SCIENCE FOR A FOOD-SECURE FUTURE

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

Annex 3a: Economic and Financial Analyses - Narrative

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Contents

List of Acronyms

BAU	Business-as-Usual
BCR	Benefit-to-Cost Ratio
CBA	Cost-Benefit Analysis
CIS	Climate Information Services
CO_2	Carbon dioxide
EA	Economic Analysis
EFA	Economic and Financial Analysis
EIRR	Economic Internal Rate of Return
FA	Financial Assessment
FIRR	Financial Internal Rate of Return
GCF	Green Climate Fund
GHG	Greenhouse gas
ha	Hectare
LARACI	Project “Enhancing Sustainable Land Management and Climate-Resilient Agri-food Systems”
IRR	Internal Rate of Return
MSME	Micro, Small & Medium Enterprises
XOF	West African Franc
NPV	Net Present Value
O&M	Operation and maintenance
SHF	Smallholder farmers
SRI	System of Rice Intensification
tCO_2eq	Tons (t) of carbon dioxide (CO_2) equivalents (eq)
USD	United States dollar

1 Overview of the economic and financial assessment

We have carried out two assessments of the investments proposed under the LARACI project: one economic and one financial.

- The economic assessment, presented in the sheet Economic Analysis (EA), is broad in nature, as it includes indicators that are relevant to the project (e.g., full project investment, farmers incremental income as well as benefits to society, even if these are not directly connected to the financial performance of beneficiaries (e.g., value of greenhouse gas emissions reduction). For this assessment, we considered the incremental income which the project will induce to selected value chains (rice, cassava, yam), and a 20-year investment lifetime to calculate the Economic Internal Rate of Return (EIRR).
- The financial assessment (FA) focused on financial returns and evaluates the profitability and viability of investing in Climate-Smart Agriculture (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 footprints. The assessment compares 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 have been 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. The business-as-usual scenario applies annual yield decline rates of 2.2% for rice, 2.5% for cassava, and 3.0% for yam over the 20-year analysis horizon, reflecting projected climate-induced productivity 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[1].
    - 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

[1] The West Africa regional median documented by Carr et al. (2022), equivalent to approximately 0.3% per year, aggregates across diverse agro-ecological zones including more climate-buffered coastal areas and is therefore not representative of the target regions, where Ashap et al. document a projected shift from humid to semi-arid conditions by 2100, representing one of the most severe climate transitions in the country. At the other end of the range, Fatondji et al. (Agronomy Journal, 2025) project rice yield reductions of 77% to 82% by 2070-2100 without adaptation in the derived savannah zone of central Côte d'Ivoire, implying annual decline rates substantially higher than those applied in this model. For yam in comparable West African savannah conditions, Srivastava et al. document yield declines of 27% to 33% by 2050 under high-emission scenarios. For cassava, Knox et al. (2012) note that rainfed cassava in dryland zones faces considerably higher climate stress than regional averages suggest.

LARACI project, which fully or partially covers the cost of CSA adoption in the targeted area.

The analysis includes 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. 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. A sensitivity analysis has been carried out to gauge the effect of this choice on the financial performance of farms. 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:

- Uncertain Investment Allocation: CSA technologies proposed by the project are known for each crop, but the exact adoption per ha 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.
- 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.
- 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.

TABLE 1: COMPARISON OF KEY RESULTS OF THE FINANCIAL ASSESSMENT

CROP	**SCENARIO 1: BAU (NO CSA)**	**SCENARIO 2: CSA (SELF-FINANCED)**	**SCENARIO 3: CSA (GCF-FUNDED)**
Rice	Low return (11%), due to low yields worsened by climate effects	Lower return (8%), improved yields are offset by high adoption cost	Good return (20%), CSA increases yields, and profitability is achieved as initial adoption costs are covered
Cassava	Moderate return (14%), performance	Weak return (7%), CSA boosts yields but	Strong return (22%), CSA technologies improve

	constrained by low climate resilience	farmers' born costs outweigh gains	margins while adoption cost is subsidized
Yam	Modest return (13%), crop is more susceptible to land degradation which impacts yields	Weak return (8%), CSA helps but high self-financed costs reduce impact	Very strong return (39%), CSA adoption and adoption subsidies significantly boost productivity.

Finally, a sensitivity analysis has been conducted to assess the effect of the discount rate variation, adoption ceiling, implementation timing, price shocks, carbon price volatility, and partial co-financing on the financial and economic performance of farms across the above three scenarios. The effect of partial co-financing scenarios on farmers' financial incentives, projected adoption rates and the number of farmers reachable within the USD 40 million GCF envelope has been analyzed.

Table 2Table 2 below summarizes the FIRR under each co-financing level compared to the GCF-funded baseline and the prevailing MFI lending rate ceiling of approximately 18% in Côte d'Ivoire.

