soil fertility, and mitigates water scarcity while reducing reliance on inputs such as seeds, water, and fertilizer.
- Combined Application of Biochar and Nitrogen Fertilizer: This approach improves soil health, optimizes nutrient management, and enhances crop resistance. It directly addresses drought, water scarcity, and soil fertility degradation, leading to higher productivity and increased farmer income despite climate change.
- Mid-Season Drainage: A water management technology that removes surface water from rice fields between the mid- and late-tillering stages, allowing the soil to dry and re-aerate before being reflooded. This reduces iron toxicity, improves rice yield, and enhances water productivity.
- Dissemination of Climate Information Services and Early Warning Systems: This system provides forecasts on growing season onset and cessation, dry spells, and potential climate hazards such as drought, flooding, pests, and disease outbreaks. By enabling climate-informed decision-making, it strengthens the resilience of rice farmers and the entire value chain.

If implemented on the foreseen area of agricultural land, these climate-resilient rice technologies are expected to benefit 80,000 farmers directly and 240,000 individuals in farming communities indirectly, while playing a crucial role in enhancing climate adaptation and resilience in the rice sector to ensure food security and sustainable livelihoods for farmers in Côte d'Ivoire.

6.2.2 Cassava

Several climate-smart cassava production technologies could be supported in Côte d'Ivoire to enhance productivity, mitigate climate risks, and promote sustainable agricultural practices. The following technologies have been identified, each addressing key climate-related challenges to cassava cultivation:

- Cassava-legume intercropping: Growing cassava together with legumes makes more efficient use of land cleared for cassava cultivation because the cassava benefits from the nitrogen fixed by the legumes. Although intercropping often results in slightly lower cassava yields, the overall land equivalent ratio (LER) typically exceeds 1, indicating greater productivity per unit area. Additionally, the legume intercrop helps reduce soil erosion. The spatial layout of cassava and legumes can be adjusted to simplify management or to accommodate two successive companion crops. Whether a second intercrop is feasible depends on the cassava's vigor, growth form, and size during the period of the second legume crop.

- AKILIMO tailored agronomic advisory service – optimum planting and harvesting time: AKILIMO (https://akilimo.org) offers agronomic recommendations tailored to Côte d'Ivoire's agro-ecological zones and considers the ENSO phenomenon. Using the CGIAR's AgWise framework, it provides site-specific advice on timing, planting practices, and harvest schedules. The models incorporate digital soil maps and ENSO phase information, to improve the accuracy and relevance of recommendations.
- AKILIMO: tailored agronomic and site-specific advisory service: Site-specific tailored and appropriate quantity levels of fertilizer recommendations based on crop model simulations for cassava support in sustainable intensification.
- Cassava seed systems: Cassava's resilience to harsh growing conditions and its ability to store roots underground for extended periods make it a vital crop to combat food insecurity and economic vulnerability in many sub-Saharan African countries affected by climate change. Sustainable increases in cassava production require empowering farmers to boost productivity, access climate-smart and improved varieties, adopt effective production technologies, and strengthen the supply systems for planting material.

Implementation of these climate-resilient cassava technologies is expected to benefit 30,000 farmers directly and 90,000 individuals in farming communities indirectly. These interventions will strengthen climate adaptation, improve food security, and enhance the livelihoods of cassava farmers in Côte d'Ivoire.

6.2.3 Yam

In Côte d'Ivoire, several climate-smart yam production technologies can enhance productivity, improve resilience, and reduce environmental impacts. The following technologies have been identified as potentially adequate to address key climate-related challenges and promote sustainable agricultural practices:

- Efficient plant arrangements for better resource use: Replacing traditional mounds with ridges enhances crop management efficiency and allows for higher planting densities—increasing from 4,000–6,000 plants per hectare on mounds to 10,000–10,416 plants per hectare on ridges. While yams harvested from ridges tend to be smaller than those from mounds, this can be advantageous for the export market. For farmers, the key benefit is the ability to harvest a greater number of tubers from the same land area.
- Climate-smart staking and soil fertility improvement: Yam thrives in fertile soil and benefits from staking to support its climbing growth. Although tree-based annual cropping systems have seen limited adoption, using *Gliricidia sepium* as a fallow species

in yam systems shows promise for improving soil health and providing staking material. *Gliricidia* grows quickly from stem cuttings, fixes atmospheric nitrogen, and is easy to manage. Moreover, its long, unbranched shoots allow light to reach the soil, making it ideal for producing yam stakes. Two farmer-friendly systems are available: live *Gliricidia* stakes planted densely during fallow that mature into bushes and are retained for 3–4 years, and a cut-and-carry system where shoots are harvested for stakes. In the live stake system, after clearing the fallow, 2–3 stakes are left and pruned to support yam vines, with excess shoots used as stakes, firewood, or mulch. After yam harvest, *Gliricidia* regrows, sustaining soil fertility and staking resources.

- Yam seed systems: Strengthening yam seed systems will accelerate the adoption of high-ratio propagation technologies and establish a formal seed production system to deliver genetic improvements to farmers more quickly. Traditional yam production currently lacks specialized seed producers. Rapid multiplication techniques under consideration include Semi Autotrophic Hydroponics (SAH), minisetts, and leaf bud cuttings (LBC). Seed entrepreneurs use LBCs from disease-free mother plants to dramatically increase seed multiplication rates, from 1:3 up to 1:300, making quality planting materials more widely available. Regarding nutrient efficiency, IITA has identified yam genotypes responsive to nutrient uptake and use, which could be further evaluated under Côte d’Ivoire conditions. These varieties will be assessed through gender-inclusive, participatory citizen science methods such as the tricot approach, facilitating broader adoption and enhancing the climate change adaptation and mitigation potential of improved yam varieties.
- Nutrient uptake and/or nutrient use efficient varieties: Incorporating yam genotypes with high nutrient uptake efficiency maximizes the use of existing soil nutrients, reducing the need for external fertilizers. This makes yam cultivation more sustainable and cost-effective under climate stress. It also enhances yield stability, supporting food security in changing environmental conditions.

The adoption of these climate-resilient yam production technologies is expected to directly benefit 100,000 farmers and indirectly support 300,000 individuals in farming communities. These interventions will strengthen climate adaptation efforts, improve food security, and promote sustainable livelihoods for yam farmers in Côte d'Ivoire.

Overall, LARACI is expected to reach 147,000 direct beneficiaries in Côte d’Ivoire broken down by value chain as per Table 13.

TABLE 13: LARACI BENEFICIARIES BREAKDOWN BY VALUE CHAIN

VALUE CHAIN	**DIRECT BENEFICIARIES**	**INDIRECT BENEFICIARIES**
Rice	80,000	240,000
Cassava	30,000	90,000
Yam	100,000	300,000

Grand Total – after adjustment for double-counting[89]	147,000	455,650

6.3 Incremental analysis

Building on the beneficiary breakdown outlined in Table 13, this section examines the incremental benefits of the LARACI project in mitigating climate-related risks for selected value chains. The incremental analysis evaluates how availing climate information services, agro-advisory services, promoting climate-smart technologies and institutional support will enhance productivity and resilience, and reduce GHG emissions compared to a baseline scenario where these interventions are absent. The following analysis highlights the key challenges farmers currently face and the expected improvements under LARACI interventions. Without access to reliable weather forecasting data, farmers struggle with poor timing of planting and harvesting, resulting in increased losses due to droughts, floods, and unpredictable rainfall. Additionally, the absence of climate-smart recommendations limits the adoption of adaptive agricultural practices, further reducing resilience and leading to higher production losses and higher GHG emissions. A lack of timely agro-advisory services means that farmers receive little or no guidance on weather risks and optimal farming practices, exacerbating vulnerability to climate shocks. Furthermore, limited capacity among farmers and extension workers to interpret and apply climate data leads to poor decision-making, negatively affecting agricultural productivity and therefore limiting the level of GHG that could be potentially sequestrated under better yields. Weak institutional frameworks and inadequate policy support further contribute to uncoordinated climate action, inefficient responses to climate shocks, and financial losses for farmers.

This incremental cost analysis aims to quantify the economic benefits of the LARACI project by assessing the income increment that its interventions will generate. By strengthening agrometeorological networks, enhancing climate-smart advisory services, providing training to farmers on the effective use of CSA technologies, LARACI is expected to significantly reduce climate-related losses and enhance both farmer resilience and GHG sequestration. The analysis quantifies incomes increment induced by each technology compared to the baseline scenario, where these challenges persist, with the improved scenario under LARACI, demonstrating the additional value generated by the project in terms of increased agricultural productivity, higher farmer incomes, and reduced climate-induced losses.

6.3.1 Rice

The application of various adaptation technologies in rice production is projected to generate substantial economic benefits by enhancing yield, increasing production, and improving farmers' incomes. See Table 13 for number of direct and indirect beneficiaries expected to adopt and

[89] As outlined in Annex 23, it is assumed that 30% of beneficiaries will adopt multiple technologies in combination (within, or across crops in mixed cropping systems).

benefit from these technologies. This study has assessed the key contribution of each eligible adaptation technology:

- RiceAdvice: This technology leads to a yield increase of 0.9 t/ha. Smart-Valleys: This technology leads to a yield increase of 2.2 tons per hectare.
- System of Rice Intensification (SRI): SRI induces a significant yield increase of 2.4 tons per hectare and reduced water use of 330 m3/ha.
- Combined Application of Biochar and Nitrogen Fertilizer: This technology leads to a yield increase of 1 ton per hectare as well as reduced water usage of up to 350 m^3/ha.
- Mid-Season Drainage and Alternate Wetting and Drying: Mid-season drainage and alternate wetting and drying contribute to a 0.6-ton per hectare yield increase.
- Dissemination of Climate Information Services and Early Warning Systems: This technology leads to a yield increase of 0.7 tons per hectare.

The total yearly impact in terms of improved yield for applying identified adaptation technologies on rice cultivation is provided in Table 14 below. This demonstrates how the promotion of these adaptation technologies by LARACI will significantly enhance yield, and therefore overall financial well-being of farmers and the economy in Côte d'Ivoire. Table 14 summarizes yearly yield increment by technology applied for rice.

TABLE 14: YEARLY INCOME INCREASE INDUCED BY RICE CULTIVATION

Technologies	**Number of direct beneficiaries by the end of the project**	**Number of indirect beneficiaries by the end of the project**	**Average cultivated area per farmer per season (ha)**	**Total targeted area (ha)**	**Yield increment induced by the technology (t/ha)**
RiceAdvice	12,500	37,500	0.6	7,500	0.90
Smart-Valleys	17,500	52,500	0.6	10,500	2.20
System of rice intensification	12,500	37,500	0.6	7,500	2.40
Combined application of biochar and	12,500	37,500	0.6	7,500	1.00

nitrogen fertilizer					
Mid-season drainage	12,500	37,500	0.6	7,500	0.60
Dissemination of climate information services and early warning systems	12,500	37,500	0.6	7,500	0.70

6.3.2 Cassava

The adoption of climate-smart technologies in cassava production is projected to deliver substantial economic and climate resilience benefits for smallholder farmers. See Table 13 for number of direct and indirect beneficiaries expected to adopt and benefit from these technologies. This analysis evaluates the incremental impacts of the selected technologies in terms of yield:

- Cassava-legume intercropping - replacing sole cropping by intercropping: This technology does not provide any yield increase for cassava since the space is occupied with other crops, yet it results in an income increase for farmers. Despite a yield decrement of 8,676 tons per ha, farmers benefit with a yearly net income increase in the project's scope area due to diversification which enables them to build their climate resilience.
- AKILIMO tailored agronomic and site-specific advisory service/site specific recommendations: This technology results in a substantial yield increase of 1.38 tons per hectare. . The total yearly production increase is 10,381 tons.
- AKILIMO tailored agronomic advisory service - optimum planting and harvesting time: Through site-specific recommendations based on crop models and soil/climate data, this service ensures efficient fertilizer application that supports sustainable intensification while reducing nutrient losses. This leads to a yield increase of 1.38 tons per hectare. . The measures will result in a yearly production increase of 10,381 tons.
- Seed System: This technology results in a substantial yield increase of 1.32 tons per hectare. The total yearly production increase is 9,887 tons.

Total impact: The combined yearly yield increase across all these adaptation technologies demonstrates a significant improvement in cassava productivity and farmers' financial gains. Notably, Cassava-Legume Intercropping contributes the highest due to its substantial income gains, making it a key technology for maximizing the economic benefits of cassava farming. Table 15 summarizes yearly yield increases by technology applied for cassava.

TABLE 15: A SUMMARY OF YEARLY INCOME INCREMENT BY TECHNOLOGY APPLIED FOR CASSAVA

Technologies	Number of direct beneficiaries by the end of the project	Number of indirect beneficiaries by the end of the project	Average cultivated area per farmer per season (ha)	Total targeted area (ha) (end of project)	Yield increment induced by the technology (t/ha)	Reduced water use (m3/ha)	Yearly production increment induced by the technology (t)
Cassava-legume intercropping - replacing sole cropping by intercropping	7,500	22,500	1	7,500	-1.16	na	8,676
AKILIMO: tailored agronomic and site specific advisory service/site specific recommendations	7,500	22,500	1	7,500	1.38	na	10,381
AKILIMO tailored agronomic advisory service - optimum planting and harvesting time	7,500	22,500	1	7,500	1.38	na	10,381
Seed system	7,500	22,500	1	7,500	1.32	na	9,887

6.3.3 Yam

The application of various adaptation technologies in yam production is expected to generate substantial economic benefits by enhancing yield, increasing production, and improving farmers' incomes. See Table 13 for number of direct and indirect beneficiaries expected to adopt and benefit from these technologies. This study has assessed the key contribution of each eligible adaptation technology:

- Efficient plant arrangement: This technique improves yields and results in an increase of 1 ton per hectare. The total yearly production increase is 20,000 tons, leading to substantial yearly net income increase in the project's area, as will be quantified in the next section.

