Project type	Deploying sustainable agroforestry practices in cocoa plantations including shading trees planting, intercropping, application of rescue irrigation (micro irrigation)
Sector/sub-sector/type	Agriculture/Agroforestry/Cocoa production
Climate risks occurrence	Sudden extreme events and slow onset events
Climate change parameters	Precipitation and temperature
Climate change hazards	Drought and heat wave
Type of adaptation and resilience measures	Application of sustainable agroforestry practices in cocoa plantations including: - shade trees planting, - intercropping for income diversification - rescue irrigation
Adaptation benefits	The overarching benefit is the output: - Cocoa plantation under Sustainable and Climate-Resilient practices (SCR) (ha), The detailed benefits are also measured: - Improved survival rate of cocoa saplings at farm establishment (percentage of planted seedlings) - Complementary farm output (USD/ha) - Enhanced productivity of cocoa farm (kg of cocoa beans/ha)
Implementation area	Targeted implementation area = 3,000 ha meaning 3,000 SCR to be generated A total of 3,000 farmers is expected to benefit from the project, as only one hectare of farm is supported per farmer.
Cost of implementation (USD)	The cost of 1 SCR is four thousand one hundred fourteen dollars and eighty cents (USD 2,547) The total cost of implementation is Nine million one hundred ninety-six thousand two hundred US dollars (USD 9,196,200)
Applied Methodology	ABM Methodology Cocoa Resilience Version 1
Project owner	Center for International Forestry Research and World Agroforestry (CIFOR-ICRAF)
Contacts	Amani Kouassi, Climate Change Specialist, CIFOR-ICRAF, K.Amani@cifor-icraf.org Kouamé Christophe, Côte d'Ivoire Country Director, and Humid West Africa Regional Convenor, CIFOR-ICRAF, C.Kouame@ cifor-icraf.org

1. **About the adaptation project**

1.1. Project title

Cocoa livelihood resilience-enhancing the resilience of smallholder cocoa farmers in Côte d'Ivoire

1.2. Rationale

The West-Central Africa Cocoa Landscape is the largest cocoa bean production zone in the world, where Côte d'Ivoire (42.5%), Ghana (11.7%), Nigeria (5.2%) and Cameroon (5.2%) account for 40%, 20% and 5% of world cocoa production, respectively [1]. In Côte d'Ivoire, cocoa production accounts for 15% of the Gross Domestic Product (GDP) and 43% of exports. More than 2.5 million Ivorians are involved in cocoa production and feeding the chocolate market with an estimated US$64 billion [2].

Cocoa production in the region faces significant environmental and climatic changes that already challenge the livelihood of millions of cocoa producer households. Climate desiccation process was noticed since 1970s in Côte d'Ivoire. Elevated temperatures and longer dry seasons were already occurring at higher frequencies. According to the IPCC Sixth Assessment Report (AR6), West Africa has already experienced a rise in average annual and seasonal temperatures of 1–3°C since the mid-1970s with the highest increases in the Sahara and Sahel. Heatwaves are projected to become hotter, longer, and more frequent. Under global warming of 1.6–2.5°C, West Africa could face 50–250 days per year of potentially lethal heat [3].

For cocoa, a crop highly sensitive to temperature and water stress, this trend directly threatens survival and productivity, as excessive heat reduces flowering, pod set, and bean quality [4].

In parallel, drought frequency and intensity have increased since the 1950s, with multi-year droughts becoming more common and expected to worsen under future warming. Given cocoa's reliance on stable rainfall and adequate soil moisture, recurrent droughts jeopardize yields, increase tree mortality, and force shifts in cultivation zones. The combination of more frequent heatwaves and prolonged droughts therefore makes cocoa production in Côte d'Ivoire especially vulnerable, underscoring the urgency of adopting adaptation strategies such as shade-based agroforestry, soil moisture conservation, and climate-informed farm management [5,6].

In these conditions, farmers repeatedly established new cocoa farms in the remaining forest areas where microclimate is still suitable to cocoa growing. That led the cocoa production basin to continually move from the already degraded lands to the new forest zones. This resulted in one of the alarming deforestation trends in the World, important biodiversity loss, large land degradation, and ultimately increased vulnerability of farmers (women, youth, and men). As climate change is likely to drive more temperature increases [7] and more rainfall uncertainties, these problems are going to exacerbate in the decades to come [6].

1.3. Objectives

The overarching objective is to enhance smallholder cocoa farmers' resilience in a deforestation-free cocoa landscape. For this to be achieved, the project is specifically designed to:

- train smallholder cocoa farmers on agroforestry,
- disseminate agroforestry seeds and/or planting materials,
- and evaluate and report the areas of cocoa plantations under sustainable and climate resilient practices.

1.4. Alignment with National and Global Adaptation Frameworks

These objectives align with Côte d'Ivoire's NDCs, which aim to reduce vulnerability in the agriculture, livestock, and aquaculture sectors [8]. The project supports the Global Goal on Adaptation (GGA) by strengthening the resilience and adaptive capacity of smallholder cocoa farmers. By applying an Adaptation Benefits Mechanism (ABM) methodology, it also advances Article 6.8 of the Paris Agreement, which promotes non-market approaches for adaptation and sustainable development. This generates verified adaptation benefits that will enhance Côte d'Ivoire's capacity to mobilize additional finance for adaptation in the cocoa sector.

2. Methodology

2.1. Selected methodology

The benefits of the project will be assessed using the methodology "Sustainable Agroforestry for enhancing the resilience of smallholder cocoa farmers against drought, rising temperature and heat waves- Version 1". The justification of its applicability to this project is summarized in table 1.

Table 1: methodology applicability

Criteria	**Required conditions**	**Compliance in this project**
Sector	Agriculture - crop production.	Cocoa beans production.
Sub-sector	Agroforestry	Cocoa agroforestry
Vulnerability to climate change hazards	Heat waves, drought, precipitation variability	Heat waves, drought
Farming system	Introduction of a sustainable agroforestry practices or a package of practices to enhance the resilience to the climate hazards of cocoa production systems that are either full-sun cocoa monocultures or systems that already include shade trees, but are not sufficiently effective against the climate hazards	The project aims at introducing sustainable agroforestry practices with rescue irrigation to enhance the resilience of smallholder farmers against the effects of heat waves and drought in cocoa production systems of Vavoua and Soubre (Côte d'Ivoire). In both areas, cocoa production is conducted in full-sun cocoa monoculture or with some random trees that afford insufficient protective shade against heat waves and drought.
Cocoa value chain related criteria	Only on-farm management practices	The project activity deals only with on-farm

Criteria	Required conditions	Compliance in this project
		management practices, namely agroforestry and rescue irrigation.
Access to planting materials	Smallholder cocoa farmers have access to high quality seeds and saplings for shading and intercropping, materials for irrigation, trainings of smallholder cocoa farmers on climate change, and use of irrigation.	Farmers, including women, are supplied with high-quality seeds and saplings.
Exclusion criteria related to deforestation	Farming systems not resulting in deforestation including plantation installed in protected areas.	The selected sites in both localities are not in protected areas. They are existing fallow of old cocoa farms (aged or destroyed by swollen shoot disease)

2.2. Adaptation benefits identification

2.2.1. Theory of change

Cocoa tree (Theobroma cacao) is an understory specie since its natural environments are humid tropical soils partially or entirely covered by rainforests trees. When cocoa trees are grown under limited or no shade, it is easily stressed when intense droughts and/or heat waves occur. Under the desiccating climate of West Africa where 70% of the world cocoa is [1] in full sun monoculture, intense droughts and heat waves regularly induce high rates of young cocoa trees mortality while reducing the lifespan of adult cocoa trees [9]. This easily leads to cocoa farm establishment failures, massive income loss in full grown cocoa plantation, increased cocoa farm destruction by diseases, early ageing of unshaded trees (reduced productive period of cocoa trees), and precarious livelihood for farmers whose 74% income is provided by raw cocoa bean selling. In this context, farmers struggle to create or regenerate cocoa farms by replanting degraded plantations [10]. Oftentimes, these farmers search for new forest areas that exhibit better suitability for cocoa growing [11]. This led to highly disrupted livelihoods, massive deforestation, biodiversity loss [12], widespread soil degradation, and encroachments of protected areas. Meanwhile, the root problem – the inadequacy between the farm practices (unshaded cocoa systems) and the climatic conditions - is predicted to worsen because of climate change [6].

In this context, sustainable agroforestry practices are deemed to concurrently mitigate the effects of droughts and heat waves while contributing to reduce deforestation [13]. Indeed, it is well established that purposedly designed cocoa-based agroforestry systems significantly reduce young cocoa trees mortality, maintain stable production, and extend adult cocoa trees lifespan [13]. This helps farmers stay on the same patches for at least 60 years, cutting the trend of deforestation while increasing the rate of regeneration of fallow land. But not every agroforestry practices provide such resilience effects, and those that do are poorly known by many stakeholders especially smallholder farmers.