TABLE 2: SUMMARY OF THE FIRR UNDER FOUR DIFFERENT CO-FINANCING LEVELS (GCF-FUNDED BASELINE 0%, 10%, 20%, 30%)

Co-financing level	Rice FIRR	Cassava FIRR	Yam FIRR
GCF-funded (0% co-financing)	19%	22%	39%
10% farmer co-financing	18%	20%	33%
20% farmer co-financing	17%	18%	28%
30% farmer co-financing	16%	17%	25%

The analysis reveals a critical threshold effect. Under the GCF-funded scenario, FIRRs across all three crops are materially above the prevailing MFI lending rate of approximately 18%, providing a clear financial incentive for adoption that differentiates CSA investment from commercially available credit. As co-financing requirements increase, FIRRs for rice and cassava compress toward or below this threshold, eliminating the financial advantage of CSA adoption relative to commercial borrowing and removing the primary incentive for smallholder uptake. At 20% co-financing, cassava FIRR reaches exactly 18%, making CSA adoption financially equivalent to taking an MFI loan with no net benefit to the farmer. At 30% co-financing, both rice and cassava FIRRs fall below the MFI lending rate, meaning farmers would be better off financially by not adopting CSA practices at all.

Beyond the direct impact on financial returns, introducing farmer co-financing creates two additional cost categories that are not captured in the baseline model and would further reduce the effective value for money of a co-financing scenario. First, mobilizing farmer co-financing in five regions across three value chains would require a dedicated awareness, financial literacy, and enrolment campaign. The cost of this campaign, estimated to be above farmers' co-financing, would reduce the net GCF envelope available for actual CSA support, partially or fully offsetting the theoretical gain in farmer reach from stretching the grant. Second, the introduction of co-financing requirements would be expected to reduce adoption rates, particularly among the poorest and most vulnerable households who are the primary target as outlined in the GESI Action Plan. Evidence from comparable smallholder technology adoption programs in West Africa consistently demonstrates that even modest cash contribution requirements create significant barriers among ultra-poor households.

2 Financial assessment for rice

2.1 Scenario 1: BAU - traditional rice cultivation (without CSA adoption)

This baseline scenario illustrates the current state of rice production in Côte d'Ivoire's central regions, where farmers rely predominantly on conventional agricultural practices. These include low-input farming systems with limited mechanization, minimal access to agro-climatic information, and a strong dependency on rain-fed cultivation. The productivity levels remain relatively low, constrained by erratic rainfall patterns, poor soil fertility, and lack of access to modern technologies or advisory services.

Under this scenario, farmers typically achieve modest yields and revenues. Gross margins are also limited due to low input costs but relatively higher production risks and inefficiencies. Climate risks, such as droughts or floods, significantly reduce yield stability, making livelihoods precarious and food security vulnerable.

The assessment resulted in a financial internal rate of return **(FIRR) of 11% under this scenario**, indicating that current practices offer acceptable (under current economic circumstances) but little incentive for investment. The Net Present Value (NPV) under this scenario remains low, **at USD 582 for an investment lifetime of 20 years**, or can even become negative in the event of slight increase of water management costs. This demonstrates the unsustainable nature of rice production in Côte d'Ivoire currently under changing and uncertain climatic conditions. Overall, the BAU scenario reinforces the need for transformative interventions that enhance productivity, resilience, and sustainability.

In this baseline scenario, the rice yield which stands currently **at 4.6 tons per hectare** is prone to reach levels as low as 2.6 tons per hectare after 20 years[2], as yields are expected to continue to decrease impacted by the effects of climate change (slow-slop modelling). In this scenario, farmers typically use basic hand tools for land preparation and harvesting. The low NPV under this scenario suggests that the long-term profitability of rice farming under traditional practices is limited in Côte d'Ivoire, indicating marginal attractiveness for investment in the future.

This scenario serves as the counterfactual for comparison. It underscores the structural challenges rice farmers face in the absence of targeted interventions, including low resilience to climate change, limited scalability, and constrained income potential. Without improved practices or access to climate-smart technologies and services, farmers remain vulnerable to both market fluctuations and environmental stressors.

[2] Assuming a yield decrease of 2.2% per year.

2.2 Scenario 2: CSA Adoption through farmers self-financing

In this scenario, farmers adopt climate-smart agriculture (CSA) technologies without external support, relying instead on their own resources. The promoted technologies for rice include alternate wetting and drying, Smart Valleys, RiceAdvice (a decision support tool), System of Rice Intensification (SRI), combined biochar and nitrogen fertilizer, mid-season drainage, and access to Climate Information Services (CIS) and Early Warning Systems (EWS).

The adoption of these technologies enhances yields through better water management, improved nutrient efficiency, and climate-informed decision-making. Adoption of these technologies leads to a yield increase from 4.6 tons per hectare in the baseline scenario to 5.97 tons per hectare within a 20-year lifespan, assuming a slow build-up of CSA adoption effects as follows.