- Climate-Smart Staking: This advanced staking method leads to a 1.05 ton per hectare increase in yield. The total yearly production increase is 20,902 tons.
- High Nutrient Uptake Yam Varieties: This technology leads to a yield increase of 2.2 tons per hectare. The total yearly production increase is 44,000 tons.
- Yam-Seed System: This technology significantly enhances yield, leading to an increase of 1.44 tons per hectare. The total yearly production increase is 28,741 tons.

Total impact: The combined yearly yield increment across all these adaptation technologies showcases a remarkable enhancement in yam productivity farmers' financial gains and economic gains. Notably, nutrient uptake and use of efficient yam varieties contribute the highest revenue increases due to their significant yield benefits, making them the most impactful technologies for optimizing yam farming under the LARACI project. Table 16 below summarizes yearly yield increment by technology applied for yams.

TABLE 16: A SUMMARY OF YEARLY INCOME INCREMENT BY TECHNOLOGY APPLIED FOR YAM

Technologies	Number of direct beneficiaries by the end of the project	Number of indirect beneficiaries by the end of the project	Average cultivated area per farmer per season (ha)	Total targeted area (ha) (end of project)	Yield increment induced by the technology (t/ha)	Yearly production increment induced by the technology (t)
Efficient plant arrangements	25,000	75,000	0.80	20,000	1.00	20,000
Climate-smart staking	25,000	75,000	0.80	20,000	1.05	20,902
Nutrient uptake and/or nutrient use efficient yam varieties	25,000	75,000	0.80	20,000	2.20	44,000
Yam seed systems	25,000	75,000	0.80	20,000	1.44	28,741

6.3.4 Farmers Incremental incomes

The economic effects of these yield increments have been computed in Annex 3 following a 3-step approach. First, the baseline yields trajectory for the next 20 years has been quantified for each crop, applying conservative yearly decrease per year due to climate change. These conservative yearly decrease in the baseline are 2.2% for rice, 2.5% for cassava, and 3.2% for yam. To remain further conservative, the baseline yield trajectory assumption has been estimated by holding yields static at their Year 5 level from Year 6 onward, rather than allowing the decline to continue over the full 20-year horizon. This directly reduces the long-term divergence between baseline and project scenarios.

As a second step, yields trajectory over 20 years have been estimated. Conservative adjustments have also been applied while doing these estimates:

(i) Post-project sustainability adjustment: A 70% post-project sustainability adjustment factor has been applied to the incremental income from Year 6 onward, reflecting uncertainty in the sustained effectiveness of CSA practices in the long-term, after intensive project support ends. This ensures that incremental income estimates account for post project uncertainties.

(ii) Refined benefit realization pathway: The economic benefit build-up profile has been revised to explicitly distinguish between adoption rates and realized economic performance, recognizing that agronomic benefits (soil restoration, water productivity gains, input efficiency) and institutional factors (skills, market linkages) are materialized with a lag. As a result, full economic benefit realization occurs only by Year 12 in the model, reflecting a more conservative diffusion of the impact pathway.

As a third step, we have estimated the incremental yield trajectory induced by the project under these conservative assumtions. And finally, these yield increments have been multiplied by farmers gate price to assess farmers' incremental income induced by LARACI. The results of these estimates are presented in Table 17 and make the foundation of the economic analysis. Under these conservative assumptions and assuming a shadow price of carbon of USD 35 per ton, the GCF USD 40 million investment will generate an economic return of 45%.

TABLE 17: TRAJECTORY OF FARMERS' INCREMENTAL INCOME UNDER LARACI

Farmers incremental income analysis		Year																				
BAU yield trajectory	Unit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Rice yield per Ha	t	0	4.6944	4.5888	4.4832	4.3776	4.272	4.272	4.272	4.272	4.272	4.272	4.272	4.272	4.272	4.272	4.272	4.272	4.272	4.272	4.272	4.272
Cassava yield per Ha	t	0	5.85	5.7	5.55	5.4	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25
Yam yield per Ha	t	0	5.335	5.17	5.005	4.84	4.675	4.675	4.675	4.675	4.675	4.675	4.675	4.675	4.675	4.675	4.675	4.675	4.675	4.675	4.675	4.675
Total Rice yield per yer in BAU	t	0	225331.2	220262.4	215193.6	210124.8	205056	205056	205056	205056	205056	205056	205056	205056	205056	205056	205056	205056	205056	205056	205056	205056
Total Cassava yield per year BAU	t	0	175500	171000	166500	162000	157500	157500	157500	157500	157500	157500	157500	157500	157500	157500	157500	157500	157500	157500	157500	157500
Total Yam yield per year	t	0	426800	413600	400400	387200	374000	374000	374000	374000	374000	374000	374000	374000	374000	374000	374000	374000	374000	374000	374000	374000
Vith Project Yield Trajectory	Unit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Rice yield per Ha with CSA	t	0	4.9755	5.2095	5.3265	5.502	5.6775	5.853	5.9115	5.97	5.97	5.97	5.97	5.97	5.97	5.97	5.97	5.97	5.97	5.97	5.97	5.97
Cassava yield per Ha with CSA	t	0	6.1095	6.2555	6.3285	6.438	6.5475	6.657	6.6935	6.73	6.73	6.73	6.73	6.73	6.73	6.73	6.73	6.73	6.73	6.73	6.73	6.73
Yam yield per Ha with CSA	t	0	5.711875	5.994375	6.135625	6.3475	6.559375	6.77125	6.841875	6.9125	6.9125	6.9125	6.9125	6.9125	6.9125	6.9125	6.9125	6.9125	6.9125	6.9125	6.9125	6.9125
Total Rice yield per yer in BAU	t	0	238824	250056	255672	264096	272520	280944	283752	286560	286560	286560	286560	286560	286560	286560	286560	286560	286560	286560	286560	286560
Total Cassava yield per year BAU	t	0	183285	187665	189855	193140	196425	199710	200805	201900	201900	201900	201900	201900	201900	201900	201900	201900	201900	201900	201900	201900
Total Yam yield per year	t	0	456950	479550	490850	507800	524750	541700	547350	553000	553000	553000	553000	553000	553000	553000	553000	553000	553000	553000	553000	553000
Incremental Yield Trajectory Parameters	Unit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Maximum Potential Total Incremental Rice yield	t	0	13492.8	29793.6	40478.4	53971.2	67464	75888	78696	81504	81504	81504	81504	81504	81504	81504	81504	81504	81504	81504	81504	81504
Maximum Potential Total Incremental Cassava yield	t	0	7785	16665	23355	31140	38925	42210	43305	44400	44400	44400	44400	44400	44400	44400	44400	44400	44400	44400	44400	44400
Maximum Potential Total Incremental Yam yield	t	0	30150	65950	90450	120600	150750	167700	173350	179000	179000	179000	179000	179000	179000	179000	179000	179000	179000	179000	179000	179000
Economic benefits build up	%		0%	0%	5%	10%	20%	30%	40%	50%	60%	80%	90%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Incremental Yield Trajectory	Unit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Incremental Rice yield trajectory	t	0	0	0	2023.92	5397.12	13492.8	22766.4	31478.4	40752	48902.4	65203.2	73353.6	81504	81504	81504	81504	81504	81504	81504	81504	81504
Incremental Cassava yield trajectory	t	0	0	0	1167.75	3114	7785	12663	17322	22200	26640	35520	39960	44400	44400	44400	44400	44400	44400	44400	44400	44400
Incremental Yam yield trajectory	t	0	0	0	4522.5	12060	30150	50310	69340	89500	107400	143200	161100	179000	179000	179000	179000	179000	179000	179000	179000	179000
Incremental income Trajectory	Unit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Incremental Rice income	$	0	$ -	$ -	$ 887,684	$ 2,367,158	$ 5,917,895	$ 9,985,263	$ 13,806,316	$ 17,873,684	$ 21,448,421	$ 28,597,895	$ 32,172,632	$ 35,747,368	$ 35,747,368	$ 35,747,368	$ 35,747,368	$ 35,747,368	$ 35,747,368	$ 35,747,368	$ 35,747,368	$ 35,747,368
Incremental Cassava income	$	0	$ -	$ -	$ 420,390	$ 1,121,040	$ 2,802,600	$ 4,558,680	$ 6,235,920	$ 7,992,000	$ 9,590,400	$ 12,787,200	$ 14,385,600	$ 15,984,000	$ 15,984,000	$ 15,984,000	$ 15,984,000	$ 15,984,000	$ 15,984,000	$ 15,984,000	$ 15,984,000	$ 15,984,000
Incremental Yam income	$	0	$ -	$ -	$ 1,809,000	$ 4,824,000	$ 12,060,000	$ 20,124,000	$ 27,736,000	$ 35,800,000	$ 42,960,000	$ 57,280,000	$ 64,440,000	$ 71,600,000	$ 71,600,000	$ 71,600,000	$ 71,600,000	$ 71,600,000	$ 71,600,000	$ 71,600,000	$ 71,600,000	$ 71,600,000

6.4 Theory of change and logic of actions

The theory of change (ToC) diagram (Figure 9) synthesizes how the proposed project will contribute towards the goal statement by linking the three components consisting of five sets of activities to five outputs that are interlinked and mutually reinforcing, as well as the assumptions, risks and barriers that are considered and addressed in project design.

Component 1 is national in scope and aims to strengthen the capacity of farmers and agribusinesses to manage climate risks by addressing key systemic barriers that are technological, financial, institutional, policy, and gender related. It focuses on creating the enabling conditions for large-scale adoption of CSA. SODEXAM currently operates 131 agrometeorological stations nationally. A 2022 SODEXAM inventory recorded 159 synoptic, agrometeorological, and climatological stations across the country, of which 83% function well, 8% operate acceptably, and 9% are in poor technical condition. A diagnostic conducted to assess effective coverage in the project zones identified a need for approximately 40 functional stations. Based on recommendations from SODEXAM experts, the project will install 20 new automatic agroclimatic stations and rehabilitate 20 existing ones, achieving the required coverage across the five target regions. Key outputs include: improved access to climate information and advisory services (Output 1.1); strengthened extension services and regulatory systems to deliver timely, tailored guidance (Output 1.2); and better access to financial services for investments in CSA practices and technologies (Output 1.3). Climate information will be disseminated through a multi-channel approach combining periodic bulletins and agricultural advisory services delivered through extension agents, SMS alerts, local radio broadcasts in local languages, and community-based relays. SMS will be prioritized through public-private partnership models involving SODEXAM, ANADER, and private digital startups. The telecommunications landscape in Côte d'Ivoire strongly supports this approach: the ARTCI 2022 annual report recorded a cellular penetration rate of 164.5%, mobile network coverage reaches over 94% of the total population for 2G/3G/4G networks, and over 98% of Ivoirians access the internet via mobile devices. Extension agents trained on the PICSA methodology will serve as the primary last-mile relay during the digital adoption phase. Together, these outputs support Outcome 1 by equipping producers with the tools, information, and capacity to make informed decisions and investments, laying the foundation for a national transition to a climate-smart agrifood sector (Figure 10). The yield stability and loss avoidance impact of climate information services will be measured through crop-cut surveys at sentinel sites established in each of the five target regions. Sentinel sites will enable consistent longitudinal comparison of yield outcomes between CIS-adopting and non-adopting farmers across seasons and years. This design will generate attributable estimates of yield loss avoidance over the project period, directly linking CIS delivery to measurable farm-level outcomes.

The long-term institutional sustainability of Output 1.2 results is anchored in three existing national institutional mandates. The agrometeorological data infrastructure established under Activity 1.1.1 will be hosted by SODEXAM as the legally mandated national entity for weather and climate data collection, ensuring continuity of station operation and data management beyond the project period. The agricultural advisory dissemination platform developed under

Activity 1.2.2 will be hosted by FIRCA, whose established interprofessional levy mechanism provides a sustainable domestic financing source for ongoing advisory service delivery across its 25 value chains. Curricula and training materials developed under Activity 1.2.3 will be integrated into ANADER and ADERIZ's existing extension training frameworks, ensuring that climate-responsive extension capacity is institutionalized within national public extension systems rather than dependent on continued project funding.

Components 2 and 3 focus on delivering concrete adaptation and mitigation benefits in Côte d'Ivoire's central regions. They support the national component (Component 1) by applying CSA principles through targeted, on-the-ground interventions. These include promoting climate-smart integrated soil fertility management and agroforestry (Output 2.1), which enhance productivity, reduce emissions, and protect biodiversity. Additionally, proven CSA practices will be scaled up in three priority value chains—cassava, yam, and rice (Output 3.1)—contributing to a resilient, low-emission agrifood system with improved food security and inclusive income growth.

Processing and storage infrastructure established under Output 3.1 represents a core sustainability asset requiring clear ownership, operation and maintenance responsibilities, and financing arrangements beyond the project period. Infrastructure ownership transfer and operation and maintenance arrangements are formally governed by Section 7 of the project Term Sheet under the Covenants provisions, which require that these modalities be fully defined in the Project Operations Manual to be developed and approved during the inception phase. The Operations Manual will determine, on an asset-by-asset basis, whether individual assets are transferred to professional producer organizations, community-based organizations, or relevant public entities, based on the nature, location, and intended use of each asset. To ensure long-term operability, receiving institutions will be provided with preventive maintenance training, operational manuals, and a minimum stock of fast-wear spare parts at the point of handover. Recurrent maintenance costs will be financed through professional producer organizations' service charges levied on processing services provided to members and revenues from market linkages established during the project period. FIRCA will maintain a post-project advisory role to support receiving institutions in the early years following handover, funded through its interprofessional levy mechanism.

