Restoring Degraded Coffee Landscapes and Scaling up Sustainable Production in South-West Ethiopia

Feasibility study for the development of the business case for scaling up

Hanns R. Neumann Stiftung

UNIQUE forestry and land use

Supported by:

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ACRONYMS

BoA	Bureau of Agriculture
CIP	Coffee Improvement Project
CO_2	Carbon Dioxide
CoC	Chain of custody
CPA	Cooperative Promotion Agency
ECX	Ethiopia Commodity Exchange
ESF	Environmental and Social Framework
ETB	Ethiopian Birr
GAP	good agricultural practices
GBE	green bean equivalent
HRNS	Hanns R. Neumann Stiftung
IRR	Internal Rate of Return
IT	Information technology
MFI	Micro-finance institution
MIS	Management Information System
NPV	Net-present value
OFLP	Oromia Forested Landscape Program
OWFE	Oromia Wildlife and Forest Enterprise
ROI	Return On Investment
SACCO	Savings and Credit Cooperatives
USD	United States Dollar

SUMMARY

The Hanns R. Neumann Stiftung (HRNS) and UNIQUE forestry and land use are jointly implementing the project "Restoring degraded coffee landscapes" in Ethiopia. The goal of the project is to develop and pilot a scalable business model for sustainable coffee production that contributes to Ethiopia's ambitious Bonn Challenge target and helps reducing the continuing pressure on remaining forests.

Ethiopia's Afromontane forests are a hotspot of diversity, and provide a wide range of environmental services. Growing coffee under the shade of forest trees is a very common management system across south-west Ethiopia. While less densely stocked and diverse than primary forest, the semi-forest coffee system provides income to farmers and contributes significantly to biodiversity conservation, carbon storage, and watershed protection. For example, the average above and below ground carbon stocks of semi-forest coffee farms in the project area is estimated at 270 tCO_2/ha. Both, primary forests and the semi-forest coffee system are under pressure. A key driver is the expansion of (coffee) crops into forests and the unsustainable management of shade trees on existing coffee farms.

Well-managed shade trees are beneficial for coffee cultivation. Shade trees increase the resilience of coffee farms against the effects of climate change; protect coffee plants from weather extremes, help to maintain soil fertility and provide additional products. Shade tree management is site-specific, and must take into account the environmental conditions, and existing and suitable tree species. However, the density and composition of shade trees on surveyed coffee farms was found to be very heterogeneous. Shade tree regeneration is needed, i.e. to replace the existing old trees over time. As this seldom takes place, the consequence is a gradual loss of trees (and biomass) and a decline of biodiversity.

This feasibility study explores the potential of scaling up proven best practices and successful pilot measures, by enabling private sector investments into sustainable coffee production. It focusses on Illubabor zone, Oromia Regional State, where the project is currently implemented. Coffee is an important income source for rural households in Illubabor zone, where coffee is cultivated on about 230,000 ha, mostly in the semi-forest coffee system. Traders capture over 80% of export quality coffee turnover in Illubabor. The remaining market share is equally divided between cooperatives and larger coffee growers who market their production individually. The coffee plants are often very old, i.e. well beyond the most productive age, and outbreaks of coffee diseases are common. Few farmers apply good agronomic practices. Owing to these factors, yields are quite low.

Of particular interest for the planned upscaling are:

- The financial viability of small holder coffee farmers with and without the project,
- factors posing barriers to on-farm and in coffee processing investments, which can be addressed by the project,
- the potential impact of the project on biodiversity and carbon storage,
- project investment, business case, and design, and
- project risks and risk mitigation strategies.

The investment project does not target an expansion of coffee production areas. The goal of the project is the sustainable improvement of existing coffee farms aligned to forest landscape restoration and enhancing biodiversity conservation. The project would be implemented in three phases over a period of 15 years.