At least, if the smallholder farmers become enough knowledgeable on resilient agroforestry practices while having access to seedlings, they will adopt agroforestry for securing multiple outputs and outcomes. According to several peer-reviewed research papers, sustainable cocoa agroforestry practices mitigate drought effects by improving soil moisture conservation, increasing rainfall infiltration, abating soil desiccation intensity during prolonged droughts, and reducing impacts of heat waves [9]. This means that by applying sustainable agroforestry, farmers will succeed in cocoa farm establishment better than before (positive for rural employment rate), experience less income uncertainty, and be able to stay on the same lands for longer periods - at least 60 years instead of 19-30 years. Additionally, as multi-purpose trees integrated in cocoa agroforestry systems help diversifying income streams, complementary farm outputs will be reaped by farmers on regular bases (mostly women) while contributing to better biodiversity [14]. This will improve farmers' capacities to cope not only with climate uncertainties but also with cocoa bean price volatility. Ultimately, they will be more resilient in a sustainable cocoa landscape.

Thus, it can be anticipated that if farmers are properly trained, and provided with proper seedling supports, they will adopt sustainable agroforestry practices and secure the following adaptation (co-)benefits: improved survival rate of cocoa saplings at farm establishment (or increased efficiency in cocoa farm establishment), improved rural employment, extended farm productivity, complementary farm outputs, improved biodiversity, reduced land use change and improved carbon sequestration. These benefits will improve the cocoa landscape sustainability and ultimately farmers' resilience.

From this theory of change, the following result chain is drawn with the objective of improving smallholder cocoa farmers' resilience in the context of the regions of Vavoua and Soubre (Côte d'Ivoire).

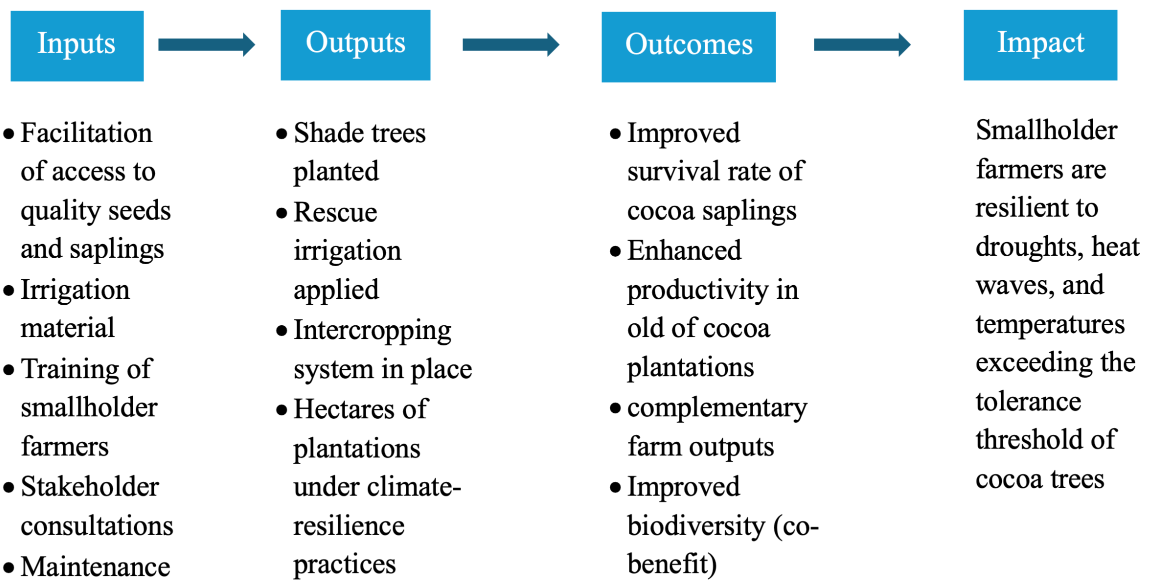

Fig. 1: Result chain

2.2.2. Adaptation benefits

Based on the above results chain and the applied methodology, the measured adaptation benefits of this project are Certified Adaptation Benefits (CABs), determined under two different time-bound options. The first option considers cocoa trees at three years of age. In this case, one

Adaptation Benefit (AB) corresponds to one hectare of cocoa plantation under sustainable and climate-resilient practices. Under the second options, cocoa trees are age is in the range 7-10 years old and one AB equals to the set of benefits from one hectare of cocoa plantation under sustainable and climate-resilient practices, expressed as improved survival rate of cocoa saplings at farm establishment (USD/ha), enhanced productivity of cocoa farming (kg of cocoa beans/ha), and complementary farm output (USD/ha)

2.3. Demonstration that the activity is new and not business as usual.

Step 1 – NDC Check: Cocoa agroforestry practices are not explicitly included in the unconditional components of Côte d'Ivoire's NDC [8]. While the NDC identifies forestry and agriculture as priority sectors and promotes general measures such as sustainable agriculture, afforestation, and reforestation, it does not specifically refer to cocoa agroforestry systems or define targets and financing mechanisms for their implementation. Accordingly, the proposed activity is consistent with the NDC's overall objectives but represents a more targeted and operational contribution to achieving its adaptation goals in its agricultural sector.

Step 2 – Laws and Regulations Check: There are **no widely enforced laws or regulations** mandating cocoa agroforestry implementation in Côte d'Ivoire. Although policies encourage tree planting or sustainable agriculture, compliance is voluntary and enforcement on the ground is very limited, particularly in rural cocoa-growing regions. Surveys conducted by the project promoter [10] confirm that farmers are not legally required to adopt agroforestry practices.

Step 3 – Common Practice Check: Although tree distribution campaigns have been conducted previously in Côte d'Ivoire, they are **not yet common practice** in the target regions. Existing initiatives show **very low survival rates of distributed cocoa seedlings (<2%)** [16] and surviving shade trees are frequently cut down during farm management due to poor agroforestry techniques among sharecroppers and other farm workers [16]. Field assessments indicate that only a small fraction of cocoa farmers consistently maintain agroforestry systems [17], demonstrating that the practice is **not widespread** in the target area.

Step 4 – Barriers Demonstration:

- **Step 4.a – Investment Barrier:** Cocoa agroforestry involves substantial upfront investment in seedlings, labor, and training. While the profitability of a Sustainable Climate-Resilient plantation analysis shows good financial performance over a 10-year horizon (NPV = USD 11,214.92; IRR = 37.64% exceeding WACC of 7%), cash flows become positive only from Year 5, and the initial investment is fully recovered only by Year 9 and 2 months (Spreadsheet of Appendix 3). This delayed payback period means that, despite medium-term viability, smallholder farmers face high short-term financial risks that they are often unable or unwilling to bear without external support. No government or private entity has committed full funding to cover these costs over the next five years, making ABM support critical to trigger adoption at scale.
- **Step 4.b – Technology or Practice Barrier:** The activity faces **technical barriers.** Farmers and farm-level workers lack the knowledge and skills required to successfully implement the proposed agroforestry package of this project. Seedling survival rates remain extremely low due to poor planting and maintenance practices [16]. Although *rescue irrigation* was successfully tested and yielded highly satisfactory results according to cocoa stakeholders, its wider replication requires large-scale

training on tube preparation and installation. Overcoming these technical barriers requires **trainings and access to suitable germplasm**, which are not currently available at scale.

- **Step 4.c – Access to Finance Barrier:** Although long-term financial projections indicate profitability, smallholder farmers face limited access to capital due to real or perceived investment risks, including the delayed recovery of initial costs and uncertainties from climate variability or crop yield fluctuations. Sensitivity analysis confirms that even under pessimistic scenarios (IRR = 31.32–33.12%), returns remain positive, but short-term cash flow deficits persist in the early years. ABM support is therefore required to overcome this access-to-finance barrier and de-risk the investment.

In light of these constraints, and considering that no government or private investor has committed to fully funding these activities within the next five years, the proposed activity would not be implemented without ABM support. De-risking the project is therefore indispensable to attract co-financing and to enable the large-scale implementation of climate-resilient agroforestry in Vavoua and Soubré.

2.4. Baseline methodology

2.4.1. ABM activity boundary

- Technological boundary

Among the 8 steps of the cocoa value chain, this project applies only to the production stage, the cocoa trees growing (Fig 2). This stage constitutes the foundation of the entire cocoa value chain, as all subsequent stages (harvesting, processing, trading, manufacturing, and distribution) depend on a resilient and sustainable supply of cocoa beans.