Adoption uptake scenarios									
Year	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
Up take trajectory	0%	15%	35%	45%	60%	75%	90%	95%	100%

For example, SRI, Smart Valleys and mid-season drainage reduce water use while increasing productivity, while soil fertility management boosts yield consistency. RiceAdvice and CIS enable timely planting and optimized input use. However, because farmers must finance the initial investments themselves as well as the ongoing costs for receiving CIS, the expected adoption rate for this scenario would remain limited, adopted only by better-off, early adopters, or risk-tolerant producers. The capital costs, particularly for biochar application create barriers for smallholders. However, for those risk-taking farmers that may choose the option of financing CSA technologies themselves, the returns are similar to those in the BAU scenario as benefits are offset by unsubsidized adoption costs.

Financially, this scenario yields higher revenues due to improved yields. **The FIRR is lower than BAU, at 8%**, demonstrating the effect which the cost of adaptation has on profitability when adopting CSA practices. The NPV increases slightly, at USD 1,247 over 20 years lifetime, reflecting the impact of upfront and recurrent technology costs, which the activity hardly recoups.

In this scenario, climate resilience improves agricultural yields, but the financial returns do not make the scenario appealing. Returns are comparable to BAU scenario, suggesting that farmers will likely not choose to invest in adaptive technology on their own.

2.3 Scenario 3: Rice CSA technology adoption with GCF-financed support

This scenario assumes that CSA technologies are adopted at scale with concessional support from GCF, targeting inclusive adoption among smallholders, women, and vulnerable groups. The same set of technologies is promoted: alternate wetting and drying, Smart Valleys, RiceAdvice, SRI, biochar and nitrogen, did-season drainage, and CIS/EWS. Under this scenario, GCF funding covers a substantial share of the initial CSA technology adoption costs as well as climate information services.

The adoption rate of CSA technologies under this scenario is foreseeably higher, which would lead to systemic improvements across rice value chains. Smart-Valleys, SRI and nutrient management boost yields, and the use of digital advisory tools and climate services reduces decision-making uncertainty. The synergy of these practices generates significant productivity gains, income growth, and resilience.

From a financial standpoint, this scenario delivers the highest NPV, **at USD 4,803 in 20 years at a discount rate of 5%.** The FIRR is also positive, **standing at 20%,** reflecting both profitability and climate risk reduction.

The financial analysis reveals the highest performance across all three scenarios. The **NPV** peaks under the GCF-funded scenario, at a level 10 times better than the BAU scenario. The **FIRR** is higher than in previous cases, signaling reduced impacts from climate change and long-term profitability under adoption of adaptive measures in a supported manner. This scenario demonstrates the impact of climate finance, how GCF support can catalyze adoption of climate resilient practice, and enable the delivery of a stronger food system.

3 Financial assessment for cassava

3.1 Scenario 1: BAU - traditional cassava cultivation (without CSA Adoption)

This baseline scenario reflects the prevailing conditions of cassava production in Côte d'Ivoire's central regions (N'Zi, Moronou, Iffou, La Mé, and Gbêkê), where farming practices are characterized by low-input, subsistence-level systems. Farmers' preference for monocropping or intercropping varies within the region from almost 70% to almost 40% monocropping. Farmers typically rely on minimal soil fertility management and have limited or no access to improved cassava varieties. The absence of climate information services and advisory support further exacerbates production inefficiencies and limits adaptive capacity to climatic variability.

Baseline yields under this scenario remain modest, standing at 5.95 tons per hectare in the first year, but decreasing over time due to climate change. The productivity stagnation is largely attributed to degraded soils, erratic rainfall, and a lack of climate-resilient practices. Cassava cultivation is conducted with basic tools, minimal mechanization, and little to no use of external inputs such as fertilizers or organic amendments.

The financial analysis of this scenario indicates an **FIRR of 14%,** and an NPV of **USD 1,206** over a 20-year investment horizon. While this suggests slightly better returns than the rice baseline, the narrow margin signals that cassava production under traditional practices remains economically fragile. Profitability is highly sensitive to climatic variability and declining soil health, and any increase in production costs or decrease in market price could erode these returns.

This scenario illustrates the limited financial attractiveness[3] and low resilience of current cassava production systems. Despite low upfront investment needs, the added financial value in this BAU scenario offers minimal incentives for scaling up or sustaining production over

[3] This return can be put in perspective with the reference MFI lending in rural Côte d'Ivoire which stands at 18%

time. It emphasizes the pressing need for transformative interventions that integrate climate-smart technologies and practices to enhance yields, improve profitability, and secure livelihoods. Without such interventions, cassava farming will continue to face diminishing returns amid exposure to climate-related risks.