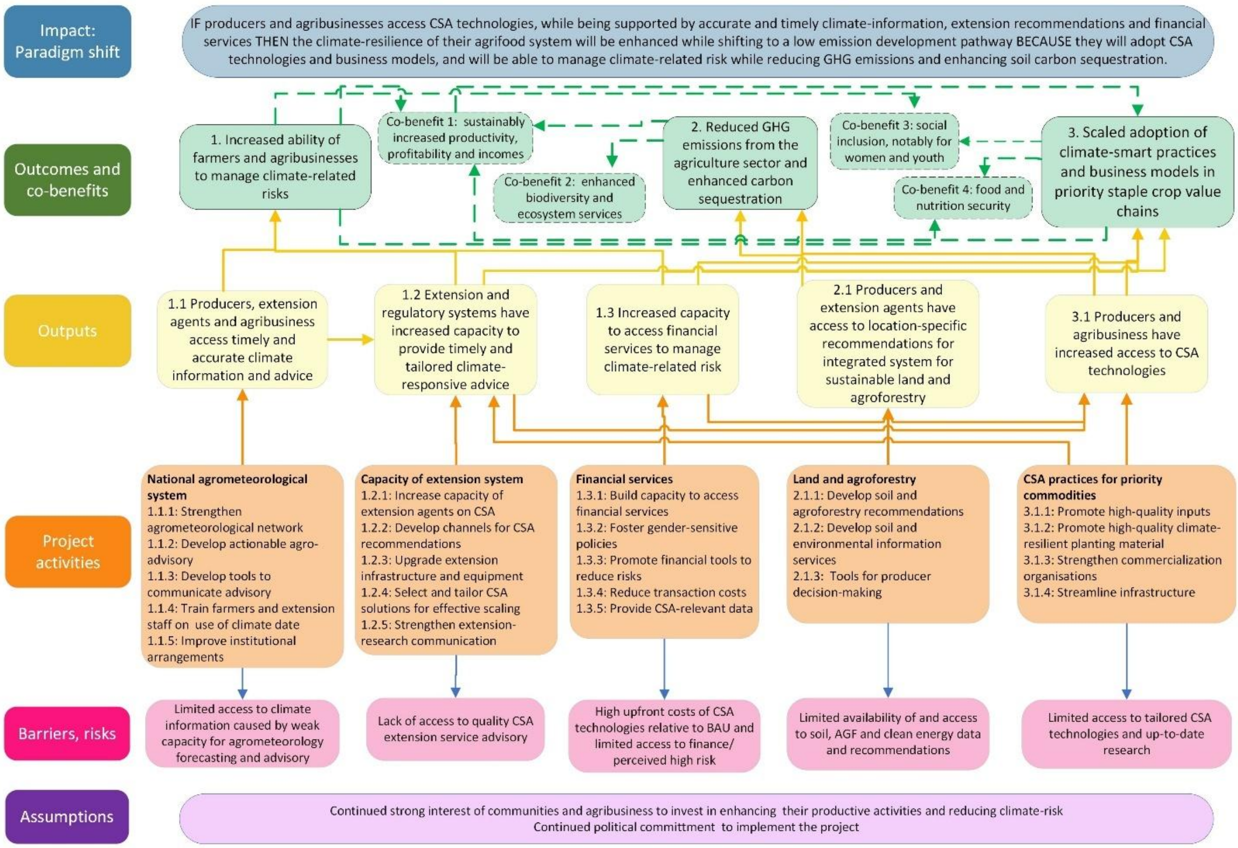

FIGURE 9: LARACI THEORY OF CHANGE

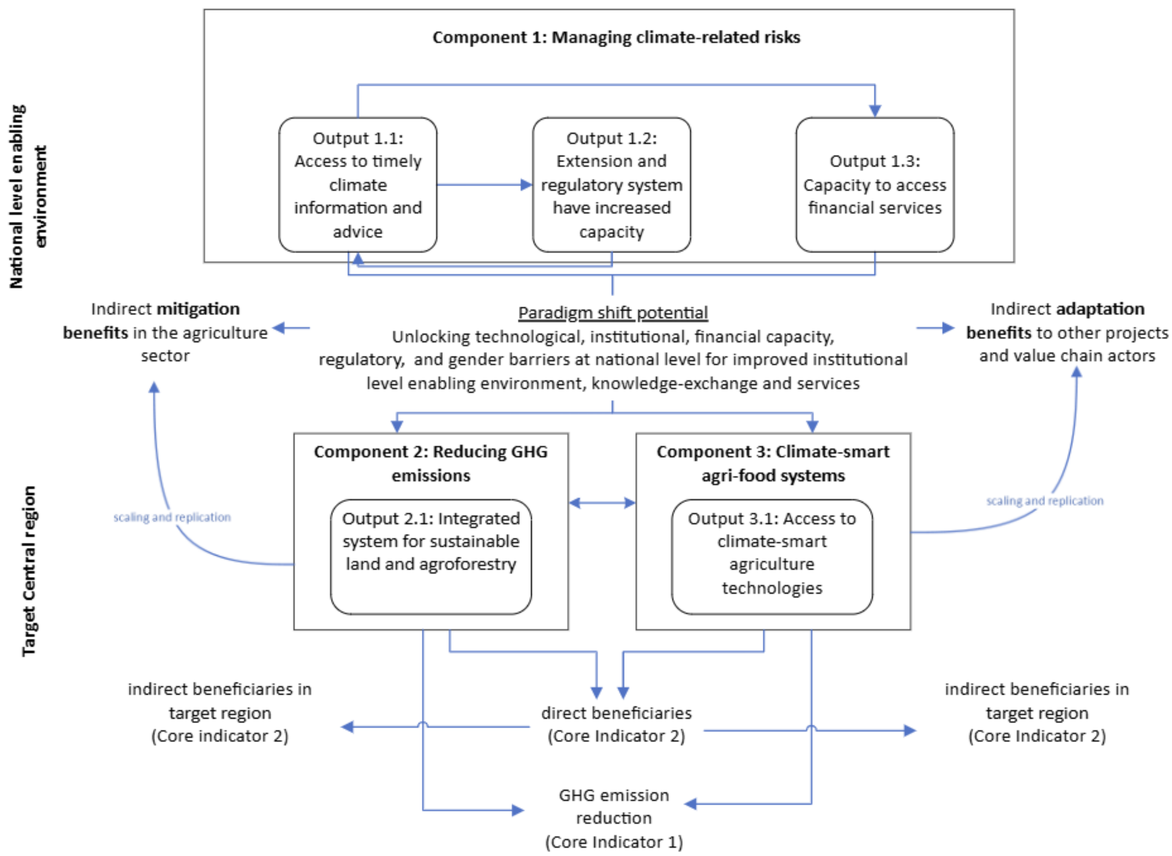

FIGURE 10: DIAGRAM OF INTERLINKAGES BETWEEN COMPONENT 1 INTERVENING AT NATIONAL LEVEL DIRECTLY SUPPORTING COMPONENTS 2 AND 3 THAT INTERVENE AT REGIONAL (SUB-NATIONAL) LEVEL (2 AND 3) TO DELIVER ON-THE-GROUND ADAPTATION AND MITIGATION BENEFITS

The outputs of the three components are closely interlinked and mutually reinforcing (see Figure 10). For example, increasing incomes and access to investment resources (Component 1, Output 1.3) enhances resilience by helping farmers recover from climate shocks (Component 3), while reduced vulnerability, in turn, supports sustained income growth. Output 1.1, which focuses on timely, tailored climate information, will guide better land management decisions (Component 2) and the adoption of appropriate climate-smart technologies (Component 3). Output 1.2 will strengthen extension services by equipping them with relevant knowledge and digital tools (e.g., e-extension) to disseminate climate-smart advisories effectively. This will be supported through public-private partnerships, enabling private sector actors to access financial mechanisms and invest in CSA solutions.

6.5 Implementation arrangements

Accredited Entity: The CGIAR System Organization is the GCF Accredited Entity (AE) for this project. The CGIAR System Organization is an independent international organization established in 2012 under the agreement establishing the Consortium of International Agricultural Research Center[90], with its headquarters in Montpellier, France pursuant to the Agreement between the CGIAR System Organization and the Republic of France. The CGIAR System Organization was accredited to GCF in 2018 and signed the AMA in 2022.

CGIAR (formerly Consultative Group on International Agricultural Research) was established as a global partnership in 1971 for a food-secure future. CGIAR's science is dedicated to transforming food, land and water systems in a climate crisis, in order to reduce poverty and inequity, enhance food and nutrition security, and improve natural resources and ecosystem services. With over 10,000 staff with multi-disciplinary expertise in gender, climate, economics, policy, agronomy, biology, ecology, and sociology, CGIAR is the world's largest publicly funded agricultural research network. CGIAR is an integrated partnership consisting of 15 CGIAR centers (CGIAR Centers)[91] and the CGIAR System Organization. Each CGIAR Center and the CGIAR System Organization are independent legal entities with their own governing board, governing instruments, and host country agreements. For the avoidance of doubt, none of the CGIAR Centers is an Affiliate (as defined in the AMA) of the CGIAR System Organization. CGIAR's research for development activities are carried out by the 15 CGIAR Centers in close collaboration with thousands of partners, including national and regional research institutes, civil society organizations, academia, development organizations, and the private sector.

The project leverages CGIAR's 50 years of experience, and a portfolio of ready-to-scale CGIAR technologies and practices that can deliver adaptation benefits to smallholder farmers and mitigate GHG emissions. CGIAR brings world-leading technical capacity to enhance capacity and design integrated solutions that overcome structural, cultural, and economic barriers to climate adaptation and mitigation.

Executing Entities: The AE will implement the project through the following two Executing Entities (EEs) who together bring complementary strengths that uniquely position them as EEs for the LARACI project. The EEs will be engaged through Subsidiary Agreements.

- **Africa Rice Center (AfricaRice)**: AfricaRice Center is an international organization established on 4 September 1970 with its headquarters in Côte d'Ivoire and with privileges and immunities under its host country agreement with the Government of Côte d'Ivoire (Accord de siège entre le Centre du Riz pour l'Afrique et le Gouvernement de la

[90] The legal name of the Consortium of International Agricultural Research Centers was changed to the CGIAR System Organization upon the amendment of the International Organization Agreement on 21 November 2016.

[91] As of date, the following 15 research organizations are recognized as CGIAR Research Centers: Africa Rice Center, also known as AfricaRice, Bioversity International, Center for International Forestry Research (CIFOR), International Center for Agricultural Research in the Dry Areas (ICARDA), International Centre for Research in Agroforestry (ICRAF), also known as World Agroforestry Centre, International Center for Tropical Agriculture (CIAT), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), International Food Policy Research Institute (IFPRI), International Institute of Tropical Agriculture (IITA), International Livestock Research Institute (ILRI), International Maize and Wheat Improvement Center (CIMMYT), International Potato Center (CIP), International Rice Research Institute (IRRI), International Water Management Institute (IWMI), and International Center for Living Aquatic Resources Management (ICLARM), also known as WorldFish.

République de Côte d'Ivoire), dated 14 November 2014. Today, its membership comprises 28 countries. AfricaRice assists its member states to achieve operational cooperation in the field of rice production, including increasing quality and quantity, researching production methods adapted to the local conditions, promoting and implementing effective phytosanitary controls and improving storage and processing facilities. It contributes to reducing poverty, achieving food and nutrition security and improving livelihoods of farmers and other rice value-chain actors in Africa by increasing the productivity and profitability of rice-based agri-food systems, while ensuring the sustainability of natural resources. As a CGIAR Center and pan-African research organization, AfricaRice brings to the project a strong track record in CSA innovation, with world-class expertise in developing, testing, and scaling context-specific technologies and practices for resilient, low-emission agri-food systems, particularly in rice-based systems, but also across diverse value chains. Its extensive scientific network, proven capacity to generate actionable climate information services, and experience in gender-responsive technology deployment ensure that the project innovations are both technically sound and socially inclusive. AfricaRice has extensive experience in GHG quantification, soil carbon assessment, and the development of MRV systems in rice-based systems across West Africa. In Côte d'Ivoire, AfricaRice has conducted multi-year field measurements and modeling of GHG emissions across irrigated lowland, rainfed lowland, and rainfed upland rice systems, generating robust datasets on CH_4, N_2O, and soil carbon dynamics. These studies have evaluated emissions and mitigation potential of several climate-smart innovations, including AWD, mid-season drainage, biochar application, integrated rice–fish systems, improved rice varieties, conservation agriculture practices, and nutrient management strategies. Emissions are quantified using internationally recognized methodologies, including field-based chamber measurements and gas chromatography technique, soil carbon monitoring, and IPCC-compliant emission factor development, combined with digital tools and modeling approaches for scaling results. In addition, AfricaRice is developing institutional MRV systems, including the design of a digital MRV framework for rice-based mitigation interventions in Nigeria, which integrates farm-level data collection, remote sensing, and national reporting requirements aligned with IPCC guidelines and NDC reporting frameworks. These experiences provide a strong technical foundation for establishing transparent MRV protocols under the LARACI project, ensuring that soil carbon sequestration and emission reductions are monitored, verified, and reported in a manner consistent with GCF results management and climate impact reporting standards. AfricaRice is one of the CGIAR Research Centers. For the avoidance of doubt, AfricaRice is not an Affiliate of the AE. The AE will enter into a Subsidiary Agreement with AfricaRice in the form of a grant.