Given this reality, all stakeholders—including farmers, cooperatives, research institutions, processors, exporters, and the chocolate industry—are directly dependent on the sustainability of cocoa production systems. Therefore, ensuring sustainable cocoa production is not solely the responsibility of producers but a shared need across the entire value chain. Strengthening this stage through sustainable and resilient practices is essential to securing both the livelihoods of smallholder farmers and the resilience of downstream actors who rely on a stable and traceable cocoa supply.

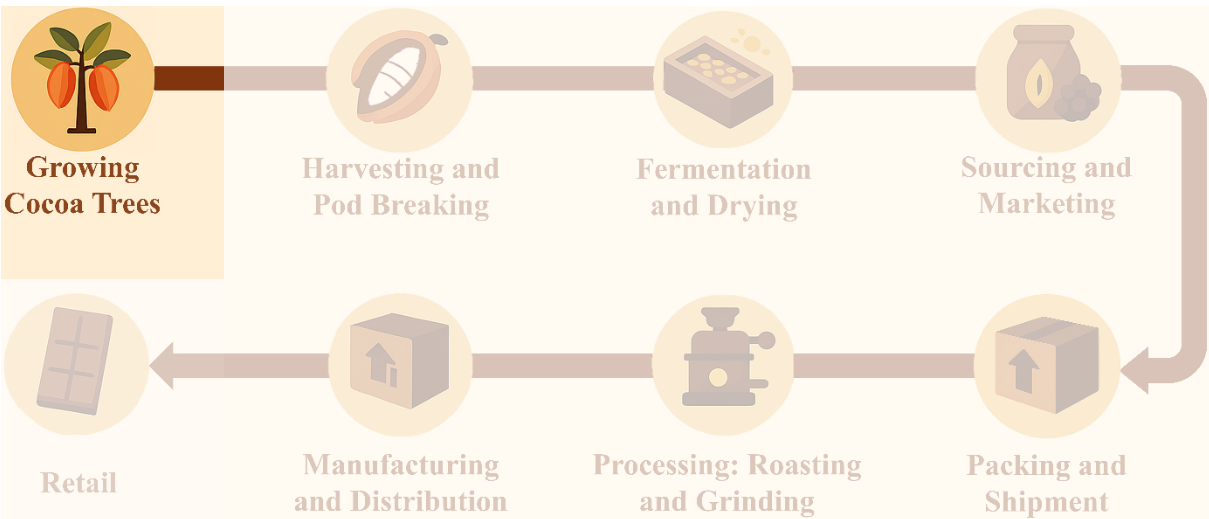

Fig. 2: Technological boundary of the project activity

- Geographic boundary

The geographic boundary includes two specific cocoa-growing regions in Côte d'Ivoire (Fig. 2), Soubre in the South-West and Vavoua in the Central-West. Both areas are in the same longitude range (6.2° W and 6.8° W) but different longitudes. Vavoua is between latitude 7.0° N and 8.0° N and Soubré between 5.7° N and 6.2° N.

Vavoua annual precipitation is in the range 1100-1350 mm with maximum temperature of 36°C in dry season. Vavoua is in marginal cocoa production. Precipitation in Soubre is between 1250 mm and 1500 mm with maximum temperature of 35°C. Most of the inhabitants are smallholder cocoa producers: 93% in Soubre, from a population of approximately 1.01 million inhabitants and 95% in Vavoua, from a population of approximately 422,000 [17].

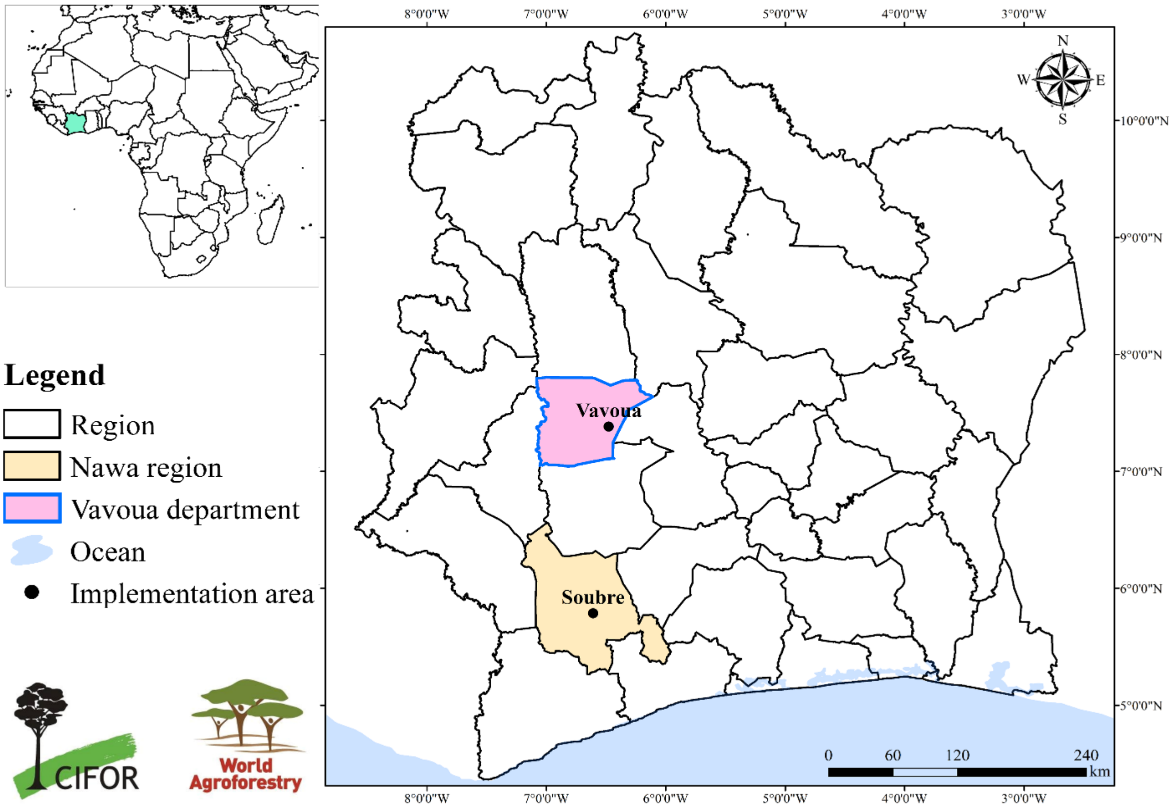

Fig. 1: Project implementation area

The impact of climate change on cocoa producing areas in Côte d'Ivoire is not homogenous including in the current project area. Agroclimatic zoning is thus required for differentiating homogeneous agroclimatic areas based on recent climate change impact study. According to the impact assessments (Fig. 3) Vavoua and Soubré experience different levels of climate change impact (Fig. 3). Vavoua is expected to register annual cocoa income losses reaching 60-100% and Soubre areas are predicted to register 30-50% income losses [18]. Given this difference, the baseline and monitoring methodology will be applied separately in each climatic zone. In other words, each zone will have its own baseline and monitoring data.

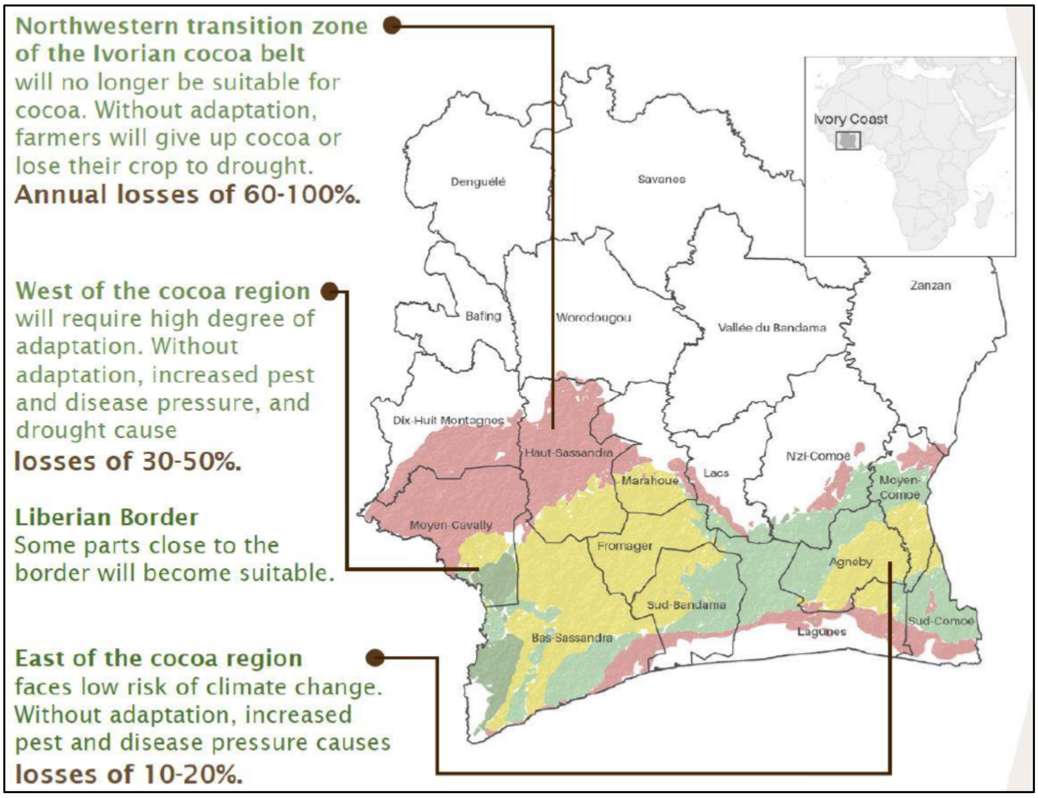

Fig. 2: Agroclimatic zoning based on climate change impact (Bunn et al., 2020)

2.4.1. Definition of the adaptation baseline scenario

Drawing on ICRAF's experience in the cocoa sector, farmers in the project area require trainings and access to suitable planting materials to adopt sustainable agroforestry practices. Without these requirements, cocoa production systems in Soubre and Vavoua would mainly consist of cocoa farms without sustainable and climate-resilient practices including in full sun monoculture or under very limited shade (up to 13% shade) [20].