Financial viability of smallholder coffee farms and financing required

The financial viability of coffee farmers was assessed for three scenarios: the (i) baseline, (ii) rejuvenation (stumping) and (iii) replacement of unproductive coffee plants. In the baseline, yields reduce further from the already low yield of 350 kg green beans (GBE)/ha until leveling out at about 200kg green beans/ha, resulting in minimal income. Rejuvenation / replacement lead to above baseline yield by year three / four, reaching the long-term maximum of 800 /900 kg GBE/ha after six years.

The annual management cost in the baseline is about 150 USD/ha and around 550 USD/ha for the good practice scenarios. The additional investment in rejuvenation/replacement is substantial with 230 and 370 USD/ha respectively.

The economic benefit of the investment was calculated for a one-hectare model farm over 20 years. We assumed gradual rejuvenation or replacement in combination with adoption of good agricultural practices in three stages spread over five years. Coffee prices were assumed stable at the 2019/2020 price level of 25 ETB/kg dry cherry.

As shown in the table below, investing in rejuvenation or replacement is profitable. However, the relatively long time until break even, emphasizes the need for external finance to bridge the income gap.

On-farm investments

Scenario	Investment	Break even	Profit after reaching maturity	Internal Rate of Return over 20 years
Rejuvenation	230 USD/ha	In year 4	455 USD/ha*year	55%
Replacement	370 USD/ha	In year 6	550 USD/ha*year	36%

If reflecting the labor of household members in the cashflow analysis, Internal Rates of Return (IRR) are much lower with 13% and 12% respectively. Nonetheless, this shows that smallholder coffee farms can be profitable with good management and accessing mainstream commodity markets.

The adoption of good agricultural practices is a major cost factor for coffee farmers. The application of GAP after rejuvenation or replacement would result in about 200 to 300 kg GBE/ha higher yields in comparison to not implementing GAP. Lower cost and lower income from yields almost offset each other, especially in the first few years. As a result, farmers may decide not to adopt GAP fully.

The profitability of coffee farms is price sensitive. Farms remain marginally profitable in the baseline and investment scenarios (assuming GAP adoption) with price falling by 20% (about 5 ETB/kg dry cherry (0.12 USD)) against the current price. This emphasizes the need to buffer farmers from sharp price drops.

Loans need to be in the range of 1,300 – 1,550 USD/ha to cover the cost of rejuvenation or replacement and GAP. Loan duration has to be stretched across several years to avoid periods with negative cashflow. In comparison, loans from micro-finance institutions for individuals are available for up to 550 USD, but on an annual basis only.

Risks and risk mitigation approaches

Internal risk factors are the recruitment of coffee farmers and uptake of loans, handing over responsibilities to the local actors, secure data management, and stimulating private sector investment. These risk factors can be addressed in the project design, adjustments for phase 2 and 3, and during implementation.

External risk factors include civil unrest, climate change, and the market environment. Maintaining and improving the resilience of the coffee production system, increasing productivity of coffee farms, and building the capacity of producer organizations will help farmers and producers to face climate change and price fluctuations. Politically motivated unrest may lead to temporary delays of implementation that can be compensated later on.

Project investment, business case, and gaps

To achieve tangible, i.e. measurable results, the project has to implement its activities at large scale but in a well-defined area - Illubabor. Implementation should not be insular (as is the case in many development projects), but rather cover all coffee growing areas in the zone and all stakeholders engaged in coffee production, processing and trade.

The scaling up of sustainable coffee production requires investments by:

- Coffee producers,
- Aggregators (cooperatives, traders, larger coffee farmers working with outgrowers), and
- Processors / traders.

These investments may be partially funded by the investors themselves, but require third party finance as well. Especially impact investors may be interested in the quantification of the environmental benefits of the project. Biodiversity and climate change mitigation and adaptation benefits resulting from avoided degradation / restoration of the shade tree layer can be monitored and quantified. However, monitoring of changes within a forest (versus outright conversion) is complex. It requires a sophisticated approach, including the development of a reference level and combination of different monitoring methods.