- **Fonds Interprofessionnel pour la Recherche et le Conseil Agricoles (FIRCA)**: FIRCA is a public-interest organization established in 2002 by Presidential Decree No. 2002-520, dated December 11, 2002, and titled "Creating and organization of the Interprofessional Fund for Agricultural Research and Advice (FIRCA)" ("Establishing Decree"). As set out in Article 2 of the Establishing Decree "FIRCA is an agricultural development fund. It is a legal person of private law of a particular type recognized as being of public utility. The FIRCA has an establishment fund. Its assets are exclusively assigned to the exercise of its mission of agricultural development, as provided for by its purpose." FIRCA supports the development of Côte d'Ivoire's plant, forestry, animal production, and fisheries sectors through the financing of programs of technical and economic research, knowledge dissemination, and capacity building. FIRCA became a GCF accredited entity in 2024 and signed its AMA with GCF in 2025. As a national institution with deep operational presence in Côte d'Ivoire, FIRCA has an established mandate to coordinate agricultural research, extension, and value chain development, and a proven ability to engage directly with farmers, agribusinesses, and key government institutions including MINETE and MINADER PV. Its strong relationships with national stakeholders, capacity to mobilize and manage resources, and experience in facilitating public–private partnerships provide the institutional leverage necessary to integrate CSA solutions into national systems and policies. The primary mission of FIRCA is to mobilize financing from agricultural value chains, technical and financial partners, and the State in order to ensure the sustainable funding of service-delivery programs for producers across 25 agricultural value chains. This includes financing tailored research programs, training, experimentation and demonstration activities to transfer knowledge between research and farming, disseminating knowledge through training, providing advisory and technical-economic support, contributing to the sustainable improvement of farm profitability, strengthening the capacities of agricultural professional organizations, and providing vocational training for producers and organizations. Since 2011, FIRCA has been called upon to provide technical and fiduciary coordination for programs agreed upon by various development partners including the World Bank, European Union, and AFD amongst others. Between 2011 and 2018, FIRCA has mobilized approximately USD 344 million in the context of its role as technical and fiduciary coordination agency for 16 projects. FIRCA currently manages an active portfolio of approximately USD 60 million. This track record includes direct experience in strengthening of professional producer organizations, value chain grant management, and large-scale extension-based program delivery, all of which are directly relevant to FIRCA's responsibilities under Output 3.1 of the LARACI project. A dedicated LARACI project team has been established within FIRCA to ensure continuity, institutional ownership, and effective day-to-day management of project activities throughout the implementation period. The AE will enter into a Subsidiary Agreement with FIRCA in the form of a grant.

For the implementation of the Project, AfricaRice will engage the following service providers "**Service Providers**" through collaboration agreements (i) that will deliver specialized technical services for specific project activities, and (ii) that will provide co-financing for such activities. For clarity, these Service Providers are not Executing Entities, but are engaged to deliver clearly defined technical services to project activities that are under the full responsibility of AfricaRice, as the EE, which retains sole responsibility for implementation, decision making, reporting, and delivery of the relevant activities. These entities are also co-financiers to the Project:

- The International Center for Tropical Agriculture (CIAT): CIAT is an international non-profit organization established in Washington through an agreement dated May 28, 1986, between the World Bank and the United Nations Development Program, UNDP, with headquarters in Palmira, Colombia and governed in Colombia under Law 29 of 1988 which gives it privileges and immunities. CIAT is part of the Alliance of Bioversity International and CIAT since 1 January 2020, with an end-to-end comparative advantage in climate science and climate-smart agriculture. CIAT will serve as a specialized technical service provider to AfricaRice, responsible for delivering clearly defined technical services to the project's climate aligned finance, data systems, and land management activities. Under Output 1.3, CIAT will build investment readiness of professional producer organizations and partner financial institutions (under Activity 1.3.1), design and operationalize gender responsive financial products and policy instruments (1.3.2), develop and validate agricultural risk mitigation instruments including warehouse receipt finance, climate index insurance, and value chain finance (1.3.3), and deploy digital platforms, credit scoring tools, and MRV ready data systems that reduce transaction costs and enable climate informed underwriting (1.3.4 and 1.3.5). Under Output 2.1, CIAT will develop high-resolution soil and agroforestry intelligence, including field sampling, remote sensing, optimization trials, informing agro-advisories produced by IITA on the SEIS platform (2.1.1) and contribute to establishing and operationalizing the SEIS, providing the climate and weather related analytics which will be correlated with the soil analytics co-produced with IITA (2.1.2). CIAT will also provide expertise to support the design, validation, and long-term scientific robustness of producer-facing decision support tools (2.1.3). Across all activities, CIAT's role is limited to the provision of specific technical deliverables such as tools, systems, methodologies, datasets, and capacity building. AfricaRice retains full accountability for implementation, financial management, and delivery of results as the Executing Entity for these activities.

- The International Institute of Tropical Agriculture (IITA): IITA is a leading African research-for-development organization, headquartered in Ibadan, Nigeria under the headquarters agreement between Nigeria and IITA, dated 7 June 1988, with operations in over 20 countries in sub-Saharan Africa. Under the headquarters agreement (Article 6), IITA is granted "the same privileges as are accorded to other International Organizations in Nigeria in respect of Foreign exchange facilities." IITA is also granted privileges and immunities relating to its assets, taxes, customs and personnel under the Nigerian Diplomatic Immunities and Privileges (IITA) Order 1991. IITA will be engaged by AfricaRice to deliver technical services to Activities 1.3.2, 1.3.5, 2.1.1, 2.1.2, and 2.1 bringing expertise and innovations related to CSA and related services for cassava and yam, customized digital advisory tools, climate information services, and decision support tools. The technical services provided by IITA will focus on the value chains of cassava and yam. The services that will be provided include: producing Gender-Sensitive Maps to identify key constraints and solutions (under Activity1.3.2); customizing the AKILIMO digital advisory to the conditions of Côte d'Ivoire (under activity1.3.5); contribution to the assessment of the status of Climate Information Services (CIS) and the development of forecast models (under Activity 1.3.5); leading the selection of agronomic recommendations and the ensuing optimization trials for cassava and yam (under Activity 2.1.1); contributing to the SEIS platform aspects that are relevant to the development and maintenance of services around solutions for yam and cassava (under Activity 2.1,2); and lead the identification and packaging of recommendations as decision support tool (DST) for cassava and yam (under Activity 2.1.3). Across all activities, IITA's role is limited to the provision of specific technical deliverables such as tools, systems, methodologies, datasets, and capacity building. AfricaRice retains full accountability for implementation, financial management, and delivery of results as the Executing Entity for these activities.

The CGIAR System Organization, AfricaRice, CIAT, and IITA are independent legal entities, each governed by their own independent Board of Trustees, with AfricaRice additionally overseen by a Council of Ministers. Each entity's Board maintains a dedicated Audit, Finance and Risk Committee responsible for independent oversight of financial performance, procurement decisions, and compliance. This governance structure ensures effective separation of oversight responsibilities across the implementing entities and mitigates the risk of conflict of interest in procurement and financial reporting under LARACI.

At the system level, CGIAR applies a unified, systemwide internal audit framework that provides independent, risk-based assurance over governance, financial management, safeguards, and compliance across all entities. The Internal Audit 2026 plan includes a dedicated engagement assessing oversight mechanisms for bilateral funding, directly supporting fiduciary assurance for GCF resources under LARACI. Periodic GCF compliance and preparedness reviews will confirm that financial, procurement, and safeguard systems across the AE and EEs remain aligned with GCF standards throughout the project period. Additional assurance activities at EE and partner level will be identified through annual risk-based planning and delivered jointly with Center Internal Audit teams, with ongoing monitoring and follow-up ensuring timely resolution of issues and continuous strengthening of internal controls during implementation.

During implementation, the EEs will also engage procured parties to support implementation of the project activities through a competitive procurement process in accordance with the AE's procurement policy. Where the EE's own procurement policies and procedures are more stringent than those of the AE, the EE shall apply its own policies. The policies and procedures of FIRCA, being a GCF Direct Access Entity, have been assessed by GCF as part of the accreditation assessment. AfricaRice undertakes procurement in line with the Africa Rice Center Procurement Procedures Manual[92].

Technical leadership for warehouse receipt system and index insurance design and implementation under Activities 1.3.3 and 1.3.4 will be provided by CIAT, drawing on its experience with WRS implementation in Ghana and index insurance design in East and West Africa. Formal partnership agreements with financial institutions and insurance providers will be finalized during the project inception phase and documented in the Project Operations Manual. These agreements will specify data-sharing protocols, cost-sharing arrangements between the project and participating institutions, and the risk-sharing architecture governing each instrument. The risk-sharing architecture is structured in layers: individual farmers bear residual production risk; professional producer organizations aggregate and partially absorb price and

[92] AFRICA RICE CENTER Procurement Procedures Manual

storage risk through collective warehouse receipt arrangements; MFI partners carry credit risk mitigated by WRS collateral and index insurance triggers; and the project provides technical assistance and partial first-loss coverage during the pilot phase to catalyze institutional participation. Finally, all insurance products will undergo formal actuarial validation and regulatory filing with the Direction Nationale des Assurances (DNA) to ensure solvency and consumer protection.

In Côte d'Ivoire, warehouse receipt finance operates under the OHADA Uniform Act on General Commercial Law, which provides the legal basis for the use of warehouse receipts as negotiable collateral instruments. However, a dedicated national WRS regulatory framework and registry are not yet in place, and the project will support the development of operational WRS protocols in coordination with FIRCA, MINADER PV, and participating financial institutions during the inception phase. Index insurance for smallholder agriculture remains at an early stage of market development in Côte d'Ivoire, with limited existing products targeting the staple crop value chains. The project will draw on index insurance design experience from comparable CGIAR and CIAT-supported programs in Senegal, Ghana, and Kenya, while adapting product parameters to Côte d'Ivoire's specific agroclimatic conditions and regulatory environment. Engagement with the Insurance Regulatory Authority of Côte d'Ivoire will be initiated during inception to ensure that pilot products are developed within the applicable regulatory framework.

To ensure effective implementation across regions, the project incorporates a set of safeguards to address potential absorptive capacity constraints. A phased rollout approach prioritizes regions with stronger institutional capacity and professional producer organization structures in the early years, allowing lessons learned to inform subsequent expansion. In parallel, foundational activities under Component 1, including extension strengthening, climate information services, and financial system support, are front-loaded to build the necessary capacity before scaling up field-level interventions. FIRCA’s established presence and partnerships with ANADER, ADERIZ, and regional institutions provide a strong operational base, while the PMU will conduct regular capacity reviews and adjust the pace of implementation as needed to ensure alignment with regional readiness.

All processing and storage infrastructure assets acquired under the project will be transferred at project closure to designated beneficiary institutions, either professional producer organizations, community organizations, or relevant government entities, based on an asset-by-asset assessment conducted during the inception phase.

Financial institution engagement in Côte d'Ivoire will build on FIRCA's existing relationships with the national microfinance sector, developed through its mandate to coordinate agricultural finance across 25 value chains. Specific MFI and financial institution partners will be formally identified and engaged during the project inception phase, with at least one formal partnership agreement per target region targeted by the end of Year 2. Partner selection will prioritize institutions with existing rural agricultural portfolios in the five target regions and demonstrated interest in CSA-linked product development. FIRCA's AMA with GCF signed in 2025 and its established relationships with MINADER PV and the national financial sector regulators provide the institutional leverage to convene and formalize these partnerships within the project timeline.

The carbon-related activities under Activity 1.3.1 are justified primarily on the basis of MRV readiness and data system strengthening rather than near-term carbon revenue generation. The primary purpose of these activities is to build community and professional producer organizations' capacity for rigorous GHG emissions accounting, establish MRV protocols at the level of professional producer organizations, and develop the data infrastructure required for credible climate attribute reporting, all of which generate independent value for GCF reporting and adaptive management regardless of carbon market conditions. Carbon revenue is treated as a potential long-term upside and additional co-benefit that could reduce the residual cost of CSA adoption for farmers operating beyond the project's target area, not as a core project benefit or financial sustainability mechanism. The project acknowledges that a viable carbon credit issuance pathway may not materialize within the five-year project period, and the activity is therefore designed to deliver near-term value through data system strengthening and readiness capacity, while positioning professional producer organizations to access carbon finance in the longer term if market conditions and regulatory frameworks develop as anticipated. All emission reductions generated within the project scope and reported to GCF are fully attributed to GCF and will not be separately issued as carbon credits or counted toward any other mitigation claim.

Together, AfricaRice and FIRCA combine international scientific excellence with national implementation capacity, enabling the LARACI project to systematically address both the institutional and on-the-ground barriers to CSA adoption, while ensuring lasting impact through policy integration, stakeholder ownership, and sustained capacity building. The specific roles of the two EEs are defined in line with their respective comparative advantages. FIRCA is responsible for the delivery of Outputs 1.1, 1.2, and 3.1, and AfricaRice is responsible for the delivery of Outputs 1.3 and 2.1 (see Table 18, and Appendix 2 for a more detailed table of activity level roles of EEs and service providers).

TABLE 18 THE EXECUTING ENTITIES ARE RESPONSIBLE FOR THE IMPLEMENTATION OF THE FOLLOWING OUTPUTS

COMPONENT	OUTPUTS	EXECUTING ENTITY
1	Output 1.1: Timely access to accurate climate information and advice	FIRCA
	Output 1.2: Extension and regulatory system have increased capacity	FIRCA
	Output 1.3: Increased capacity to access financial services	AfricaRice
2	Output 2.1: Integrated system for land and agroforestry	AfricaRice
3	Output 3.1: Access to CSA technologies	FIRCA

Flow of funds: As the AE, CGIAR System Organization is responsible for administering the GCF proceeds, carrying out technical and fiduciary oversight and supervision, project evaluation aspects and submitting financial information to GCF in accordance with Accreditation Master Agreement (AMA) and the Funded Activity Agreement (FAA). Project funds will be disbursed to the EEs in accordance with the terms outlined in their respective Subsidiary Agreements (see Figure 11).