Under this business-as-usual scenario, the production landscapes are increasingly degraded. The near absence of shade trees further exposes cocoa trees to extreme microclimatic fluctuations, such as excessive heat and moisture loss [21]. As a result, young cocoa plants experience very low survival rates, while mature trees suffer from shortened lifespans and increased vulnerability to drought [6]. These environmental stressors not only reduce productivity but also drive land-use expansion into forest areas, as farmers seek to compensate for declining yields [22]. This contributes to ongoing deforestation, loss of biodiversity, and increased carbon footprint, making the cocoa production system environmentally unsustainable [23].

At the socioeconomic level, the predominance of low-yielding and climate-vulnerable cocoa systems translates into low and unstable farmer incomes [11]. Smallholders remain heavily dependent on cocoa as their sole income source, leaving them highly exposed to both climate variability and international market fluctuations [24]. Limited access to financial services, technical support, and improved inputs further constrains their ability to adapt or invest in sustainable practices [25].

The situation also exacerbates rural poverty and gender inequalities, as women, though actively engaged in cocoa-related activities, often lack equal access to land, credit, and training opportunities [26]. The resulting economic insecurity discourages youth participation in cocoa farming and fosters a cycle of vulnerability, land degradation, and livelihood instability [27].

Overall, the baseline scenario reflects a climate-fragile and economically precarious cocoa production system. Environmental degradation and socioeconomic vulnerability are mutually reinforcing, undermining the resilience of both farming households and the wider cocoa value chain. Without targeted adaptation interventions to promote sustainable agroforestry, soil restoration, and diversified livelihoods, the sustainability of cocoa production in the project area will remain at serious risk.

2.4.2. Adaptation baseline

Adaptation baseline under option 1:

In baseline conditions, farmers aren't trained and not provided with suitable planting and irrigation materials. This results in zero hectares of cocoa plantation under sustainable and climate-resilient practices.

$$SCR_{BL} = 0\ ha \quad (1)$$

Where:

SCR_{BL} = Baseline area of cocoa plantations under sustainable and climate resilient practices

Adaptation baseline under option 2:

The baseline is also determined for "Area of cocoa plantations under sustainable and climate-resilient practices (ha)"; "Productivity of cocoa farming (kg of cocoa beans/ha)" and "Complementary farm output (USD/ha)"

- Baseline of cocoa farm establishment costs

$$SCR_{BL} = 100 * \frac{NS_{BL}}{N_{BL,COCOA,TOT}} \quad (2)$$

Where:

SR_{BL}= Survival rate of young cocoa tree planted under baseline (% of planted saplings);

NS_{BL}= Number of surviving cocoa saplings three years after planting under baseline, saplings/hectare.

$N_{BL,COCOA,TOT}$ = Total number of cocoa seedlings (including replanted saplings) at farm establishment. It depends on the recommended number of cocoa trees, the local climate (drought and heat) and the sensitivity of the cocoa germplasm to these climate risks.

- Baseline for enhanced productivity of cocoa farm

In both project areas, the baseline for enhanced productivity of cocoa farms is zero kilograms per hectare when cocoa trees, planted without protective shade trees, reach ages between 19 and 30 years old. This is what farmers in Soubre and Vavoua are observing as their cocoa plantations were established without protective shade.

$$PROD_{BL(31-60)} = 0\ kg \quad (3)$$

Where:

$PROD_{BL(31-60)}$ = production of cocoa farm aged between 31 and 60 years old under baseline condition (kg)

- Baseline for complementary farm output

In Soubré and Vavoua, the baseline complementary farm output consists solely of a perfectly pure monoculture. The additional earnings generated by species other than cocoa are negligible. Thus, the baseline complementary farm output accounts for cocoa earnings only (USD).

$$\mathrm{CO_{BL,t}(cocoa)} = \mathrm{V_{BL,t}(cocoa)} * \mathrm{P_{BL,t}(cocoa)} \quad (4)$$

For:

$\mathrm{CO_{BL,t}(cocoa)}$ = earnings from cocoa bean under baseline on the period t in USD;

$\mathrm{V_{BL,t}(i)}$ = price of 1 kg of cocoa bean on the period t; expressed in USD/kg;

$\mathrm{P_{BL,t}(i)}$ = production of cocoa (in kg) under baseline on the period t

The baseline of complementary farm output from all plant species is:

$$\mathrm{tCO_{BL,t}} = \mathrm{CO_{BL,t}(cocoa)} \quad (5)$$

Where:

$\mathrm{tCO_{BL,t}}$ = baseline of complementary farm output

2.4.3. Adaptation activity scenario

Option1: Adaptation activity scenario under option 1

The area of cocoa plantation under sustainable and resilient practices is the total cocoa farm area covered by the ABM activity. It will be one of the project outcomes that can be claimed either at the establishment phase of the farm as well as at the adult phase.

One hectare of cocoa plantation under sustainable and climate-resilient practices has AT LEAST the following characteristics: More than 50% of the cocoa farming area has co-planted shading plant species providing 30-50% shade to cocoa trees. AND, in case the farm is aged three years old or younger, more than 50% of cocoa trees are put under rescue irrigation during dry season. Under project activity scenario, the area of cocoa plantations under sustainable and climate resilient practices will increase. Thus:

$$SCR_{PROJ} \neq 0 \quad (6)$$

With SCR_{PROJ}= Area of cocoa plantations under sustainable and climate resilient practices when the project is implemented.

Option2: Adaptation activity scenario under option 2

- Adaptation activity scenario for Improved survival rate of cocoa saplings at farm establishment (% of planted saplings)

When project activity is applied, the survival rate of planted seedlings changes positively. The survival rate will be obtained using the formula below:

$$SR_{PROJ} = 100 * \frac{NS_{PROJ}}{N_{PROJ,COCOA,TOT}} \qquad (7)$$

Where:

For:

SR_{PROJ} = Survival rate of young cocoa tree planted under project activity (% of planted saplings);

NS_{PROJ}= Number of surviving cocoa saplings three years after planting under project activity

$N_{PROJ,COCOA,TOT}$ = Number of cocoa saplings replanting despite the application of sustainable and climate-resilient practices.

- Adaptation activity scenario for enhanced productivity of cocoa farm (kg of cocoa beans/ha)

The promoted agroforestry systems include companion trees with height and density sufficient to provide 30-50% shade to mature cocoa trees. The lifespan of cocoa trees will be prolonged, allowing for the continuous production of cocoa beans on the same land for at least 60 years, as opposed to the 20-30 years typical of full sun monoculture [15,19,20]. Hence the cocoa farm production beyond 30 years of age is determined through the application of the following formula:

$$PROD_{PROJ(31-60)} = \sum_{t=31}^{60} PROD_{PROJ,t} \qquad (8)$$

Where:

$PROD_{PROJ,t}$ = annual cocoa productions under sustainable agroforestry practices at ages t between 31 and 60 years old.

- Adaptation activity scenario for complementary farm output (kg/ha)

The agroforestry package promoted allows for the cocoa farm to provide diversified farm outputs that mitigate income fluctuations. Each farm output under project activity is determined using the formula below:

$$CO_{PROJ,t}(i) = V_{PROJ,t}(i) * P_{PROJ,t}(i) \quad (9)$$

For:

$CO_{PROJ,t}(i)$: farm output from specific crop i, on the period t, USD/ha;

$V_{PROJ,t}(i)$ economic value of crop i intercropped with cocoa on the period t, USD/kg;

$P_{PROJ,t}(i)$ = production of one crop i under project activity on the period t, Kg/ha. It strongly depends on the specific crop, climate, and the farm management practices; It can be pre-assessed using the tool "Ex-ante assessment of one crop production under sustainable agroforestry".

$$tCO_{PROJ,t} = \sum_{i=1}^{n} CO_t(i) \quad (10)$$

Where:

$tCO_{PROJ,t}$ = Complementary farm output under project activity

2.4.4. Quantification of the Adaptation Benefits of the activity

1.1. Quantification of the Adaptation Benefits of the activity

For zone, the adaptation benefits are calculated per Option and indicator.