Assuming investments in rejuvenation / replacement and GAP on about half of the current coffee area, and related investments in aggregation and additional processing capacity, the total lending volume is estimated to be 44 million USD over a period of 20 years. The vast majority of these loans (90%) would go to coffee farmers. To avoid market distortions, lending would apply standard interest rates but provide credits with longer tenor, especially for on-farm investments. These loans, issued by micro-finance institutions or commercial banks would be financed and/or guaranteed by international lenders.

The loans could be covered by guarantee with a first loss coverage of 25% and 5% guarantee fee. The guarantor would achieve a Return On Investment (ROI) of 59% and IRR of 4%. The micro-finance institutions / bank would achieve an IRR of 10%. In the case of providing loans for on-lending, 22 million USD would enough to finance the investments. Individual loans would be in

the range of 1.8 million USD/year, with a tenor of 10 years. The national lender starts to accumulate profits from loans to farmers after year 15.

The international investor would achieve a ROI of 64% and IRR of 10%. This IRR is relatively low in comparison to commercial investments, highlighting the need to identify an investor that prioritizes development outcomes over profitability.

Additionally to the access to finance component, the project will require a technical assistance facility that provides extension services to farmers, aggregators, and processors; supports the domestic lending institutions in rolling out financing; and implements/coordinates monitoring. Grant finance will be required to finance the technical assistance facility.

The technical assistance facility could be implemented by a consortium of organizations able to: (i) deliver farmer extension services and support the organizational development of aggregators, (ii) coordinate digitization of stakeholders, and develop and implement the management information system, (iii) support financial services providers.

Key government stakeholders at regional and local level would need to be engaged directly e.g. as members of the steering committee. Of particular relevance are the Bureau of Agriculture, the Cooperative Promotion Agency, the Oromia Wildlife and Forest Enterprise and forest departments implementing the Oromia Forest Landscape Program.

Additionally to the provision of extension services (as in the pilot project), the project has to address market and finance constraints:

- Build the capacity of producer organizations and other coffee aggregators to market coffee
- Foster the establishment of long-term linkages between producer organizations and off-takers, both national and international ones
- Support the provision of small-scale commercial loans with a mid-term tenor by providing finance and/or loan guarantees to banks and micro-finance institutions.

To achieve scale, the project should support the organizational development of all producer organizations, traders, and farmers with outgrowers interested in providing stable markets and services to producers.

1 INTRODUCTION

The Hanns R. Neumann Stiftung (HRNS) and UNIQUE forestry and land use are jointly implementing the project "Restoring degraded coffee landscapes" in Ethiopia. The International Climate Initiative of the German Ministry for the Environment, Nature Conservation and Nuclear Safety and the Lavazza Foundation are funding the project.

The goal of the project is to develop, pilot, and disseminate a scalable "sustainable coffee" business model which contributes to reducing deforestation pressure. To that end, the ongoing pilot project provides extension services to 2,000 smallholder coffee farmers, to improve productivity and quality, while conserving the environment. The project supports the organizational development of coffee farmer cooperatives, the marketing of coffee, and is developing a management information system and monitoring application.

This feasibility study builds on the pre-feasibility study from 2019 (UNIQUE).[1] The prefeasibility study confirmed the need and potential for scaling up the pilot project. HRNS and UNIQUE jointly decided to set the focus for the envisioned scaled project on sustainably increasing coffee productivity and income, and improving coffee quality and market access.