The Government of Côte d'Ivoire will provide co-financing through MINETE in-kind support to the activities that FIRCA will implement as EE. CGIAR will provide co-financing through grant and in-kind contributions from AfricaRice, CIAT and IITA to the implementation of project activities.

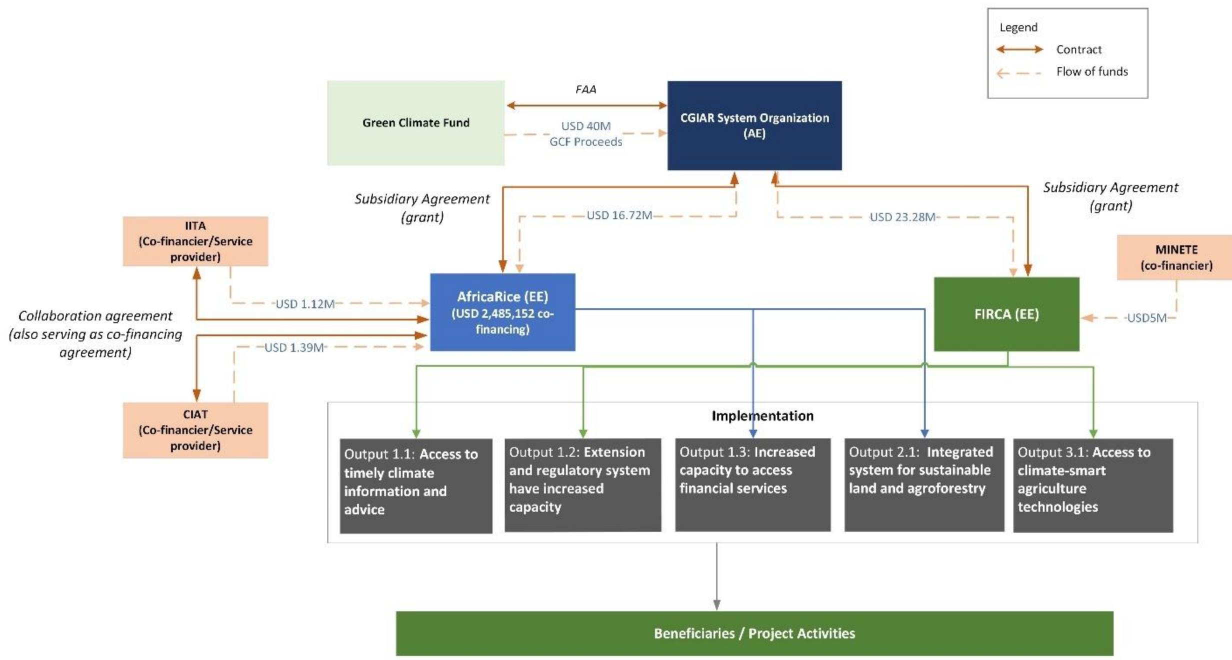

FIGURE 11: DIAGRAM OF THE FLOW OF FUNDS AND CONTRACTUAL ARRANGEMENTS

Project governance arrangement: Several mechanisms will be put in place to ensure that the LARACI project is coordinated and managed efficiently and that it delivers the expected results using the financial resources as planned. The project falls under the administrative facilitation of Côte d'Ivoire's Ministry of Environment and Ecological Transition (MINETE) that will ensure strategic alignment with national policies. MINETE also hosts the NDA who plays a critical role in the reporting of climate impacts.

A **Project Steering Committee (PSC)** will be established and will include the Government of Côte d'Ivoire (chaired by MINETE as the NDA, including also the MINADER PV and other relevant line ministries), the CGIAR System Organization as the AE and co-chair, the EEs (AfricaRice and FIRCA), and other selected representatives e.g. from local governance, private sector, regional councils of the target zones, as well as key national institutions linked to the project. The PSC will provide strategic guidance and advice on the following:

- **Coordination:** Facilitating coherence and coordination across key stakeholders, including the EEs, the NDA and national stakeholders, and relevant local actors.

- **Strategy:** Information sharing and guidance to ensure alignment and synergy with national strategies, policies, and related investments.
- **M&E and adaptive management:** Reviewing and providing input on reports on adaptive management and performance in view of emerging opportunities, challenges, and risks.

The EEs retain final approval authority over any matter submitted to, or decision adopted by, the PSC.

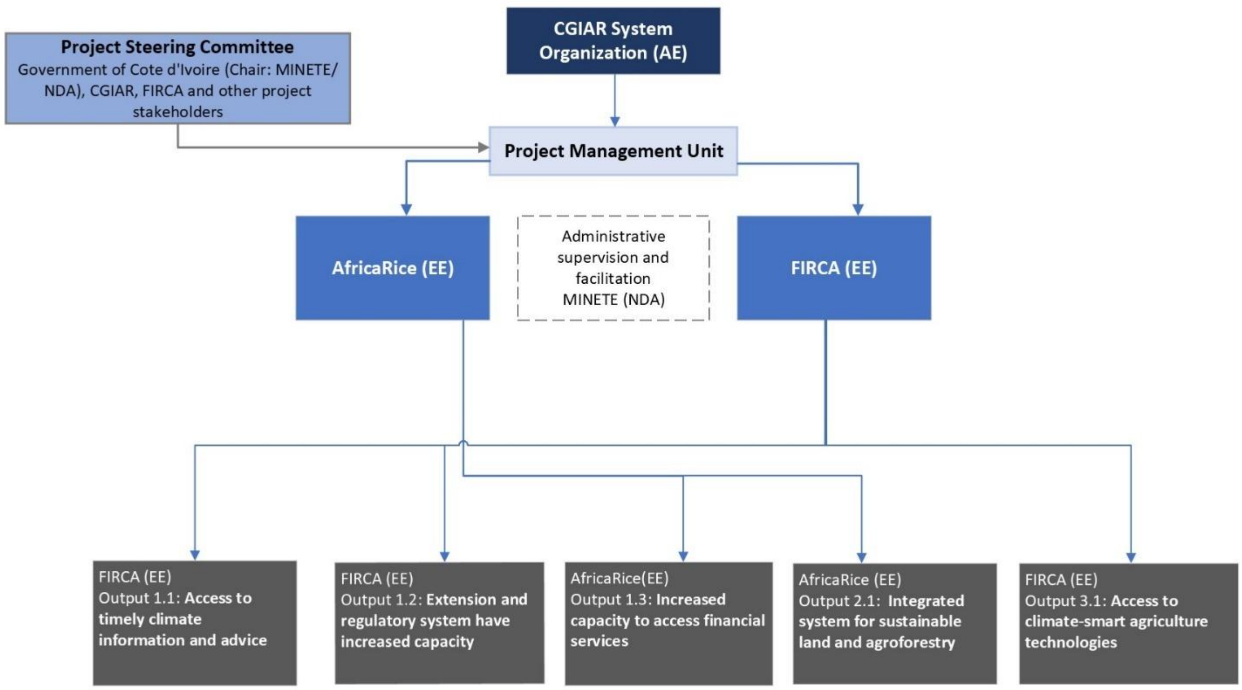

FIGURE 12 PROJECT GOVERNANCE AND IMPLEMENTATION ARRANGEMENTS

The CGIAR System Organization will put in place a **Project Management Unit (PMU)** through AfricaRice in charge of overall coordination between AfricaRice and FIRCA to avoid fragmentation (joint programming, preparation of overall project reporting - financial and technical - to GCF based on input from the two EEs, design and coordination of monitoring activities), financial oversight and provision of technical orientation to day-to-day implementation of all project outputs by the EEs. By aligning tasks according to each entity's comparative advantage, the PMU will ensure efficient delivery of outputs, avoid duplication, and maintain coherence across interventions.

For this purpose, the PMU includes capabilities spanning project coordination and reporting, technical oversight, finance, legal, gender, environmental and social safeguards (ESS), and knowledge management and communication; and monitoring, evaluation and learning (linked to the MEL Function).

The PMU will comprise the following roles (with indication of FTE based on Annex 4 budget): Project Manager (climate change and agriculture), Grants and Contracts Manager, Gender

Specialist, Environmental and Social Safeguard Specialist, Knowledge Management and Communications Specialist, Finance Planning and Budget Expert, Project Administrative Assistant, and Monitoring and Evaluation Specialist (through the MEL Function).

The PMU will have the following responsibilities in coordination with the EEs:

- preparation of funded activity documents (annual workplan, budget, analysis and reporting, procurement plans, requests for disbursement, TOR and procurement packages);
- tracking and monitoring of results (costs, deliverables, knowledge and records system, financial reports, coordination with EEs on implementation of the M&E plan (Annex 11));
- follow-up, coordination with Ees, and monitoring to ensure implementation of the GESI action plan (Annex 8) and ESAP (Annex 6);
- support to the PSC; and
- liaison with auditors and audit matters.

MEL function: The MEL function will be key in generating information on the performance of the project, which in turn indicates the level of commitment and satisfaction of actors. Lessons learned along the implementation steps will help guide orientation towards successful trajectories that will feed into the knowledge sharing system, while also enhancing the project ability to adapt and improve based on experience and findings**.** The function will include strengthening the capacity of the NDA (MINETE) on climate impact monitoring, Means of Verification and the country measurement, reporting and verification (MRV) system. In Côte d'Ivoire, a national MRV system is under development but not yet fully operational, and efforts are ongoing to strengthen linkages with the national greenhouse gas inventory system. Given this evolving context, it is critical for the LARACI project to establish its project-level MRV system in close coordination with national stakeholders and to ensure that linkages with the national inventory system are made as early as possible. This will maximize alignment, avoid duplication, and enhance the integration of mitigation and adaptation data into national reporting processes. See Annex 22a, Section 9.4 for the detailed national MRV alignment strategy.

6.6 Stakeholder engagement

Effective stakeholder engagement sits at the core of LARACI's feasibility study and the project's design process. Dialogue with stakeholders began early in project preparation. From the outset, consultations were organized to ensure that the perspectives of government institutions, local authorities, research organizations, private sector actors, civil society, and producer organizations were integrated into project design.

The first major consultation took place in Abidjan on 20–21 September 2022, with more than 50 participants representing ministries, international organizations, private sector actors, and civil society. This workshop provided the foundation for identifying priority challenges in the N'Zi region, including land degradation, recurrent bushfires, illegal mining, declining soil fertility, and youth migration. Stakeholders validated the relevance of proposed project components, the need for soil fertility management, climate information services, extension systems, agricultural finance, and climate-smart value chains, and confirmed their alignment with the country's development priorities, NDCs, and GCF country program.

A series of follow-up consultations were conducted with farmer groups, women's associations, and value-chain actors to deepen understanding of community needs, refine gender and social inclusion considerations, and review environmental and social risk mitigation options. On 5 August 2025, FIRCA, MINETE/NDA, and CGIAR convened an additional multi-stakeholder consultation, which served to validate the refined project design, update the stakeholder map, and test communication and engagement approaches to ensure inclusiveness and cultural relevance. As a result of this final consultation, the no-objection letter for the GCF Funding Proposal was signed by the NDA (see Annex 1) as well as a joint commitment of the Executing Entities to deliver on the project's objectives targeting the ultimate interest of the beneficiaries.

As a result, the project now benefits from a robust Stakeholder Engagement Plan (SEP) included in the funding proposal package (see Annex 7). The SEP ensures that engagement remains gender-responsive, while the process has reinforced national ownership, strengthened local buy-in, and enhanced the project's legitimacy and feasibility.

6.7 Financial institution engagement and risk-sharing

Engagement with financial institutions under Output 1.3 is structured around a layered de-risking architecture designed to progressively shift climate and credit risk from farmers and financial institutions to project-supported instruments. The architecture operates as follows:

(i) At the farmer level, index insurance pilots under Activity 1.3.3 protect against climate-induced income shocks that would otherwise trigger loan default, directly reducing the credit risk that financial institutions face when lending to smallholder farmers.
(ii) At the level of professional producer organizations, warehouse receipt systems provide lenders with a liquid and verifiable collateral instrument, reducing the collateral gap that currently prevents professional producer organizations from accessing working capital finance.
(iii) At the financial institution level, the project provides technical assistance and capacity building to enable MFIs and banks to design, price, and manage CSA-aligned loan products, reducing the operational risk and information asymmetry that currently deter institutional engagement.

Formal partnership agreements with financial institutions will be established during the inception phase, specifying data-sharing protocols, cost-sharing arrangements, and portfolio targets for CSA-aligned lending disaggregated by sex and region. At least one formal financial institution partner per target region will be secured by the end of Year 3.

The project does not assume that all beneficiaries become fully bankable by project end, nor would this be a realistic or appropriate target for subsistence smallholder farmers in the target regions. Rather, the project improves key parameters that are critical inputs to financing decisions across a spectrum of lenders, from MFIs to commercial banks. These parameters include agricultural productivity and income stability, which reduce the income volatility that makes smallholders unattractive to formal lenders; risk visibility through climate-integrated credit scoring and farm-level data systems, which enable lenders to assess creditworthiness based on agronomic performance rather than asset ownership; and collective governance and asset management capacity within professional producer organizations, which transforms individual un-bankable farmers into potentially bankable collective borrowers. A Year 1 baseline study will establish the starting conditions for these parameters across the five target regions, and the project's M&E framework will track improvements over the implementation period.