3.2 Scenario 2: CSA adoption through farmers self-financing

In this scenario, cassava farmers adopt a full suite of climate-smart agriculture (CSA) practices using their own financial resources. The promoted package includes:

- Cassava-legume intercropping for improved soil fertility and productivity
- Cassava seed systems
- AKILIMO tailored agronomic advisory services
- Optimized planting and harvesting windows to enhance dry matter and starch yields

Commercial CSA advisory services, including climate information and extension support at a fee, are also included. These technologies collectively enhance resilience and productivity. Intercropping improves soil health and yield stability, and improved fertilizer use boosts nutrient efficiency. The improved varieties increase both yield potential and climate tolerance. However, since adoption is entirely self-financed, access remains limited to better-off or risk-tolerant farmers. Initial investment costs, particularly for improved inputs, can be substantial. As a result, benefits are offset by the adoption cost. Adoption of these technologies leads to a yield increase from 5.8 tons per hectare in the baseline scenario to 6.7 tons per hectare.

Financially, this scenario's yields should have provided higher revenues due to improved yields, but cash flows are lower and the FIRR is also lower compared to BAU, **standing at 7% only** and demonstrating the effect which the cost of climate smart technology adoption has on profitability. The NPV also decreases compared to BAU scenario, standing **at USD 808 at 5% discount rate,** reflecting the impact of upfront costs.

In this scenario, climate resilience improves agricultural yields, but costs of adaptation are unsurmountable. The moderate NPV under this scenario suggests that farmers will likely not adopt any of the listed adaptive technology on their own.

3.3 Scenario 3: CSA adoption with GCF-financed support

This scenario envisions the scaled-up adoption of climate-smart agriculture (CSA) technologies for cassava production, supported through concessional financing from the GCF. The intervention targets widespread adoption among smallholders, women, and vulnerable groups across Côte d'Ivoire's central regions. The promoted CSA technologies include cassava-legume intercropping for improved soil fertility, climate-smart cassava varieties, tailored agronomic advisory services, and optimum planting and harvesting time. GCF financing plays a catalytic role by covering a significant share of technology adoption costs, including inputs and training. This financial support lowers barriers to entry and accelerates uptake, especially among resource-constrained farmers. As adoption rates increase, systemic improvements are observed in productivity, soil health, and overall farm resilience. Intercropping improves nutrient cycling and land efficiency, while improved cassava varieties counteract climate change induced yield reductions and enable efficient use of resources, particularly plant nutrients from the site-specific fertilizer recommendations. The productivity gains under this scenario are substantial, with yields increasing by over 25%, resulting in higher revenues and significantly improved net cash flows. From a financial standpoint, this scenario performs exceptionally well. The NPV reaches **USD 4,553 over a 20-year investment period at a 5% discount rate**, about five times higher than the baseline scenario. **The FIRR climbs to 22%,** indicating strong profitability and substantial risk reduction under climate stress.

This scenario demonstrates how strategic climate finance can unlock transformative potential in cassava value chains. GCF support not only enables inclusive access to CSA technologies but also ensures long-term viability, resilience, and scalability of climate-smart cassava farming systems.

4 Financial assessment for yam

4.1 Scenario 1: BAU- traditional yam cultivation (without CSA adoption)

This scenario reflects the current practice of yam cultivation in the project area, without the integration of climate-smart agriculture (CSA) technologies. It serves as the baseline against which financial performance under CSA adoption scenarios is compared. The financial results under this scenario suggest that yam production under BAU is not profitable and offers limited long-term scalability. Profitability could be significantly further threatened by yield variability, input price increases, or climate-related disruptions. The financial viability of the BAU scenario was assessed using a standard discounted cash flow model over a 20-year project horizon with a 5% discount rate.

Under these conditions, productivity remains constrained by erratic rainfall, poor soil fertility, and increasing pest and disease pressures. The baseline current yield under BAU conditions is estimated at 5.3 tons per hectare but decreases over the years due to the impacts of climate change to reach 2.2 tons per hectare by 2045 assuming no adaptive measures are adopted. With a farm-gate price of **USD 400 per ton**, gross revenue amounts **to USD 2,134 per hectare**. Input costs, including labor, basic planting material, and minimal soil management, are estimated at **USD 1,530** per hectare, yielding a positive gross margin per hectare.

Although input costs are relatively low, the overall financial performance remains modest. The financial internal rate of return (FIRR) is **calculated at 13%,** and the financial net present value (FNPV) over a 20-year horizon, using a 5% discount rate, is **USD 574**.

Climate-related risks therefore could lead to total abandonment of cultivation of this crop over the years under this scenario. In adverse years, additional costs may arise from water management or increased pest control, which can push farmers into more financial losses. Without support mechanisms or improved practices, farmers have limited capacity to absorb such shocks.

This scenario serves as the counterfactual for evaluating the impact of CSA interventions. It highlights the systemic limitations faced by yam producers in the absence of innovation or support. Productivity gains are minimal, scalability is limited, and the financial viability of yam farming remains fragile under climate change. The findings reinforce the need for targeted interventions to improve efficiency, resilience, and profitability across the yam value chain.