1.1.1. Quantification of the Adaptation Benefits for Option 1

Adaptation benefits are calculated as hectares of sustainable managed cocoa plantation after 3 years upon establishment of the farm and application of the sustainable agroforestry package of measures. The number of hectares of sustainably managed cocoa farms due to the project is calculated by subtracting the total area of such farms under the baseline scenario from that under the project activity.

$$SCR = SCR_{PROJ} - SCR_{BL} \quad (11)$$

Where:

SCR_{BL} = Cocoa plantation under sustainable and climate-resilient practices in baseline conditions (in hectare).

SCR_{PROJ}= Cocoa plantation under sustainable and climate-resilient practices in project scenario (in hectare).

SCR= Sustainably Managed Cocoa plantation (in hectare).

Since $SCR_{BL} = 0\ ha$,

We have: $SCR = SCR_{PROJ} - 0$

Giving:

$$SCR = SCR_{PROJ} \quad (12)$$

1.1.2. Quantification of the Adaptation Benefits for Option 2

In each area, adaptation benefits are calculated as the combined benefits per hectare of sustainably managed cocoa plantation after 7-10 years upon establishment of the farm and application of the sustainable agroforestry package of measures. The quantification is separate for each of the three indicators.

Quantification of improved survival rate of cocoa saplings at farm establishment

$$ISR = SR_{PROJ} - SR_{BL} \qquad (13)$$

Where:

ISR = Improved survival rate of cocoa saplings at farm establishment.

SR_{PROJ} = Survival rate of cocoa farms under sustainable agroforestry.

SR_{BL} = Survival rate of cocoa farms under baseline, USD

Quantification of enhanced productivity of cocoa farm (kg of cocoa beans/ha)

$$PROD_{(31-60)} = PROD_{PROJ(31-60)} - PROD_{BL(31-60)} \qquad (14)$$

$PROD_{(31-60)}$ = Gains from enhanced productivity of cocoa farming (kg/ha)

$PROD_{PROJ,t}$ = annual cocoa productions under sustainable agroforestry practices at ages t between 31 and 60 years old.

$PROD_{BL(31-60)}$ = production of cocoa farm aged between 31 and 60 years old under baseline condition (kg)

Quantification of complementary farm output (USD/ha)

$$CO_t = tCO_{PROJ,t} - tCO_{BL,t} \qquad (15)$$

$CO_{PROJ,t}(i)$: complementary output from specific crop i, on the period t, USD/ha;

$CO_{BL,t}(i)$ = complementary output from specific plant species i under baseline on the period t in USD;

2.4.5. Adaptation Benefit issuance period

A sustainable cocoa farm typically operates for about 60 years, after which cocoa trees may need rejuvenation. To accelerate the recovery of investments for ABM project developers and partners, the AB claiming will be based on generating revenue from Certified Adaptation Benefits post-monitoring and reporting. One share of the benefit will be claimed three years after the project activity and the remaining share in the period 7-10 years after the project activity. Stakeholder consultation will be held to agree on the percentage to be paid three years after planting.

2.5. Monitoring Methodology

2.5.1. First monitoring when cocoa trees are 3 years of age.

Monitoring of the AB "Cocoa plantation under sustainable and climate-resilient practices"

The baseline of "Cocoa plantation under sustainable and climate-resilient practices" is zero for both Vavoua and Soubré. The hectare of Cocoa plantation under sustainable cocoa plantation will be assessed three years after the project activity.

2.5.2. Second monitoring, when cocoa trees are beyond 7 years of age.

Monitoring the AB "improved survival rate of cocoa saplings at farm establishment"

Monitoring "**improved survival rate of cocoa saplings at farm establishment**" consists in assessing $N_{BL,\ COCOA,\ TOT}$; $N_{PROJ,\ COCOA,\ TOT}$; NS_{BL} *and* NS_{PROJ}

- Monitoring of the parameter $N_{BL,\ COCOA,\ TOT}$

$N_{BL,\ COCOA,\ TOT}$ refers to the total number of cocoa saplings planted per hectare under the baseline scenario, evaluated separately for the agro-climatic zones of Vavoua and Soubré. It will include the initial planting at establishment and the replanting of dead saplings. Each replanting will be recorded right after the first and second dry seasons.

This parameter will reflect the cumulative planting effort required to establish and maintain, during first three-years, a standard cocoa plantation under local baseline practices. It will serve as the reference point for comparing sapling survival and replanting needs under project activities.

$N_{BL,\ COCOA,\ TOT}$ will be determined as follows:

- At least four test plots of 0.5 ha will be established in each homogeneous agro-climatic zone.
- Local baseline cocoa planting practices will be applied, respecting the recommended spacing of 3 m × 2.5 m.
- Dead saplings will be identified at the end of the first and second dry seasons (March–April).
- Losses will be replaced through replanting, and the number of replanted saplings will be recorded for each plot.
- The total number of saplings planted per hectare will be calculated as the sum of the initial planting and all replanting after the first and second dry seasons.

The monitoring approach described is to comply with that recommended by the applied methodology (Table 2).

Table 2: Monitoring of the parameter $N_{BL,COCOA,TOT}$

Data / Parameter:	$N_{BL,COCOA,TOT}$
Data unit:	*Unit of planted cocoa saplings per hectare*
Description:	*Assessment of the baseline number of cocoa saplings planted per hectare in new cocoa farms within each homogeneous agro-climatic zone, including both the initial planting and any replanting carried out after the first and second dry seasons.*
Source of data:	*Field tests in each homogeneous agroclimatic zone: A conservative assessment of baseline number of cocoa saplings planted per hectare in each agro-climatic zone.* *Conservative value for the costs can be derived from:* - *agronomy research database.* - *Plant growth model.* - *specialized tool in the appendix*
Measurement procedures (if any):	*Procedures for field tests:* • *Establish at least 4 plots in each homogeneous agro-climatic zone (e.g., 0.5–1 ha per plot).* • *Apply the local baseline cocoa planting practices with recommended spacing (3 m × 2.5 m)* • *At the end of the first and second dry seasons (March–April), identify dead sapling* • *replant to replace losses and record the number of replanted seedlings for each plot.* • *Calculate the total number of seedlings planted per hectare as the sum of the initial planting and all replanting after the first and second dry seasons.* *In case there are too many agroclimatic zones, application of the tool "Assessment of the number of cocoa trees (re)planted at cocoa farms establishment under baseline" may be considered to reduce monitoring cost.*
Monitoring frequency:	*3 years*
QA/QC procedures:	
Any comment:	*Conservative value can be used following local context*

- Monitoring of the parameter NS_{BL}

NS_{BL} is the number of cocoa saplings that survive three years after planting under the baseline scenario, evaluated separately for the agro-climatic zones of Vavoua and Soubré. It includes the cocoa saplings, for each 05-hectare test plots, that remain alive after the first three dry seasons. Each surviving sapling will be recorded at the end of the third dry season. From the above test plots established under local farmers' practices, the monitoring of NS_{BL} will be done by counting and recording the number of surviving cocoa saplings in each plot.

Table 3: Monitoring of the parameter NS_{BL}

Data / Parameter:	NS_{BL}
Data unit:	*saplings*
Description:	*Number of surviving cocoa saplings three years after planting under baseline scenario. This number depends on the cocoa variety and local climate conditions. It is expressed in number of surviving saplings per hectare*
Source of data:	*Field test in each homogeneous agroclimatic zone: A conservative assessment of surviving saplings from field test plots established in each agro-climatic zone.* *If necessary other sources may be used such as:* - *agronomy research database.* - *Plant growth model.* -
Measurement procedures (if any):	*Field Test in Each Homogeneous Agro-Climatic Zone* 1. *Plot Establishment* o *Establish four test plots of 0.5-1 hectare each in every homogeneous agro-climatic zone.* o *Apply local baseline cocoa plantation practices in each plot.* o *Ensure that cocoa trees are planted according to the recommended spacing of 3 m × 2.5 m.* 2. *Monitoring During Initial Dry Seasons* o *At the end of the first and second dry seasons (March–April), record the number of cocoa saplings that died.* o *Replant all dead saplings in the optimum period after counting.* 3. *Survival Assessment* o *At the end of the third dry season (March–April), count and record the number of surviving cocoa saplingsin each plot.*
Monitoring frequency:	*During the initial three years of the farm establishment*
QA/QC procedures:	- *Ensure homogeneity of climate in the agroclimatic zone*

	- *Follow standardized protocol including the same planting schedule and the same practices as BAU* - *Ensure that every planting and replanting event is accurately documented, verifiable, and traceable* - *Check and prevent double counting of surviving saplings at the end of the third year*
Any comment:	

- Monitoring of the parameter $N_{PROJ,COCOA,TOT}$

$N_{PROJ,COCOA,TOT}$ accounts for the total number of cocoa saplings planted per hectare under the project activity scenario (unit of planted cocoa saplings/hectare). Each agroclimatic zone has its separate $N_{PROJ,COCOA,TOT}$. This includes both number of planted saplings after the initial planting operation and all those after the replanting of dead saplings. They are recorded after the first and second dry seasons. This will reflect the planting effort required to establish and maintain cocoa farms when project-supported adaptation measures are applied. The measurement will be done as per the dedicated monitoring approach described in the table 3.