The primary objectives of LARACI are climate resilience and GHG emission reduction. Output 1.3 improves farmers' access to finance as an enabling condition for CSA adoption, not as an end in itself.

7 Technical assessment

7.1 Technical feasibility and justification

The LARACI project is technically feasible and justified based on the alignment of its design with local agroecological conditions, stakeholder readiness, and availability of affordable and proven CSA technologies. The project proposes interventions that have already been proven in similar agro-climatic contexts across West Africa and are ready to be adapted and scaled, including improved seed varieties, agro-advisory services, and integrated soil fertility management. These technologies will be introduced through this project in partnership with national partners and research institutions (e.g., CNRA), CGIAR Centers, and local agri-input markets. LARACI promotes a suite of CSA practices and technologies, including high-quality, climate-resilient planting materials, tailored agroforestry models, and conservation agriculture, which are validated locally or in similar agroecosystems and aligned with agroecological conditions. The project ensures their affordability through bundled support: financial tools (Component 1.3), public-private de-risking partnerships, and the development of a loan monitoring platform for mobilizing CSA finance. The availability of extension infrastructure (Component 1.2.3) and research-backed CSA solutions (Component 1.2.4) further guarantees technical uptake.

In the central regions of Côte d'Ivoire, N'Zi, Moronou, Iffou, La Mé, and Gbêkê, farmers and farmer associations have shown strong interest and willingness to adopt CSA technologies. This is driven by increasing climate change, declining soil fertility, and pest/disease pressure, all of which threaten livelihoods dependent on rice, cassava, and yam value chains. Participatory consultations and stakeholder engagement during the project design phase confirm the readiness of professional producer organizations and community-based organizations to participate in climate-smart production models. The project regions are connected by a functioning road network, including feeder roads that link production zones to markets. While some rehabilitation may be necessary, especially for commercial scaling (Component 3.1.4), FIRCA's parallel infrastructure investments will target value chain bottlenecks. The logistics for input delivery, extension visits, and data collection are therefore operationally feasible, aided by digital systems such as the CSA-relevant climate information platform (Component 1.3.5). Additionally, the presence of active agricultural platforms and extension services in the region enhances the feasibility of scaling CSA innovations through local institutional channels. Physical access to key market centers, including Abengourou, Bongouanou, Dimbokro, Daoukro, and Bongouanou is possible.

The technical design is also supported by strong baseline data and analytics across all selected technologies. Emission baselines and mitigation potential have also been estimated using GHG baseline assessments in the region for the implementation of proposed CSA technologies. In addition:

- National agrometeorological and extension system (Component 1.1 and Component 1.2): Provides reliable data for agro-advisories and early warning.
- CSA financial tracking and de-risking mechanisms (Component 1.3): Help monitor flows of green finance and reduce adoption barriers.

- Soil and agroforestry decision-support tools (Component 2.1.3): Guide localized, emissions-reducing land-use decisions.
- CSA digital extension and marketing platforms (Component 3.1.3): Enable traceable support to producers and improved commercialization.

7.2 Environmental, economic and social assessment

7.2.1 Environmental assessment

The LARACI project has undergone a comprehensive Environmental and Social Action Plan (ESAP), which includes a detailed Stakeholder Engagement Plan (SEP). Based on the Green Climate Fund (GCF) Environmental and Social Screening Checklist, the project has been evaluated against exclusion criteria to determine the appropriate environmental and social risk categorization. These exclusion criteria cover a range of factors such as proximity to sensitive ecosystems, potential for significant displacement, and impacts on Indigenous Peoples or cultural heritage sites. Following this rigorous assessment, the project has been categorized as Category C (Low Risk). This categorization is due to the project's focus on small-scale, localized interventions in agriculture, land restoration, and infrastructure improvements which are inherently low impact. The activities promote CSA, integrated soil fertility management, and sustainable water use — all of which are environmentally beneficial practices.

Furthermore, Côte d'Ivoire, particularly in its northern and central regions, has experienced increasing temperatures and environmental degradation affecting sensitivity to climate change while contributing to increased emissions, including widespread deforestation and water scarcity. The LARACI project directly addresses these issues by supporting sustainable land and agroforestry systems and building resilience in vulnerable agricultural zones. Importantly, the project does not involve any activities within or near environmentally sensitive or culturally significant areas, thereby minimizing any potential adverse impact. The ESS framework established under FIRCA and AfricaRice/CGIAR for the project will ensure that environmental safeguards are upheld throughout implementation.

7.2.2 Economic, social and gender assessment

The LARACI project is expected to generate substantial economic and social co-benefits,

The LARACI project is expected to generate substantial economic and social co-benefits, particularly in the central regions of Côte d'Ivoire (N'Zi, Moronou, Iffou, La Mé, and Gbêkê), where agriculture is the primary source of livelihood. The project's targeted interventions across the rice, cassava, and yam value chains are designed to address key structural constraints in productivity, resilience, and market access, while promoting inclusive and climate-resilient rural development and a reduced GHG footprint. LARACI's economic impact is anchored in its potential to increase agricultural yields amid climate change, and beneficiaries income through the promotion of climate-smart practices and technologies. By improving access to high-quality, climate-resilient planting material and agro-advisory services, the project will enable farmers to adopt more efficient and sustainable production methods. These improvements are expected to result in ameliorated and climate resilient yields, improved revenues, and farmers enhanced resilience to climate change. Additionally, the project will promote digital solutions for financial access and climate information, enhancing producers' ability to access finance and adopt adaptive practice. By supporting or promoting the development of financial services such as index insurance, de-risking tools, and flexible credit products tailored to the needs of smallholders and professional producer organizations, the project will reduce exposure to climate risks and improve access to productive assets.

The financial instrument for LARACI was made following a structured assessment of alternative financing modalities conducted as part of the Economic and Financial Analysis. Three scenarios were explicitly modeled and compared: (i) business-as-usual (BAU) without GCF support, (ii) self-financing or market-rate credit, and (iii) GCF grant-supported adoption.

- Under the BAU scenario, farmer returns are low and volatile due to climate-induced yield variability, and the financial analysis demonstrates a limited or negative net present value for farm investments across all three value chains without CSA adoption support. Under this scenario annual yields decline at the rate of 2.2% for rice, 2.5% for cassava, and 3.0% for yam, reflecting projected climate-induced losses in the absence of any adaptation measures (Annex 3b, Assumptions, lines 31, 32, and 33). These rates represent a deliberately conservative middle-ground estimate, sitting between the West Africa regional median at the low end and the more severe projections specific to the central Côte d'Ivoire agroclimatic context at the high end.
- Under the self-financing and market-rate credit scenario, over 85% of smallholder farmers in the target regions lack access to formal finance, available agricultural loans carry interest rates of up to 18%, are short-term in structure, and are poorly aligned with seasonal agricultural cash flows. Climate variability further increases perceived lending risk, making debt-financed CSA adoption financially risky and unlikely to scale. Concessional loans, blended finance, and partial repayable grant instruments were also assessed. However, the core constraint is not affordability alone but early-stage adoption risk under increasing climate change. Introducing any debt obligation in this context would deter uptake rather than enable the intended paradigm shift toward CSA, as the EFA's cost-sharing scenario analysis demonstrates.
- Under a GCF supported scenario farmers adopts CSA technologies with grant support from GCF via the LARACI project, which fully or partially covers the cost of CSA adoption in the targeted area.

Given the historic and projected inflation rate in Côte d’Ivoire, the assessment was carried using a discount rate of 5%, which is also aligned with GCF grant equivalent calculator. While conducting financial analysis across these scenarios, several assumptions have been made regarding market price of outputs and cost of inputs. A main assumption in the model considers that degradations induced by climate change to agriculture production are slow, rather than sudden declines of yields. The model therefore is based on slow slopes, considering that the impact of extreme whether events at any moment remains within long term observed variations.

The financial analysis evaluated these three distinct scenarios across the targeted value chains (rice, cassava, and yam) to assess the viability and investment case under varying levels of support. The baseline or business-as-usual (BAU) scenario, in which farmers continue to operate without targeted adaptation support, reveals modest but insufficient profitability, with Financial Internal Rates of Return (FIRR) of 11% for rice, 14% for cassava, and 13% for yam. These figures indicate that while farming remains technically feasible, it offers limited economic attractiveness, particularly under the mounting pressures of climate change. This poses a structural risk to food security, as persistently low returns may drive farmers (particularly smallholders) out of production.

The second scenario models a self-financed pathway in which farmers bear the full costs of adaptation measures. The results point to declining financial performance, with FIRRs stagnating at 8% for rice, declining at 7% for cassava, and decreasing at 8% for yam. These outcomes underscore the financial disincentives that constrain autonomous adoption of climate-smart technologies, particularly in resource-constrained rural contexts.

In contrast, the third scenario, which incorporates concessional support through GCF co-financing under the LARACI project, illustrates a compelling case for public investment. Under this framework, projected FIRRs improve substantially to 19% for rice, 22% for cassava, and 39% for yam, reflecting enhanced profitability, resilience, and economic viability. These results strongly justify the catalytic role of GCF. Under this scenario, the grant is structured to address a temporary climate-induced market failure rather than to create long-term dependency. It covers only the incremental upfront adoption costs during the project period and does not subsidize recurrent farm operations or long-term income streams. The EFA demonstrates that under the GCF-supported scenario, farmers achieve structurally higher and more stable incomes compared to BAU without requiring continued external subsidy beyond project completion. The transition pathway to financial sustainability operates through three sequential mechanisms. During the project period, Years 1 to 5, the project builds farmer bankability through financial literacy, farm business planning, record keeping, and strengthening of professional producer organizations, and establishes the financial infrastructure, including warehouse receipt systems, index insurance, and climate-integrated credit scoring, that enables formal finance to flow to CSA-adopting farmers. In the transition phase, Years 3 to 7, financial institutions that will have developed their capacity and de-risked through Output 1.3 begin extending CSA-aligned credit products to investment-ready professional producer organizations, drawing on the pipeline of bankable clients developed during the project. In the post-project phase from Year 7 onward, the enabling environment established by LARACI, combined with the capital deployment mechanisms of IGREENFIN, sustains CSA financing flows without continued grant support. Given the very low penetration of agricultural lending among smallholders in the target regions, the project fills an existing financing gap rather than crowding out private finance.

The grant instrument was therefore selected as the only modality capable of catalyzing adoption at scale without suppressing uptake through repayment obligations during the critical early adoption phase.

In addition to these scenarios, a sensitivity analysis has been conducted and tested scenarios where farmers will co-finance the adoption of CSA practices alongside GCF. Within this additional scenario, the GCF-funded FIRR for rice falls to 18%, 17%, and 16% respectively; for cassava to 20%, 18%, and 17%; and for yam to 33%, 28%, and 25%. These results demonstrate that even with meaningful farmer co-investment, returns under the GCF-supported model remain substantially above those of the self-financed scenario, confirming the leverage effect of the GCF grant in enabling viable and equitable CSA adoption. Yet, the observed return compression in the partial co-financing scenario (where profitability converges toward BAU levels) indicates that introducing farmer cost-sharing at that level would likely complicate implementation without delivering sufficient financial incentives to drive meaningful CSA adoption.

On the social front, LARACI is expected to significantly improve equity, inclusion, and well-being in the project regions. The project places strong emphasis on participatory approaches, working through farmer organizations and community structures to ensure local ownership and relevance of interventions. It will directly benefit vulnerable groups including women, youth, and smallholder farmers, aiming at training and empowering extension agents and farmers, with a target of 40% women and 30% youth participation, thus promoting gender equality in agricultural decision-making and leadership. A gender-responsive approach will be adopted to address gender-based barriers. This will be done taking into consideration the gender differences in needs and preferences with regard to the channels of information, practices, and technologies. This, in turn, ensures that methodologies, tools, capacity building, and innovation delivery are sensitive to gender. Transformative approaches will be integrated into the project to address structural barriers such as land rights, labor allocation, and other social barriers. The project will enhance access to climate information, agronomic knowledge, and CSA practices, which will improve food and nutrition security, especially for poor rural households. Supporting youth entrepreneurship and employment through value chain development and agro-service delivery, will reduce rural-urban migration and foster local opportunity. The project is designed to create community resilience through inclusive stakeholder engagement and transparent benefit-sharing mechanisms.

The economic analysis of LARACI has combined benefits from emissions reductions and farmers incremental incomes across the three target value chains: rice, cassava, and yam. It compares the economic costs of the investment with the flow of economic benefits over a 20-year time horizon to determine the overall value for money and viability of the intervention.

The total project investment which amounts to **USD 50 million**, financed through a **GCF grant of USD 40 million** and **co-financing of USD 10 million** from the Government of Côte d'Ivoire and CGIAR Centers translates into a total economic investment of **USD 36.1 million**. Incremental income gains are distributed across 20 years mirroring adoption build-up (see Annex 3: Economic and Financial Analysis). When combining these two sources of benefit - emissions reductions and incremental income growth - the project economic NPV is

USD 442 million over 20 years, showcasing the economic impulse which the GCF grant will achieve. The project presents an EIRR of 38% in the same period. The EIRR is not sensitive to the shadow price of carbon that has been assumed at USD 35/tCO2eq but the ENPV varies slightly with different carbon price.