4.2 Scenario 2: CSA adoption through farmers self-financing

Under this scenario, farmers adopt climate-smart agriculture (CSA) technologies for yam production without external financial support, relying instead on their own resources. The promoted CSA technologies for yam include efficient plant arrangements, climate smart staking, yam seed systems, and climate-smart staking.

These practices are designed to improve yields, enhance resilience, and reduce environmental impacts. Climate smart staking maintains soil moisture, improving soil organic matter and boosts soil nitrogen levels. The introduction of yam varieties with high nutrient uptake increases yields and resource use efficiency. Climate-smart staking also reduces deforestation by promoting efficient use of staking materials. Yam seed systems make improved varieties available more rapidly and promote the dissemination of disease-free seed/plant material.

Adoption of these technologies leads to a yield increase from current baseline of **5.3 tons per hectare in the BAU scenario to 6.91 tons per hectare after 20 years**. The farm-gate price remains the same at **USD 400 per ton**, leading revenue to rise to **USD 2,765 per hectare**. However, due to the cost of technology adoption, net cash flow per hectare is negative in the first year and stabilizes at **USD 1,385** per hectare from the third year onward, which is slightly lower than in the BAU scenario.

From a financial perspective, while yields improve, the cost burden of self-financed CSA limits profitability. The FIRR under this **scenario is estimated at 8%,** and the NPV at a 5% discount rate over **20 years is USD 3,609**. From an NPV standpoint, self-financed adoption of CSA could be justified but the FIRR remains sufficiently low (below BAU scenario) to discourage this option.

These modest returns reflect the challenge of recovering the initial investment in the absence of concessional finance or targeted subsidies. While CSA technologies enhance productivity and climate resilience, only a subset of better-resourced farmers in Côte d'Ivoire are likely to adopt these technologies themselves, despite the slight (but not material) improvement from the counterfactual BAU scenario. This limits overall impact and scalability of this option. This scenario highlights that while CSA technologies can improve yield performance for yam, and there is room to achieve this from a NPV standpoint without supportive financing mechanisms, however this window is narrow and does not generate compelling financial returns for most farmers. Widespread adoption of CSA practices will therefore require targeted support to overcome the cost barriers and de-risk the transition to resilient yam production systems.

4.3 Scenario 3: CSA adoption with GCF Financed support

This scenario assumes the widespread adoption of climate-smart agriculture (CSA) technologies in yam production, made possible through targeted financial support from the GCF. The concessional funding significantly reduces the cost burden on smallholder farmers and enables inclusive access to sustainable technologies. The promoted CSA practices are the same as in the previous scenario and include efficient plant arrangements, climate-smart staking, fertilizer responsive varieties, and yam seed systems.

Together, these interventions address the core agronomic and environmental constraints in yam cultivation. Climate-smart staking improves soil fertility and reduces deforestation using the *Gliricidia* stakes. The fertilizer responsive yam varieties increase yield and resource use efficiency. The improved yam seed systems allow the rapid multiplication of improved varieties and the production of disease-free planting material.

With GCF funds covering a substantial share of technology costs, including mulch inputs, legume seeds, and efficient staking infrastructure, farmers are empowered to adopt the full CSA package without significant upfront expenditures. As a result, **yields exceed 6.9 tons per hectare after 20 years**, leading to stronger revenues and higher net cash flows.

Financially, this scenario outperforms all other cases. The NPV at a 5% discount rate reaches **USD 13,673 over a 20-year investment period, and the FIRR stands at 39%,** signaling strong profitability and a substantial reduction in production risk. These figures reflect both the efficiency gains from CSA practices and the enabling effect of climate finance.

Beyond financial returns, this scenario catalyzes systemic transformation in yam production. It enhances resilience to climate shocks, increases input-use efficiency, and promotes sustainable intensification. Most importantly, the GCF support ensures that even resource-constrained farmers can transition to climate-resilient production systems, contributing to food security, livelihood stability, and environmental sustainability across Côte d'Ivoire's yam-growing regions.

5 Economic Analysis

The economic analysis of LARACI has combined benefits from emissions reductions and increased incomes for farmers across the three target value chains: rice, cassava, and yam. It compares the 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 economic analysis incorporates a slower trajectory of benefits build-up reflecting progressive uptake of CSA practices. The economic benefit ramp-up profile reflects the agronomic reality that the full realization of economic benefits from CSA adoption lags behind the adoption uptake. While technology adoption and economic benefit realization tend to move in the same direction in practice, they are not simultaneous. A farmer who adopts an improved variety or practice does not achieve full yield gains immediately, as soil health improvement, skill consolidation, and market linkage establishment typically require additional seasons and years for economic ramp-up beyond initial adoption uptake. Therefore, incremental income benefits and associated emission reductions are assumed to materialize gradually and after CSA adoption, reaching full realization in the base case by Year 12, consistent with agronomic adjustment periods, project implementation sequencing, and guidance from FAO, IFAD, and World Bank on agricultural investment appraisal. This replaces an earlier approach that assumed uniform trajectory of economic and financial benefits and ensures consistency between the economic analysis and the per-hectare financial cashflows modelled in the crop-level worksheets.