$N_{PROJ,COCOA,TOT}$ will be determined as follows:

- A representative sample of farms under project activity will be selected (depending on the number of beneficiaries), using random sampling in both Vavoua and Soubre.
- The project's adaptation measures applied by farmers will be documented.
- The number of seedlings initially planted per plot will be recorded, along with the planting date and seedling source.
- The number and date of replanted seedlings will be recorded. GPS coordinates and photos of replanting will be collected to support verification.
- The total number of seedlings planted per hectare will be calculated as the sum of the initial planting and the replanting carried out after the first and second dry seasons.

Table 4: Monitoring of the parameter $N_{PROJ, COCOA, TOT}$

Data / Parameter:	$N_{PROJ, COCOA, TOT}$
Data unit:	*Unit of planted cocoa saplings per hectare*
Description:	*Assessment of the total number of cocoa saplings (re)planted at farm establishment under project activity*
Source of data:	*Field sampling using a statistically robust protocol*
Measurement procedures (if any):	*Sampling is conducted annually for each agroclimatic zone. Within the same zone, the result is the cumulative count of cocoa sapling plantings or replantings.* • *Select a representative sample of farms (depending on the number of beneficiaries) where farmers applied the adaptation measures - using random or stratified sampling in each agro-climatic zone* • *Document the adaptation measures applied by the farmer* • *Record the number of seedlings planted initially per plot by the farmer, along with the planting date and seedling source.* • *Record the number and date of replanted seedlings* • *Calculate the total number of seedlings planted per hectare as the sum of the initial planting and the replanting carried out after the first and second dry seasons.*
Monitoring frequency:	*At the end of each dry season, during the initial 3 years of cocoa farm establishment.*
QA/QC procedures:	- *Use standardized forms or mobile apps for farmer reports or enumerator verification.* - *Supervisors randomly verify 5–10% of farms by visiting plots to confirm planting counts and adaptation measures applied.* - *Use GPS and photos for verification.*
Any comment:	

- Monitoring of the parameter NS_{PROJ}

During the same field survey conducted for $N_{PROJ,COCOA,TOT}$, an evaluation will be done for NS_{PROJ} . This parameter will represent the number of cocoa saplings that survive three years after planting on farms where project-supported adaptation measures have been applied. The surviving saplings on each selected farm will be counted and recorded to assess sapling survival under project activities. In each agro-climatic zone, the assessment will follow the same schedule used for $N_{PROJ,COCOA,TOT}$. It will comply with the content of table 5.

Table 5: Monitoring of the parameter NS_{PROJ}

Data / Parameter:	NS_{PROJ}
Data unit:	*saplings*
Description:	*Number of surviving cocoa saplings three years after planting under activity scenario. It is expressed in number of surviving saplings per hectare*
Source of data:	Field data collection from farmers' fields
Measurement procedures (if any):	Survey: - recommend and document the same project activity in the fields for each agroclimatic zone - Define the population: e.g. all farmers participating in the project - Select a representative sample of farmers based on the number of beneficiaries - conduct surveys at the end of the dry seasons after planting to record survival data per plot or farm in standardized forms (during the first three years after planting).
Monitoring frequency:	During the initial three years of the farm establishment
QA/QC procedures:	*Survey must be done following a standardized protocol* *Follow the same schedule as baseline*
Any comment:	

Monitoring the AB "Enhanced productivity of cocoa farming"

Monitoring "Enhanced productivity of cocoa farming" involves the assessment of both $PROD_{BL(31\text{-}60)}$ and $PROD_{PROJ,t}$

Where:

$PROD_{BL(31-60)}$ = production of cocoa farm aged between 31 and 60 years old under baseline condition (kg)

$PROD_{PROJ,t}$ = annual cocoa productions under sustainable agroforestry practices at ages t between 31 and 60 years old.

- Monitoring of the parameter $PROD_{BL(31\text{-}60)}$

The monitoring of $PROD_{BL(31\text{-}60)}$ is done by primarily assess the shade cover of the farms in absence of project activity. As current shade cover in both areas is close to the full sun monoculture with less than 13% [21], $PROD_{BL(31\text{-}60)}$ is zero kg/ha.

- Monitoring of the parameter $PROD_{PROJ,t}$

As per table 5, an ex-ante assessment will be used for $PROD_{PROJ,t}$, the annual cocoa production under sustainable agroforestry practices at ages between 31 and 60 years old. For each agroclimatic zone the cocoa tree density is identical. A record will be created for all companion tree species, heights and crown diameter of adult stage, lifespans, and planting densities. Based on this information an estimate of the future shade cover based will be calculated. The result of the shade will be used to verify that the shade will be in the range of the optimum 30-50%. Upon the verification that shade cover is well in the range 30-50% range, the value of $PROD_{PROJ,t}$ will be set equal to the minimum yield of aged cocoa farms under agroforestry. As this minimum yield of aged cocoa farms is site specific, it will be assessed through the tool " Ex-ante assessment of cocoa production under sustainable agroforestry measure at ages after 30 years old".

Table 6: Monitoring of the parameter $PROD_{PROJ,t}$

Data / Parameter:	$PROD_{PROJ,t}$;
Data unit:	*kg/ha*
Description:	*Annual cocoa production under sustainable agroforestry practices at ages t between 31 and 60 years old.*
Source of data:	- *Estimation of the minimum value based on the shade cover of the established agroforestry system.*
Measurement procedures (if any):	*The measurement is an ex-ante assessment. It is done in three main steps* - *Record cocoa tree density.* - *Note the name of companion tree species, heights and crown diameter of adult stage, lifespans, and planting densities.* - *estimate the future shade cover based on actual tree density and species* - *verify that the shade will be in the range of the optimum 30-50%* *Set PROD PROJ,t equal to the minimum yield of aged cocoa farms under agroforestry. This minimum yield of aged cocoa farms may be estimated through literature or through the tool " Ex-ante assessment of cocoa production under sustainable agroforestry measure at ages after 30 years old"* -
Monitoring frequency:	*7-10 years (pre-assessment)*
QA/QC procedures:	
Any comment:	*In case of actual measurement (not an ex-ante assessment), GIS and AI tools may be used to reduce monitoring cost in large project areas*

Monitoring of the AB "Complementary farm output"

Monitoring "Complementary farm output" consist in assessing $P_{BL,t}$; $P_{PROJ,t}$; $V_{BL,t}$; and $V_{PROJ,t}$

Where:

$P_{BL,t}(i)$ = production of plant i (in kg) under baseline on the period t.

$P_{PROJ,t}(i)$ = production of one crop i under project activity on the period t, Kg/ha.

$V_{BL,t}(i)$ = economic value of plant i on the period t; expressed in USD/kg;

$V_{PROJ,t}(i)$ economic value of crop i intercropped with cocoa on the period t, USD/kg;

- Assessment of $P_{BL,\ t}$

The monitoring of Baseline production of each plant species of the farm will be done as per Table 7.