7.3 Financial analysis and grant justification

The financial assessment (FA) has focused on financial returns and evaluated the profitability and viability of investing in CSA technologies for smallholder farmers (SHFs) in Côte d'Ivoire. This analysis is essential for understanding how CSA can improve livelihoods and productivity while enhancing climate-resilience and lowering GHG footprint. The assessment compared three financial scenarios for a 1-hectare (ha) farm for each of the project's target commodities: rice, cassava, and yam. In conducting the FA, the following scenarios were considered:

- Scenario 1: Business-As-Usual (BAU): The SHF does not adopt any CSA practices. This scenario reflects the current conventional farming approach, providing a baseline for comparison of cash flows under current climate change conditions.
- Scenario 2: CSA Adoption (Self-financed): The SHF adopts CSA technologies and bears the full cost of adoption (inputs, equipment, training, etc.). This scenario tests the financial feasibility of CSA without external support.
- Scenario 3: CSA Adoption (GCF support via LARACI): The SHF adopts CSA technologies with grant support from the Green Climate Fund (GCF) via the LARACI project, which fully or partially covers the cost of CSA adoption in the targeted area.

The analysis included the calculation of key financial indicators such as the Internal Rate of Return (IRR) and Net Present Value (NPV) for each of these scenarios, across all three crops. We have assessed the performance of these investments at various levels of aggregation, including with and without the GCF contribution. This multi-scenario, crop-specific assessment is essential for the following reasons:

a) Uncertain Investment Allocation: CSA technologies proposed by the project are known for each crop, but the exact adoption per hectare of agricultural land by the beneficiaries during implementation may vary based on beneficiary preferences, localized agro-ecological conditions, and existing enabling conditions. This detailed assessment enables the creation of an accurate representation of the project's financial impact based on the specific technology option which the beneficiaries will choose during implementation.
b) Performance Estimation: It helps estimate the likely financial performance of the project as outlined in the proposal, identify the magnitude of GCF contribution impact for each supported crop, and assess the potential for generating net benefits across investment areas.
c) Beneficiary Value Addition: The analysis evaluates the extent to which the LARACI interventions provide value to the beneficiaries, while providing comfort that the intervention does not distort the market, showing that adaptive benefits are achieved by the intervention together with an incremental improvement in farmers' revenues.

While alternatives to a full grant, including farmer self-financing, market-rate credit, and concessional or blended debt were explored, the financial assessment revealed that under BAU conditions, farmer returns are too low and volatile to support market-rate loans, especially since 85% of smallholders lack access to formal finance. While instruments such as partial repayable grants or risk-sharing arrangements were also considered, they were ultimately deemed inappropriate for this context; the primary barrier to CSA is not merely a lack of credit products, but high early-stage adoption risk exacerbated by climate variability. Introducing debt obligations at this stage would likely suppress uptake and jeopardize the intended paradigm shift. Consequently, the project makes use of the grant to cover only incremental upfront adoption costs, filling a specific financing gap where private finance does not operate at scale, thereby avoiding the crowding out of existing institutions while ensuring long-term income stability for farmers.

Table 19 below provides a comparison of the key results of the financial assessment.

TABLE 19: COMPARISON OF FINANCIAL ASSESSMENT KEY RESULTS

VALUE-CHAIN	SCENARIO 1: BAU (NO CSA)	SCENARIO 2: CSA (SELF-FINANCED)	SCENARIO 3: CSA (GCF-FUNDED)
Rice	Low Return, due to low and decreasing yields	Low Return, with better yields but high adoption cost	Good Return, better yield, initial adoption costs are covered
Cassava	Moderate Return, due to concentration of climate vulnerability (drought)	Very Low Return, returns from yields improvements are offset by investments	Good Return, improved margin due to subsidy
Yam	Low Return, crop is more susceptible to land degradation and yields decrease faster within BAU climate scenario	Low Return, despite benefits from agroforestry & CSA mulching due to adoption costs	Strong Return, CSA benefits + cost reduction

7.4 Exit strategy and sustainability

The LARACI project is designed with long-term sustainability embedded in its structure, ensuring that outcomes are maintained and scaled beyond the project lifecycle. The exit strategy focuses on institutionalizing climate-smart agriculture (CSA) through national systems, enabling Côte d'Ivoire's agri-food system to have in place extension systems and climate advisory services, and farmers to continue producing sustainably amid the effects of climate change. By strengthening public and private extension systems, establishing climate resilient seeds and input, and improving access to tailored agronomic and climate advisory services, the project builds durable capacity. Financial sustainability is promoted through increased access to CSA finance via local institutions and value chain actors, while the early engagement of NDAs and sectoral ministries supports policy integration and national ownership. The CSA practices promoted (such as SRI, smart staking for yam, efficient plant arrangements, and technologies like AKILIMO and RiceAdvice) are low-cost, high-impact, and designed to be profitable under local conditions, reinforcing adoption incentives. Moreover, the partnerships with CGIAR Centers and FIRCA, a Direct Access Entity of Côte d'Ivoire as an Executing Entity, will ensure continued innovation, knowledge exchange, and replication in other regions of the country.

The proposed project interventions are designed to foster long-term, sustainable change that can be replicated in other countries in the region that are facing similar agricultural challenges. This will be achieved through:

- Partnering with Government institutions to institutionalize CSA technologies and practices. The project has been developed in close consultation with key government ministries and local officials to secure support and commitments for the project.
- Building capacity for smallholder farmers and local institutions, including establishing proof of concept, and enhancing the ability of national institutions to incorporate CSA into their strategies and plans. This will strengthen coordination across sectors, promote synergies, and ensure the active involvement of local communities in planning and management. Moreover, adapting operations based on lessons learned will help build on successes, post-project.
- Improving the enabling environment for investment in the agricultural sector and the adoption of CSA technologies and practices, through policy recommendations and financing mechanisms.
- Scaling up and replicating long-term solutions by leveraging existing public and private institutional infrastructure on the ground (e.g., national extension services, rural development departments, NGOs, SMEs) to ensure widespread adoption of context-specific climate-smart innovations through both top-down and bottom-up approaches.

Additionally, the monitoring and evaluation (M&E) system will play a crucial role in tracking the project's performance, indicating stakeholder engagement, and guiding future actions. The lessons learned throughout the project will inform the knowledge-sharing process, ensuring the sustainability and successful implementation of the initiatives.

Specific mechanisms to ensure sustainability across the components include:

Component 1:

- Output 1.2 (Access to climate information and advice): This activity will build SODEXAM's capacity to manage weather stations, translate meteorological data into practical advice for farmers, and improve dissemination channels. This will ensure the sustainability and effectiveness of climate services moving forward so that they can continue to operate after the project has been completed. The agrometeorological stations installed under Activity 1.1.1 are professional-grade automatic weather stations with an estimated useful life of 15 to 20 years under a regular maintenance regime consistent with WMO standards, aligning with the project's 20-year impact horizon. No replacement investment is therefore required within the economic analysis period, and ongoing maintenance costs will be absorbed within SODEXAM's operational budget as the legally mandated national entity for meteorological infrastructure.

- Output 1.2 (Extension and regulatory system): By establishing permanent mechanisms for knowledge exchange and improving service outreach, this activity will enhance the enabling environment and provide long-term access to up-to-date technologies and advisory services.
- Output 1.3 (Access to financial services): Strengthening rural microfinance institutions and banks, alongside developing business capacity, will improve smallholder farmers' access to finance and enable them to build credit histories. Farmer bankability is operationalized through four concrete mechanisms under Output 1.3. First, financial literacy campaigns in local languages covering farm-level business planning, record keeping, and savings and loans management build the basic financial management capacity that formal lenders require of borrowers. Second, strengthening professional producer organizations under Activity 1.3.1 aggregates individual smallholders into organized groups with collective governance, shared assets, and demonstrated management capacity, transforming un-bankable individual subsistence farmers into potentially bankable collective borrowers. Third, the warehouse receipt system piloted under Activity 1.3.3 provides professional producer organizations with a formal collateral instrument that can substitute for land title as security for agricultural loans, directly addressing the primary collateral barrier to formal credit access. Fourth, the climate-integrated credit scoring system developed under Activities 1.3.4 and 1.3.5 enables financial institutions to assess the creditworthiness of CSA-adopting farmers based on agronomic and climate performance data rather than asset ownership, creating a new credit profiling approach suited to the smallholder context. Together these four mechanisms provide a structured and evidence-based pathway from financial exclusion to formal credit access, grounded in improvements that financial institutions can observe and act upon. Moving forward, this will ensure sustained use of financial services and foster long-term agricultural growth. The project does not aim to fully replace concessional or public support for CSA investments, nor to achieve a complete transition to commercial financing for subsistence smallholder farmers. Rather, the transition envisaged under Output 1.3 is a shift toward improved financing conditions, achieved through three durable foundations established during the project period. First, public goods including climate information systems and agronomic data infrastructure will be sustained through government budgets and SODEXAM's institutional mandate beyond project closure. Second, institutional capacities within financial institutions and agricultural service providers will reduce the cost and risk of CSA lending on a permanent basis. Third, a pipeline of more investment-ready professional producer organizations and farmers, with improved productivity, income stability, and risk visibility, will attract financing from a combination of public, concessional, and commercial sources suited to their profile. Together these foundations enable continued CSA financing beyond the project without dependency on continued grant support, while remaining realistic about the financing mix appropriate for smallholder farmers in the target regions.

Component 2:

- Output 2.1 (Integrated system for land and agroforestry): By equipping beneficiaries with land and agroforestry innovations, this output will enhance local ownership, reduce land degradation, and improve soil fertility, ensuring environmental sustainability.

Component 3:

- Output 3.1 (Access to CSA technologies): Access to CSA technologies will increase productivity and profitability by helping farmers adapt to current and future climate risks. Moving forward, this output will bolster the communities' capacity to cope with climate change in the long term, while also reducing greenhouse gas emissions from agricultural practices.

7.4.1 SEIS platform and processing infrastructure: ownership, O&M, and data governance

The SEIS platform will be formally transferred to the Government of Côte d'Ivoire at project closure, with MINETE designated as the legally responsible hosting institution under its mandate for national environmental and climate data management. Operational management responsibility will be assigned to the most appropriate national institution, confirmed during the inception phase in consultation with MINETE and key national stakeholders and formalized through a MoU. Candidate institutions include FIRCA, SODEXAM, or a relevant line ministry agency, depending on the final platform architecture and prevailing institutional mandates at the time of handover. Annual SEIS O&M costs are estimated at approximately USD 100,000 to USD 120,000, benchmarked against comparable digital climate information platforms in West Africa such as the ANACIM platform in Senegal, which documents annual maintenance costs in the range of USD 80,000 to USD 150,000 depending on platform complexity and user scale. These costs will be progressively absorbed into MINETE's operational budget, with FIRCA's interprofessional levy mechanism providing complementary financing for the advisory service delivery layer. The data governance framework will establish the following core principles: raw meteorological and soil data owned by MINETE as national data custodian; processed advisory outputs jointly owned by MINETE and the designated operational manager; CGIAR Centers retaining rights to anonymized aggregated data for research purposes; and national server hosting with Executing Entity’s backup during the project period. These arrangements will be formalized in the MoU during inception, as specific data sharing and access protocols depend on the final platform architecture and the evolving national regulatory framework for agricultural data governance.

For processing and storage infrastructure under Output 3.1, ownership of the processing centers and GEM parboiling units will be transferred to designated producer cooperatives at project closure, formalized through asset transfer agreements countersigned by AfricaRice and the receiving organizations. Annual O&M costs are estimated at approximately USD 45,000 to USD 75,000 in aggregate across all five regions, benchmarked against comparable IFAD and World Bank agro-processing programs in West Africa, and will be financed through cooperative service charges on processing activities provided to members. The specific transfer recipient for each asset will be confirmed during implementation once beneficiary organizations are formally enrolled and their institutional readiness and financial capacity to sustain O&M are verified.

8 Conclusion and recommendations

Climate change is significantly impacting agricultural productivity in Côte d'Ivoire, with rising temperatures, erratic rainfall, and extreme weather events affecting crop yields and water availability, particularly for small-scale farmers. Moreover, the country is ranked as one of the most vulnerable to climate change, with limited preparedness to respond to its adverse effects.

The LARACI project has been designed to address these challenges by promoting CSA practices that enhance agricultural resilience, improve food security, and reduce environmental impacts. The project's three key outputs under Component 1—establishing a national agrometeorological advisory system, implementing a CSA extension system, and unlocking CSA finance services—are aligned with the country's climate policies including its NDC, draft NAP, CSAIP, and the Abidjan Legacy Programme, and aim to reduce vulnerability in the agricultural sector.

An analysis of key value chains identified cassava, rice, and yam as priority crops for addressing and reducing the climate risks of the agrifood system in the targeted central regions. Together, these three crops provide significant nutritional value and are of economic importance. The value chain selection also aligns with the CSAIP key investment areas for the project's implementation area. These crops will serve as the focus of the project, providing a foundation for both food security and local livelihoods.

Despite the potential of the project, several barriers that prevent the adoption of adaptation and mitigation measures were identified during this feasibility study that could hinder successful implementation. These include technological, financial, institutional, gender, policy, and capacity-related barriers. The project has been designed to address these barriers through a phased implementation approach, which includes building public-private partnerships to facilitate access to technology, training extension agents, establishing financial partnerships, promoting an enabling environment for women, and enhancing digital market systems.

The success of the LARACI project heavily depends on strong engagement and collaboration with government agencies, local institutions, and other stakeholders. It is recommended that the project continue to foster these partnerships, ensuring clear roles and responsibilities and securing long-term commitment from key ministries and local officials. This will help institutionalize CSA practices and ensure their integration into national policies.

Moreover, promoting public-private partnerships that leverage advanced ICT solutions developed by the private sector is important for the dissemination of climate information. By integrating innovative digital tools and platforms, such partnerships can bridge information gaps, strengthen advisory services, and support more informed decision-making at the farm level, ultimately increasing resilience and productivity in the face of climate change.