The emission reduction benefits follow the same adoption ramp. Because the emissions benefits in this project arise mainly from incremental annual biomass associated with yield improvements, the associated carbon benefit materializes within the same growing season as the yield increases. Emission reductions therefore increase progressively alongside the economic benefit ramp-up trajectory, avoiding any front-loading of benefits, and reaching full annual impact only once full adoption is achieved in Year 12.

The economic benefits ramp-up trajectory is as follows:

Economic Build-up scenarios												
Year	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
Base case economic benefits ramp-up	0%	0%	5%	10%	20%	30%	40%	50%	60%	80%	90%	100%

On the cost side, the economic analysis has been refined in three respects:

(i) First, a Standard Conversion Factor (SCF) and shadow wage rate for unskilled labor have been introduced, consistent with international practice for economic appraisal in developing country contexts where underemployment exists. This lowers economic costs relative to financial costs and improves the EIRR relative to a uniform conversion factor of 1.00 approach.

(ii) Second, recurring O&M costs for CSA advisory services and climate information services are now reflected over the full 15-year operational horizon of the project, beyond Year 5. In the GCF-supported financial scenarios, these services are already incorporated into OPEX from Year 5 onward, and this treatment is now applied consistently in the economic model to ensure that sustained yield benefits are matched by associated institutional costs.

(iii) Finally, within the USD 5 million Government of Côte d'Ivoire in-kind co-financing, total tax incentives and exemptions amount to **USD 1,094,240**, representing approximately 22% of the total government co-financing. For the Economic Analysis, these tax incentives are deducted from the total project budget before applying the shadow pricing conversion. The remaining in-kind contribution USD 3,905,760 consists of institutional support contributions.

The tax component breaks down as follows across eight line items:

- Climate-adapted research equipment tax incentive (Activity 1.2.3): USD 253,140
- Multimedia teaching kit tax incentive (Activity 1.2.3): USD 20,627
- Maintenance kits for agrometeorological stations tax incentive (Activity 1.2.3): USD 46,127
- Tablets and smartphones tax incentive (Activity 1.2.3): USD 38,558
- Tax incentive for importing research equipment (Activity 3.1.2): USD 67,200
- Tax exemptions for imported equipment (Activity 3.1.2): USD 275,468
- VAT exemption for imported equipment for agribusiness (Activity 3.1.3): USD 93,120
- Beneficiary tax abatement on taxable profits (Activity 3.1.4): USD 300,000

Therefore, 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**.

The total project investment, exclusive of tax incentives, is spread over the five years of the project as follows:

- Year 1: USD 9.8 million

- Year 2: USD 13.74 million
- Year 3: USD 13.94 million
- Year 4: USD 6.6 million
- Year 5: USD 4.7 million

There are no additional capital expenditures beyond Year 5, meaning the benefits start flowing without further investment burdens.

The CSA technologies lead to an average yearly emission reduction of 190,438 tCO_2eq over the 20-year period. The rollout of emissions reductions is gradual and follows the same adoption rate as the CSA technologies (See Annex 22 and Annex 23).

Each ton of CO_2eq avoided is valued at USD 35, leading to total monetized emission benefits of USD 116.2 million. These are realized annually from Year 1 onward, increasing with the ramp-up in CSA adoption.

CSA adoption also leads to **significant income gains for farmers**, totaling yearly:

- **USD 35,747,368 million** for rice farmers
- **USD 15,984,000 million** for cassava farmers
- **USD 71,600,000 million** for yam farmers

The aggregate farmer incremental income figures reported in the Economic Analysis worksheet are derived through a five-step scaling methodology. First, for each crop, the per-hectare yield increment attributable to CSA practices is estimated based on agronomic evidence from comparable CGIAR interventions in West Africa combined with local trial data, and applied to the total targeted area per crop to derive the maximum potential aggregate incremental yield. Second, the maximum potential aggregate incremental yield is phased in progressively using an economic benefits build-up trajectory that reflects the agronomic reality that full economic benefits materialize more slowly than adoption, reaching 100% by Year 12. Third, the resulting annual aggregate incremental yield trajectory is multiplied by the prevailing farm-gate price for each crop to produce the annual aggregate incremental revenue trajectory. Fourth, the economic opportunity cost of incremental CSA production effort is deducted from the aggregate incremental revenue, estimated by applying 80% of the percentage yield increase attributable to CSA adoption to the total annual farm-level O&M cost, reflecting the agronomic principle that higher yields require proportionally greater production effort discounted for fixed cost components that do not scale with output intensity. Fifth, the three crop-level net incremental income trajectories are summed to produce the total farmer incremental income line in the Economic Analysis worksheet. All underlying parameters are transparently presented in the Incremental Income worksheet of Annex 3b. Income gains are distributed across 20 years and phased in progressively for the first years in line with the benefits ramp up trajectory, mirroring the gradual uptake of CSA practices. When combining these two sources of benefit, emissions reductions and income growth, the annual net economic benefit rises to over USD 84.4 million per year from Year 12 onwards.