Table 7: monitoring of baseline production of each plant species of the farm ($P_{BL,\ t}$)

Data / Parameter:	$P_{BL,\ t}$
Data unit:	*kg/ha*
Description:	*Baseline production of each plant species of the farm*
Source of data:	*Data sources include field measurements, peer-reviewed agronomic datasets, national statistics, and model inputs (climate, soil, crop parameters) from recognized database.*
Measurement procedures (if any):	*1- Identify of species that are associated to cocoa by default in baseline, If baseline is pure monoculture, then* $P_{BL,\ t}$ *= 0 kg/ha* *2- In case baseline isn't pure monoculture, select representative farms across the project area using stratified random sampling* *3- collect farmer-reported yields (last 3–5 years) for each non-cocoa species and triangulate with agricultural statistics* *4- Establish the conservative baseline yield as the mean of observed yields for each species.*
Monitoring frequency:	*7-10 years*
QA/QC procedures:	*- Define a clear rule for what qualifies as an "associated crop" and apply it consistently across all farms* *- Ensure sample size provides at least 95% confidence level with acceptable margin of error*
Any comment:	*It depends on the specific plant, local climate, soil and the farm management practice*

Table 8: Monitoring $P_{PROJ, t}$

Data / Parameter:	$P_{PROJ, t}$
Data unit:	*kg/ha*
Description:	*Production of each non-cocoa crop of the farm under project activity on the period t*
Source of data:	*Field survey, Agronomy research database, and estimation using the tool "Ex-ante assessment of one crop production under sustainable agroforestry"*

Measurement procedures (if any):	*Conservative value should be utilized, including long-term average production per hectare*
	
	Field survey:
	- *Record any plant species introduced by the project in the cocoa farms that provide complementary farm output*
	- *Select representative farms using stratified random sampling by farm size, agroecological zone, and management type.*
	- *collect farmer-reported yields (last 3–5 years) and triangulate with agricultural statistics*
	- *Establish the current conservative value of* $P_{PROJ, t}$ *as the mean of observed yields for each crop.*
	- *Estimate future Yields:*
	    o *Option 1: Apply an agronomic or crop growth modeling tool to project yields over time under the project interventions.*
	    o *Option 2 (if modeling is not feasible): Use the minimum observed yield over past years as a conservative estimate of future yield.*

Monitoring frequency:	*Yearly, during the period 7 to 10 years after planting.* *Conservative estimate is used for the period beyond 10 years after planting*
QA/QC procedures:	*Define a clear rule for what qualifies as an "associated crop" and apply it consistently across all farms* *Ensure sample size provides at least 95% confidence level*
Any comment:	*It strongly depends on the specific crop, weather, and the farm management practices*

Table 9: Monitoring $V_{BL, t}$

Data / Parameter:	$V_{BL, t}$
Data unit:	*USD/kg*
Description:	*Market price of each crop of the farm under baseline on the period t*
Source of data:	*Market price records / Surveys*
Measurement procedures (if any):	- *Identify all non-cocoa crops in the basline (If any)* - *Collect seasonal averages of price per crop* - *or use official agricultural statistics*
Monitoring frequency:	*Yearly*
QA/QC procedures:	*Ensure that statistics come from recognized, reliable institutions (government agencies, FAO, research centers).*
Any comment:	

Table 10: Monitoring $V_{PROJ, t}$

Data / Parameter:	$V_{PROJ, t}$
Data unit:	*USD/kg*
Description:	*Market price of each crop of the farm under project activity on the period t*
Source of data:	*Market prices / Agricultural Surveys*
Measurement procedures (if any):	- *Identify all non-cocoa crops (e.g., plantain, cassava, maize, fruit trees, timber, etc.).* - *Collect seasonal averages of price per crop* - *or use official agricultural statistics*
Monitoring frequency:	*Yearly*
QA/QC procedures:	*Document price sources for transparency.*
Any comment:	

2.6. Contributions to SDGs and other public/private sectors Goals

ABs contributions to SDGs will be reported (Table 11). The links between the ABs and the SDGs are drawn from the Global Indicator Framework for the Sustainable Development Goals and Targets of the 2030 Agenda for Sustainable Development. As the World Cocoa Foundaation (WCF) and NDCs has targets for the sustainability of the cocoa sector, their links with the ABs have also considered.

The contributions of the Adaptation Benefits (ABs) to the Sustainable Development Goals (SDGs) will be reported in Table 10. The links between the ABs and the SDGs will be established based on the Global Indicator Framework for the SDGs and Targets of the 2030 Agenda for Sustainable Development. In addition, the goals of the World Cocoa Foundation (WCF) and the targets of Côte d'Ivoire's Nationally Determined Contributions (NDCs) for the sustainability of the cocoa sector will also be considered in mapping the ABs.

The contributions of the Adaptation Benefits (ABs) to the Sustainable Development Goals (SDGs) will be presented in Table 10. The mapping of ABs to SDGs will draw on the Global Indicator Framework for the SDGs and Targets of the 2030 Agenda for Sustainable Development. In addition, alignment with the sustainability objectives of the World Cocoa Foundation (WCF) and the targets of Côte d'Ivoire's Nationally Determined Contributions (NDCs) will be taken into account.

Table 11: Contribution to SDGs, World Cocoa Foundation Goals, and Country NDCs

Adaptation Benefits	**SDG**	**WCF Goals**	**TARGETS OF CÔTE D'IVOIRE NDCs**
Reduced cost farm establishment	SDG 1, SDG 2, and 1 SDG 3	WCF Goals 1: Prosperous cocoa farmers	Improved crop productivity
Enhanced productivity of cocoa farming			
Complementary farm outputs	SDG 13	WCF Goals 1: Prosperous cocoa farmers	Improved crop productivity & food security

3. Risk management.

The following risks in Table 12 are to be considered in Vavoua and Soubre.

Table 12: Risks, impact, and mitigation measures

Activity Component	Risk	Risk Category	Likelihood	Impact on Benefits	Overall Risk Level	Mitigation Measures
Farmers training on agroforestry and rescue irrigation	The training may be too technical or too short for participants to fully grasp key practices	Educational	Medium	High	High	Deliver training through integrated theoretical lessons and on-farm practical exercises. Use local language and visual aids.
	Women farmers may be underrepresented due to cultural or time constraints.	Gender	Medium	Medium	Medium	Apply gender-sensitive selection criteria; schedule sessions compatible with women's availability; ensure female facilitators are involved.
	Delays in organizing trainings before the rainy season can limit farmers' ability to plan and implement field operations on time.	Operational	Medium	High	Medium	Plan and confirm training logistics well in advance of the rainy season. Maintain a buffer in scheduling
Planting material dissemination	Delays in delivery planting material	Operational	Medium	Medium	Medium	Plan timely procurement and distribution

Activity Component	Risk	Risk Category	Likelihood	Impact on Benefits	Overall Risk Level	Mitigation Measures
Post-establishment farm maintenance	Field fire during dry season destroying plantations under sustainable and resilient practices	Environmental	Medium	High	High	Train farmers on fire prevention and control; establish firebreaks around farm sites;
	Farm destruction by CSSV (Cacao Swollen Shoot Virus) outbreak	Biological	Medium	High	High	Incorporate CSSV prevention and early detection measures into the training sessions.
	Illegal logging in surrounding areas reducing seed source and landscape integrity	Environmental	Medium	Medium	Medium	Collaborate with forestry authorities and local committees to monitor forest activities; raise awareness on sustainable resource use.

The risks should be monitored as per Table 13 below

Table 13: Environmental and Social Monitoring Plan

Activity Component	**Risk**	**Mitigation Measures**	**Monitoring Indicators / Means of Verification**	**Frequency**	**Responsible Party**	**Estimated Cost (USD)**	**Documentation & Residual Risk Handling**
Farmers training on agroforestry and rescue irrigation	Training may be too technical or too short for participants to fully grasp key practices	Deliver training through integrated theoretical lessons and on-farm practical exercises; use local language and visual aids.	% of farmers correctly applying techniques; field reports, photos, participant feedback	After each training	CIFOR-ICRAF training team; ANADER	No additional budget required as this is drawn from ordinary training and M&E reports	Attendance and feedback forms archived; summary in quarterly reports.
	Women farmers may be underrepresented due to cultural or time constraints	Apply gender-sensitive selection criteria; schedule sessions compatible with women's availability; involve female facilitators.	% of women among trainees; attendance lists disaggregated by sex	Each training session	CIFOR-ICRAF Gender focal point; cooperatives	No specific budget required as it is drawn from training reports	Gender data tracked in M&E dashboard; actions discussed at review meetings.

Activity Component	Risk	Mitigation Measures	Monitoring Indicators / Means of Verification	Frequency	Responsible Party	Estimated Cost (USD)	Documentation & Residual Risk Handling
	Delays in organizing trainings before the rainy season	Plan logistics in advance; maintain a scheduling buffer.	Training calendar validated; mission reports	Annually (pre-rainy season)	CIFOR-ICRAF coordination team	No specific budget required	Schedule compliance monitored; issues discussed quarterly.
Planting material dissemination	Delays in delivery of planting material	Plan timely procurement and distribution.	% of materials delivered before planting season; delivery reports	Annually	CIFOR-ICRAF procurement officer; cooperatives	No specific budget required	Procurement delays documented; lessons integrated in next cycle.
Post-establishment farm maintenance	Field fire during dry season destroying plantations	Train farmers on fire prevention; establish firebreaks.	Number of farms with firebreaks; # of fire incidents	Annually (dry season)	CIFOR-ICRAF technicians; cooperatives	No specific budget will be needed as the module will be included in the initial farmers' training sessions	Incidents recorded in logbooks; summary shared with safeguard officer.
Post-establishment farm maintenance	Farm destruction by CSSV (Cacao Swollen Shoot Virus)	Integrate CSSV prevention and detection into trainings.	% of farms inspected for CSSV; inspection forms	Bi-annually	ANADER; cooperatives	1,500 per agroclimatic zone	Cases and responses documented; shared with ABM-EC and stakeholders

Activity Component	Risk	Mitigation Measures	Monitoring Indicators / Means of Verification	Frequency	Responsible Party	Estimated Cost (USD)	Documentation & Residual Risk Handling
Post-establishment farm maintenance	Illegal logging reducing seed sources and landscape integrity	Collaborate with forestry authorities and local committees; raise awareness.	# of awareness sessions; # of reported incidents	annually	CIFOR-ICRAF safeguard focal point; local forestry authorities	1500 per agroclimatic zone	Reports consolidated in safeguard monitoring; unresolved issues escalated.