In addition to improving dissemination of climate information, training extension agents in CSA practices is critical for the success of the project. Moreover, creating knowledge-sharing platforms for experience exchange among farmers, extension agents, and local institutions will facilitate the dissemination of best practices and improve the effectiveness of CSA adoption.

Access to finance is a key barrier for smallholder farmers adopting CSA technologies. By focusing on promoting innovative financial mechanisms, such as insurance schemes, loans, and grants, the project aims to reduce financial risks and encourage investment in CSA practices. Additionally, improving access to technology and digital tools for monitoring weather patterns, soil conditions, and market prices will support farmers in making informed decisions.

Public-private partnerships for technical support, training, and funding are also essential to promote CSA adoption. LARACI aims to create an enabling environment through supportive microfinance policies, reduced transaction costs, and enhance access to targeted financial incentives such as subsidies, grants, and credit facilities.

Women play a critical role in agriculture in Côte d'Ivoire, but they face challenges that may limit their participation in CSA practices. The project aims to promote gender-inclusive climate adaptation strategies that will foster inclusivity and enhance the empowerment of local communities. This will help ensure equal access to resources, training, and decision-making opportunities for both men and women, and can be achieved through targeted outreach and support programs designed to empower women in agriculture.

A comprehensive monitoring and evaluation (M&E) framework will be designed to track the progress and impact of the project. This will help in refining strategies as the project progresses by assessing the effectiveness of interventions and ensuring that the project remains on track to achieve its objectives. Regular evaluations should focus on both the short-term and long-term outcomes, including adoption rates of CSA practices, increases in crop productivity, and improvements in food security.

LARACI aims to create long-term, sustainable change that can be replicated across the region. This will be achieved by developing partnerships with government institutions to institutionalize CSA technologies and practices. Moreover, the project will focus on building capacity for smallholder farmers and local institutions, ensuring their active involvement in planning and management. The project also aims to improve the investment environment for agriculture through policy recommendations and promotion of financing mechanisms, while also scaling up solutions by leveraging existing public and private infrastructure. This approach ensures widespread adoption of context-specific climate-smart innovations through both top-down and bottom-up strategies that address adaptation and mitigation fostering long-term resilience in agriculture.

Appendix 1: Complementarity and coherence summary table

LEAD/AE, PROJECT TITLE (DURATION)	DONOR	SUMMARY	INTERVENTION ZONES	SYNERGIES AND LINKAGE WITH LARACI
FAO: Promoting zero-deforestation cocoa production for reducing emissions in Côte d'Ivoire (PROMIRE) (2021-2026)	GCF	This project will implement zero-deforestation agroforestry models in three southern regions of Côte d'Ivoire to reduce GHG emissions by decoupling deforestation from cocoa production. Scaling up a previous pilot project that successfully promoted agroforestry schemes, PROMIRE will build institutional capacities to implement REDD+ at national and sub-national levels. Under this plan, farmers will be encouraged to carry out non-deforestation practices through the promotion of organic and fair-trade cocoa production. Their access to markets will also be strengthened. Data will be used to reduce emissions by implementing innovative, low-carbon land use models in 30 selected villages.	Three southern regions of Côte d'Ivoire (Agnéby-Tiassa, La Mé and Sud-Comoé) but also plan to cover 8 regions nationally	Although focused on cocoa and not prioritizing the same intervention zone, lessons learnt from this Agroforestry REDD+ project can inform activities under component 2 of LARACI; especially through the scaling of the project successful approaches and best practices of soil health and agroforestry related low-carbon emissions.

WFP: Women-Adapt: Enhancing the climate change adaptive capacity of smallholder farmer communities in the Poro Region, focusing on vulnerable women and youth (2023-2028)	GCF	Women-Adapt will adopt a gender-transformative approach to overcome technical, institutional, knowledge and financial barriers to enhance the adaptive capabilities and resilience of smallholder farmer communities in the Poro region, focusing on women and youth Farmer Organizations. The project is based on tried and tested climate-risk management approaches placing at its center women awareness, financial inclusiveness, leadership, and participation in all its activities. The project is designed to synergize with the Inclusive Green Financing Initiative I (IGREENFIN I, FP183) to finance sustainable business plans in the Poro region. The specific climate hazards addressed by this project include droughts, interannual rainfall variability, and heavy floods and heat winds.	Poro region	In focusing on enhancing climate resilience of smallholder women and youth, this project has similar objectives to the LARACI, but the projects intervene different agro-climatic regions. Through Women-Adapt's focus on community-based adaptation and risk preparedness measures, the use of climate information, the scale-up of gender-sensitive climate-resilient technologies that address a similar set of climate hazards, the social innovations that enhance adoption of technologies and improved financial and market access for the rice value chain, there will be strong potential for synergies to mutually reinforce impact of these projects, especially in relation to the LARACI component 1 that is national in scope, as well as component 3. LARACI will promote climate-resilient innovations that simultaneously deliver GHG emissions reduction and facilitate knowledge exchange and capacity building to support the Women-Adapt project in scaling climate change adaptation innovations aligned with a low-emission development pathway.

IFAD: Inclusive Green Financing Initiative (IGREENFIN I): Greening Agricultural Banks & the Financial Sector to Foster Climate Resilient, Low Emission Smallholder Agriculture in the Great Green Wall (GGW) countries - Phase I (2022-2028)	GCF	Countries covered by the ambitious Great Green Wall initiative to reverse land degradation in Africa are among the world's poorest and most climate-vulnerable. Climate shocks are causing a loss of assets, crops and livestock; disruptions to value chains; and soaring food prices. Projections indicate persistent agricultural strain - as rainfall levels are set to continue declining while temperatures increase. This cross-cutting program will enhance access to credit and technical assistance for local farmers, farmers' organizations, cooperatives and micro and small-sized enterprises. This will help them implement climate-resilient and low-emission agriculture and agroforestry. This program covers 11 countries in the Great Green Wall, in addition to Côte d'Ivoire and Ghana. A major aim of the initiative is to build greater coherence and complementarity of climate action in Africa.	Regional including Côte d'Ivoire	LARACI and IGREENFIN I operate as complementary and mutually reinforcing instruments within Côte d'Ivoire's climate finance ecosystem. LARACI functions as the demand-side readiness instrument, building the enabling conditions, institutional capacity, and pipeline of bankable professional producer organizations that IGREENFIN I requires to deploy capital at scale across rice, cassava, and yam value chains. Through Component 1 Output 1.3, LARACI establishes the financial infrastructure, including warehouse receipt systems, index insurance, and climate-integrated credit scoring, that enables formal finance to flow to CSA-adopting farmers. Financial institutions that will have developed their capacity and de-risked under Output 1.3 are positioned to extend CSA-aligned credit products, creating conditions compatible with and reinforced by IGREENFIN I's capital deployment mechanisms. There are additional synergies with LARACI Component 2 through the implementation of climate-resilient and low-emission agriculture and agroforestry. LARACI fills a financing gap that is complementary to rather than duplicative of IGREENFIN I's mandate, focusing on the demand-side enabling environment while IGREENFIN I deploys supply-side capital.

FMO: &Green Fund: Investing in Inclusive Agriculture and Protecting Forests(2023-2028)	GCF	The &Green Fund will promote sustainable commodity production and higher productivity on agricultural land in selected countries with important tropical forest resources, thereby decreasing the pressure to clear forests for agricultural purposes. The fund will work to reduce emissions and increase the resilience of local communities by financing the transformation of tropical agricultural commodity supply chains from extractive to sustainable practices. The project will achieve this by providing technical assistance and financial support to producers with conditions that necessitate the protection and restoration of existing forests by focusing on supply chains in sectors that drive deforestation such as livestock, palm oil, soy, rubber, cocoa, and forestry.	Regional including Côte d'Ivoire	The outcome of this project, i.e., promoting sustainable commodity production and higher productivity on agricultural land while reducing emissions and increasing the resilience of local communities by financing the transformation of tropical agricultural commodity supply chains such as cocoa, will add value to the LARACI project through supporting the remaining cocoa producers in the LARACI intervention zone. LARACI will promote land restoration and conservation measures, such as agroforestry systems, within rice, cassava, and yam-based value chains, which are not addressed by the FMO project.

AfDB: Programme for integrated development and adaptation to climate change in the Niger Basin (PIDACC/NB)(2022-2028)	GCF	This program will address these drivers by implementing a series of integrated and comprehensive actions that reduce the silting of the Niger River, improve natural resources management and enhance the population's ability to adapt to climate change. It also includes some mitigation activities, including through forestry and land use. The main climate hazards addressed by this project include floods, extreme temperatures, sand and dust storms, strong winds, brush fires and locust swarms.	Regional including Côte d'Ivoire	The successful approaches of this project in terms of technological packages and best institutional practices to enhance the adaptability of populations to climate change; and improve natural resource management and integrated ecosystem management, the protection of biodiversity and the restoration of soil fertility, will inform the implementation of LARACI project esp. components 2 and 3. LARACI will include the PIDACC/NB project in knowledge sharing and capacity building workshops to increase awareness and application of CSA and CIS innovations developed and promoted by LARACI in the PIDACC/NB project zones.

Government of Côte d'Ivoire: The Livelihood Value Chain Development Project (PDC2V)(2021–2027)	World Bank	The PDC2V aims to support the development of inclusive, resilient, and competitive food value chains that benefit their actors in the Project areas. Specifically, it aims to: (1) Stimulate the transformation of value chains to meet a growing demand in the country and sub-region for healthy, quality, and diversified food products; (2) Accelerate private investments in agribusiness to meet domestic food product demand; (3) Strengthen institutions for service delivery, and; (4) Ensure the development of inclusive and competitive food value chains generating economic growth and diversifying employment opportunities. The value chains targeted by the PDC2V are: - Cassava; - Aquaculture; - Horticulture.	Agropole 3,4,5,6,7,9	By stimulating the transformation of value chain crops such as cassava, current outcomes of this project will be leveraged to accelerate sustainable productivity increase of the LARACI value chains (Component 3). The project will specifically seek complementarity with those activities taking place in the same regions as those targeted by LARACI (i.e. agropole 4). In addition, the private sector actors involved in this project will be leveraged to build a strong private sector engagement around the selected intervention value chains and increase their access to sustainable investment under the LARACI project (Component 1, output 1.3). LARACI will involve PDC2V in knowledge sharing and capacity building workshop to ensure the innovations promoted by PDC2V are climate resilient.

Government of Côte d'Ivoire: The Livelihood Strengthening Project for Smallholders and Women (PREMOPEF)(2021-2025)	African Development Fund	The overall objective of the project is to "contribute to the improvement of food and nutritional security and resilience to the effects of climate change of smallholders, women, and youth in the N'Zi region". This objective will be achieved through: (i) Improving the agricultural and poultry productivity of smallholders, women, and youth, and (ii) Improving access to agricultural service offerings (mechanization, transport, processing), and the marketing of products. This project addressed climate hazards including temperature increase, rainfall variability and floods and associated impacts on land degradation and reduction of arable lands.	N'Zi region	Given its geographic focus on one of the regions of the LARACI project, results achieved by this project will be leveraged to boost the gender and social inclusion lens, while also allowing a shift scaling to the other intervention zones of the LARACI project. LARACI will involve PREMOPEF in knowledge sharing and capacity building workshop to ensure the innovations promoted by PREMOPEF are climate resilient.

Appendix 2: Detailed roles of Executing Entities and Service Providers by activity

COMPONENT	OUTPUTS	EXECUTING ENTITY	SERVICE PROVIDERS
1	**Output 1.1: Timely access to accurate climate information and advice**	**FIRCA**	
	Activity 1.1.1: Strengthen agrometeorological network	FIRCA	
	Activity 1.1.2: Develop actionable agro-advisory	FIRCA	
	Activity 1.1.3: Develop tools to communicate advisory	FIRCA	
	Activity 1.1.4: Train farmers extension staff on use of climate data	FIRCA	
	Activity 1.1.5: Improve institutional arrangements	FIRCA	
	Output 1.2: Extension and regulatory system have increased capacity	**FIRCA**	
	Activity 1.2.1: Increased capacity of extension agents on CSA	FIRCA	
	Activity 1.2.2: Develop channels for CSA recommendations	FIRCA	
	Activity 1.2.3: Upgrade extension infrastructure and equipment	FIRCA	
	Activity 1.2.4: Select and tailor CSA solutions for effective scaling	FIRCA	
	Activity 1.2.5: Strengthen extension-research communication	FIRCA	
	Output 1.3: Increased capacity to access financial services	**AfricaRice**	
	Activity 1.3.1: Build capacity to access financial services	AfricaRice	CIAT
	Activity 1.3.2: Foster gender-sensitive policies	AfricaRice	CIAT, IITA
	Activity 1.3.3: Promote financial tools to reduce risks	AfricaRice	CIAT
	Activity 1.3.4: Reduce transaction costs	AfricaRice	CIAT
	Activity 1.3.5: Provide CSA-relevant data	AfricaRice	IITA
2	**Output 2.1: Integrated system for land and agroforestry**	**AfricaRice**	
	Activity 2.1.1: Develop soil and agroforestry recommendations	AfricaRice	CIAT, IITA
	Activity 2.1.2 Develop soil and environmental information services	AfricaRice	CIAT, IITA
	Activity 2.1.3: Tools for producer decision-making	AfricaRice	CIAT, IITA
3	**Output 3.1: Access to CSA technologies**	**FIRCA**	
	Activity 3.1.1: Promote high-quality inputs	FIRCA	
	Activity 3.1.2: Promote high quality climate resilient planting material	FIRCA	
	Activity 3.1.3: Strengthen commercialization organizations	FIRCA	
	Activity 3.1.4: Streamline infrastructure	FIRCA	