The cumulative net economic benefit, after subtracting investment costs and discounting future benefits to present value, results in an Economic Net Present Value (ENPV) of USD 442 million after 20 years. **The project presents an EIRR of 38% over the same period.**

6 Sensitivity analysis

To test the robustness of the financial performance of the CSA investment, a **sensitivity analysis** was conducted by varying the discount rate from 4% to 8%. This analysis reveals how changes in the discount rate affect two key financial indicators: **FIRR**, a profitability measure, and **FNPV**, the present value of net benefits over time.

The choice of a 5% social discount rate is justified as a social rate of time preference consistent with methodologies used in climate and development appraisal. Climate adaptation investments generate benefits that accrue over long horizons and manifest as avoided losses, resilience gains, and environmental externalities not captured by private market rates. The 5% rate aligns with the GCF grant equivalent methodology and falls within the range applied in comparable adaptation and rural development projects supported by multilateral development institutions. Sensitivity testing at discount rates of 4%, 6%, 7%, and 8% confirms that project outcomes remain robust under more conservative assumptions and strengthens the case for GCF involvement by showing that self-financed CSA becomes unviable as the discount rate increases.

In addition to discount rate variation, the sensitivity analysis tests the following dimensions of uncertainty:

(i) **Adoption ceiling risk**: a pessimistic scenario assumes sustained long-term adoption reaches only 85% rather than 100%, capturing potential effects of institutional constraints, service disruption, or partial system underperformance; an optimistic scenario tests 115% adoption due to stronger-than-expected institutional change.

(ii) **Implementation delay risk**: delayed and very delayed ramp-up scenarios test the impact of slower-than-expected adoption, and a faster build-up scenario tests the upside.

(iii) **Price shocks**: a 10% drop and a 10% increase in farm-gate prices are tested across all three crops and all scenarios.

(iv) **Carbon price volatility**: a 10% increase and a 10% decrease in the shadow carbon price are tested for their effect on the EIRR and ENPV.

(v) **Partial farmer co-financing**: scenarios where farmers cover 10%, 20%, or 30% of technology adoption costs are tested. The results of these additional scenarios are presented below alongside the discount rate sensitivity.

6.1 Rice component

FIRR for GCF-funded CSA stays consistently strong at **20%**, showing resilience to discount rate changes. By contrast, the self-financed scenario yields a modest 8%, while BAU remains at 11%.

FNPV under the GCF scenario declines from **USD 5,418** at 4% to **USD 3,397** at 8% but remains far superior to the other scenarios. Self-financed FNPV at 8% and 4% discount rate stays below

USD 1,860 and turns negative at 8% (USD -126), indicating low attractiveness without concessional finance.

Conclusion: GCF support keeps rice CSA adoption financially sound even under higher discount rates, while self-financed CSA struggles.

Additional sensitivity tests for rice confirm the following: Under a **reduced adoption ceiling of 85%**, the GCF-funded FIRR remains at 19% demonstrating resilience to institutional constraints. Under a **very delayed adoption build-up of 50% by** year 5, GCF-funded scenario demonstrates a FIRR falling at 17% (slightly below MFI lending rates), demonstrating that adoption by at least half of the targeted beneficiaries would be critical to the project's success. A **10% price drop** renders BAU and self-financed scenarios unviable (FIRR below the hurdle rate), while the GCF scenario retains a positive FNPV at 10%, strongly reinforcing the need for concessional support under adverse market conditions.

6.2 Cassava component

FIRR under the GCF-funded scenario remains **very strong at 22%**, unaffected by discount rate variation. In contrast, the self-financed option drops to a weak **7%**, and BAU at 14%.

FNPV under GCF support remains well above **USD 3,331**, even at an 8% discount rate. However, self-financed FNPV turns at USD 31 in 20 years at a 7% discount rate and even falls below USD 500 to reach USD -294 of net present value generated in 20 years at a discount rate of 8%, signaling unviability without support.

Conclusion: Cassava CSA technologies yield high returns when supported by GCF. Without such support, the financial case collapses under even moderate discount rates.

Additional sensitivity testing for cassava confirms similar patterns. Under an **85% adoption ceiling**, GCF-funded returns remain robust and the self-financed FIRR of 7% confirms limited viability without subsidies. Under a **10% price drop**, the BAU scenario becomes financially unviable, and the self-financed scenario turns deeply negative, while the GCF-funded FNPV remains positive at USD 1,459. This reinforces the critical role of GCF support in buffering smallholders against price risk. A **10% price increase** lifts all scenarios materially, with GCF-funded FNPV reaching USD 7,663.

6.3 Yam component

FIRR in the GCF-supported scenario is **exceptionally high at 39%** across all discount rates. The self-financed option drops at **8%**, while BAU lags at **13%**.