Based on the monitoring report, all residual risks will be recorded in cooperative and CIFOR-ICRAF logbooks, reviewed quarterly, and summarized in annual safeguard reports. Residual risks that remain after mitigation measures have been implemented and are considered acceptable if they are unlikely to materially affect project's CABs, the environment, or stakeholder well-being. Examples include minor delays in training sessions or limited tree mortality (<5%) that do not compromise overall farm productivity. All residual and emerging risks will be systematically recorded in safeguard monitoring logbooks maintained by cooperatives and CIFOR-ICRAF field teams, including a description of the risk, mitigation measures applied, status, and likelihood of impact. Risks will be reviewed and updated quarterly or annually to reflect evolving project conditions, with CIFOR-ICRAF safeguard focal points responsible for consolidating updates and reporting. Emerging risks identified during field monitoring, stakeholder consultations, or through the grievance redress mechanism will be immediately documented and assessed, and appropriate mitigation measures will be integrated. Any risk that materially affect project's CABs, the environment, or stakeholder well-being will trigger additional mitigation measures and be reported to the project steering committee to ensure timely action.

4. Environmental and social impact

The environmental and social impacts of the activity were analyzed in consistency with the Adaptation Benefits Mechanism (ABM) Environmental and Social Guidelines also considered the standards of the Green Climate Fund (GCF) Environmental and Social Safeguards (document ABM MP/2022/15/14). The assessment process included:

- Activity size classification: Small-scale, requiring less than US$ 1 million in investment (ABM Guidelines, para. 13(a)).
- Screening of potential risks and impacts related to environmental and social aspects.
- Field visits and consultations held in 2021 with key stakeholders in Vavoua and Soubré, including farmer cooperatives, local authorities (sub-prefectures and ANADER), women's associations, youth groups, and the cocoa industry (World Cocoa Foundation, REDD+ Secretariat, and Conseil Café-Cacao).
- Identification of mitigation and monitoring measures for all potential environmental and social risks, consolidated in an Environmental and Social Management Plan (ESMP).
- Disclosure and grievance handling mechanisms to ensure transparency and inclusion during project implementation.

This process confirmed that the activity generates overall positive environmental and social benefits and poses no major risks requiring a large-scale Environmental Impact Assessment (EIA). Details are provided in the document *Annex 1 (Environmental and social safeguards)*

5. Cost of implementation

The cost of implementing sustainable cocoa agroforestry on one hectare land for delivering its expected short-term and long-term adaptation benefits is divided into two components over time:

- The first component covers the initial three years of cocoa farm establishment. It includes expenses related to farmers' capacity building, acquisition of planting materials, field preparation, micro-irrigation system preparation and setting, plantation operations, weeding, harvesting of associated annual crops, and monitoring of AB "Plantations under sustainable and climate-resilient practices" or SCR.
- The second component covers the period from years 4 to 10 after planting. During this time, required expenditures encompass weeding, pest and disease management, soil management, pruning, harvesting of both associated crops and cocoa, and efforts related to monitoring the outcomes proceeding from the SCR.

Each component receives contributions from project funding and beneficiary farmers as well. These components were estimated based on ICRAF field experiences in Soubre and Vavoua (Côte d'Ivoire).

- **Component 1: Cocoa farm aged 0-3 years old.**

The cost of establishing a one-hectare sustainably managed cocoa plantation, aged 0-3 years, totals four thousand one hundred fourteen dollars and eighty cents (USD 4,114.80). The project is expected to contribute USD 2,547, with farmers contributing USD 1,567.80 in kind once this amount is provided. The details are broken down in the table below.

Table 14: Cost of 1-hectare sustainably managed cocoa farm aged 0-3 years old.

Designation	Unit	Quantity	Unit cost (USD)	Cost (USD)	Contribution from the project (USD)	Contribution from the farmer (USD)
Training 1 farmer for 1 ha	Training day	4	108	432	432	0
Companion planting materials acquisition	Sapling / seeds	100	1.5	150	150	0
Cocoa planting materials acquisition	Sapling / seeds	1200	1	1200	0	1200
field preparation	Hectare	1	150	150	0	150
micro-irrigation system preparation and setting	Tubes	1300	1.5	1,950	1,950	0
Plantation operations	Planting instance	1300	0.09	117	0	117
weeding	Labor days	8	4.2	33.6	0	33.6
harvesting of associated annual crops	Labor days	4	4.2	16.8	0	16.8
monitoring “Sustainably Managed Cocoa plantation”	Expertise	1	15	15	15	0
Total amounts (USD)				**4,114.8**	**2,547**	**1,567.8**

- **Component 1: Cocoa farm aged 4-10 years old.**

In the period from 4 to 10 years after the establishment of the sustainably managed cocoa farms, **the minimum cost for farm maintenance and monitoring is estimated at five hundred fourteen dollars and eighty cents (USD 514.80).** The maintenance cost alone is estimated at four hundred ninety-nine dollars and eighty cents (USD 499.80), provided by farmers as an in-kind contribution. The monitoring cost is estimated at fifteen dollars (USD 15), funded by the project.

Table 15: Cost of sustainably managed cocoa farm aged 4-10 years old.

Designation	Unit	Quantity	Unit cost (USD)	Cost (USD)	Contribution from the project (USD)	Contribution from the farmer (USD)
Weeding	Labor days	56	4.2	235.2		235.2
Pruning	Labor days	14	4.2	58.8		58.8
Soil management	Labor days	7	4.2	29.4		29.4
Pests and disease management	Labor days	7	4.2	29.4		29.4
harvesting of associated annual crops	Labor days	28	4.2	117.6		117.6
Cocoa harvesting	Labor days	7	4.2	29.4		29.4
Monitoring of the outcome proceeding from SMC plantation	Expertise	1	15	15	15	0
Total amounts (USD)				**514.8**	**15**	**499.8**

Remark: In the absence of ABM activities, farmers and their stakeholders bear the costs of cocoa sapling provision and farm maintenance. The incremental cost requiring external financing arises from the agroforestry measure, estimated at USD 2,547, which is covered by CAB. Some stakeholders already engaged in cocoa plant material distribution may also purchase CABs; in such cases, their contribution will cover both the cost of the CABs and the cocoa sapling provision, meaning they will provide more than the CABs price (up to **USD 4,114.80 per hectare)**.

1. **Cash Flow and sensitivity analysis**

SCR profitability analysis shows good financial performance over a 10-year horizon (Excel Spreadsheet of Appendix 3), with steady growth in projected cash flows from the fourth year onwards and a NPV of USD 11,214.92. With the effective entry into production of other agroforestry fruit crops, these cash flows will stabilize (around 15 years). This growth will cover the initial investment costs from the ninth year onwards (payback period of 8 years and 2 months), thus ensuring medium-term economic viability.

In table below, IRR for the base scenario (37.64%) exceeds WACC which is calculated at 7% based on the specific characteristics of the project. This level of return is reinforced by an IRR that remains higher than the WACC, even in the most pessimistic scenarios (IRR = 31.324% for a 20% drop in cocoa yields and IRR = 33.119% for a 10% drop in cocoa yields). Furthermore, the results of scenarios clearly reflect the model's sensitivity to the adoption or non-adoption of farming practices, as well as to climatic conditions.

Table 16. Cocoa yield-based sensitivity scenarios

Scenario	**Cocoa yield (kg/ha)**	**Estimated TRI (%)**	**NPV (USD/ha)**	**Comments**
Base (reference)	304	21,669%	11 214,9	Central assumption
Optimistic (+10 %)	334	36,249%	68 389,7	Adoption of best practices and favorable climatic conditions
Pessimistic (–10 %)	273	33,119%	54 346,2	Unfavorable climatic conditions, diseases, or failure to adopt practices
Optimistic + (+20 %)	365	37,636%	75 411,4	Adoption of best practices and favorable climatic conditions
Pessimistic + (–20 %)	243,035	31,324%	47 324,5	Unfavorable climatic conditions, diseases, or failure to adopt practices

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