The feasibility study explores the potential of scaling up investment into sustainable coffee production by smallholder farmers, involving a range of stakeholders along the coffee value chain. The study focusses on Illubabor zone, Oromia Regional State, where the project is currently implemented. The area is representative for coffee growing areas in southwestern Oromia, where coffee is mostly cultivated under shade of forest tree species.[2]

On the following pages we:

- describe coffee production in and trade of coffee from Illubabor zone, potential and constraints for sustainable coffee production,
- list key agricultural practices for improving productivity and coffee quality sustainably,
- present the economic viability of smallholder coffee farms for different scenarios,
- recommend how the project can promote sustainable shade tree management and how the continued presence of shade trees (avoided degradation) can be monitored effectively and efficiently,
- propose a model for scaling up sustainable primary coffee production, taking into consideration different financing models and the capacity of stakeholders,
- propose a monitoring system which reflects all components of the coffee value chain from the producer to the exporter, and
- identify potential risks and risk mitigation strategies for the project.

[1] The pre-feasibility report is available at: https://www.international-climate-initiative.com/en/details/project/meeting-ethiopias-bonn-challenge-target-restoring-degraded-coffee-landscapes-18_III_078-3029

[2] Smallholder farmers in the project area cultivate additional crops (e.g. grains) and keep livestock. However, coffee and other crops are cultivated on different parcels of land. While recognizing that other crops and livestock are also important sources of household income, this study focusses on coffee production only.

2 CONTEXT

2.1 Coffee production and trade in Illubabor

Smallholder coffee farms

The importance of coffee production varies across woredas. Yayu, Mettu, and Ale have the largest area under coffee and produce about 40% of Illubabor's coffee.[3] Altogether, about 100,000 tons of coffee (green beans) are produced annually in Illubabor. Production is dominated by the about 135,000 smallholder farmers with a large share of their land holding under coffee (personal communication, Coffee Department, Illubabor BoA, March 2020).

The majority of farmers in Illubabor cultivate coffee under the cover of remnant forest trees. This management system is commonly known as semi-forest coffee.[4] The average farm size of smallholder coffee farmers is two hectare and the average coffee area is one hectare, often distributed across several plots (UNIQUE, 2019). Many households use more than half of their holding to grow coffee.

Coffee plants are often very old (ibid), i.e. well beyond the most productive age. The majority of coffee farms were established before 1980 or in the framework of the Coffee Improvement Project (CIP) implemented since the 80ies.[5] To which extent improved varieties were planted on these old coffee farms and/or coffee trees rejuvenated since then (CIP or otherwise) is unknown.

Almost all farmers participating in the pilot project reported incidences of diseases (Coffee Berry Disease and Coffee Wilt Disease). Few farmers applied good agronomic practices, especially pruning, stumping, use of fertilizer, and mulching prior to the project.

Owing to these factors, yields reported by the farmers are quite low. Prior to the project, yields ranged between 170 to 470 kg green beans/ha for the majority of farmers. The average yield was 350 kg green beans/ha. In comparison, upwards of 1,000kg green beans/ha are deemed feasible for well managed semi-forest coffee farms with improved varieties (personal communication Metu Agricultural Research station, October 2018).