FNPV under GCF support is robust, starting at **USD 10,351** at 8% and remaining high at **USD 15,105** at 4%. Even self-financed yam CSA stays moderately positive, although its FNPV declines from **USD 5,031** (6%) to **USD 394** (8%). Notably, the BAU scenario struggles to stay positive, yielding less than USD 700 FNPV in 20 years at all discount rates.

Conclusion: Yam CSA with GCF support is a standout performer, demonstrating exceptional financial resilience. Even the self-financed CSA version of yam is moderately viable assuming stable sales price, while BAU is borderline viable.

Additional sensitivity testing for yam confirms its strong financial robustness. Under an **85% adoption ceiling**, the GCF-funded FIRR remains at 38% and the self-financed option at 8%, confirming that returns are not sensitive to moderate reductions in sustained adoption.

Under a **10% price drop**, the BAU scenario turns unviable and the self-financed FNPV drops to USD 321, whereas the GCF scenario retains a strong FNPV of USD 10,221 a stark illustration of the protective value of concessional finance for yam producers facing market risk.

6.4 Economic sensitivity: carbon price and adoption scenarios

At the economic level, sensitivity testing on the **shadow carbon price** shows that a 10% decrease or increase in the carbon price does not affect the EIRR which remains at 38%, but slightly affects the ENPV. The EIRR is therefore not materially sensitive to carbon price assumptions within this range, confirming that the dominant driver of project economic value is the incremental income to farmers rather than carbon monetization.

On **adoption timing**, the EIRR is highly sensitive to build-up pace, under a very delayed scenario, the EIRR falls at 26%, while under an accelerated build-up it rises to 53%. This confirms the finding from the GCF Secretariat reviewer that adoption timing is the most important driver of economic viability at the project level, though the project remains economically robust even with delayed and very delayed build-up of economic benefits. Under the realistic and a delayed scenario, the EIRR remains above 30%, demonstrating resilience to moderate implementation challenges.

Finally, on **partial farmer co-financing**, scenarios where farmers cover 10%, 20%, or 30% of adoption costs were tested. Under these scenarios, 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.

7 Conclusion

CSA technologies not only strengthen climate resilience but also significantly enhance farm productivity and profitability. With GCF support through LARACI, farmers can achieve substantially higher returns than they would under the BAU scenario.

- When CSA adoption is fully financed by smallholder farmers, the investment is often not financially viable, due to the high upfront costs and climate-related risks.
- LARACI’s grant-based support model removes financial entry barriers and de-risks the investment, making CSA adoption both feasible and attractive.
- In addition to addressing climate vulnerability, the use of GCF proceeds enables IRR between 19% and 39% across the three target crops.
- Without GCF financing, the NPV of CSA adoption remains unattractive under current climate conditions, threatening the long-term viability of rice, cassava, and yam value chains. This scenario would lead to reduced food production and increased food insecurity over time.

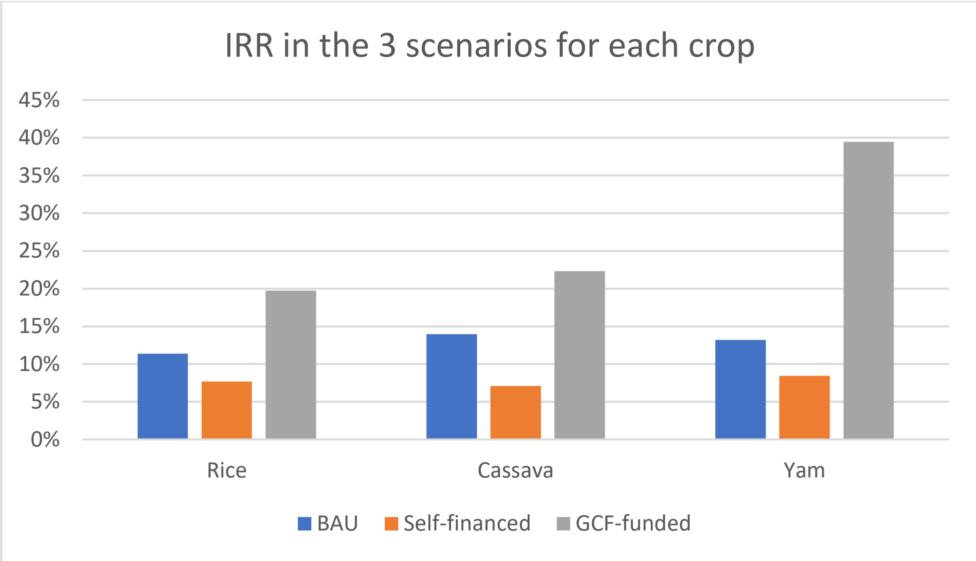

FIGURE 1 THE CHART ABOVE SUMMARIZES THE IRR FOR EACH SELECTED COMMODITY UNDER THE THREE ASSESSED SCENARIOS