Coffee processing and trade

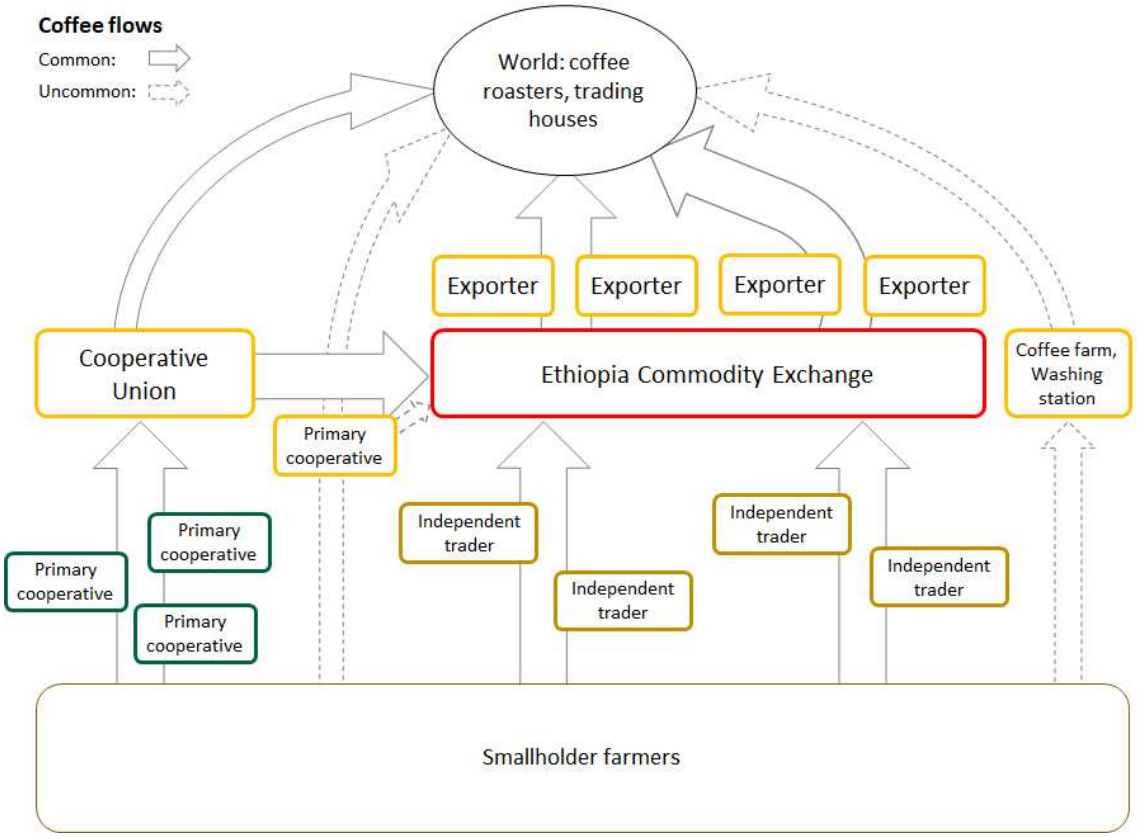
Smallholder producers sell coffee in the form of fresh or dried cherries. Fresh cherries are processed to green beans in one of the about 100 washing stations in Illubabor (35 belong to cooperatives). Production of washed coffee in Illubabor is estimated to be less than 5% of the total production (personal communication, Marketing Office, Illubabor zone, March 2020).[6]

[3] Refer to Annex 1 for production statistics.
[4] Details are provided in chapter 4.
[5] Implementation of the CIP started in 1977. At that time, almost 90,000ha of coffee existed in Illubabor (including what is now Buno Bedele zone). Seed for coffee planted before the CIP was sourced locally, i.e. was not improved and is generally considered to be low yielding (Wye College, 1984).
[6] About 80 washing stations exist in Illubabor, half of which are owned by the cooperatives.

Dried cherries are processed in privately owned hulling stations. Sorgaba Cooperative Union, based in Mettu, owns only one hulling station, which has insufficient capacity for timely processing of coffee from all coffee producing member cooperatives.

After processing, the trader or cooperative/union sort and grade coffee manually before delivery to the Ethiopia Commodity Exchange (ECX) or international buyer. Only inferior qualities are permitted for sale in the strong domestic market.

The trade channels for coffee from the producer to the international buyer are illustrated in Figure 1. The majority of coffee for export is traded through the ECX. Cooperatives and traders buy coffee from producers, delivering coffee to the ECX. Coffee from a given primary cooperative or trader forms an individual coffee lot. Both groups can separate lots further, e.g. according to quality and source. Traders, often operating in several woredas or even zones, are known to combine coffee from different areas into one lot. The individual coffee lots are auctioned at the ECX. Only licensed export businesses can conduct transactions at the ECX.



Smallholder farmers sell coffee to cooperatives and traders. The cooperatives can export coffee directly or through the ECX, but usually trade coffee with the help of their cooperative union. Farms with at least 2 ha or owners of washing stations can export coffee directly. Direct interaction between producers and international buyers is possible along the cooperative (union) value chain and farms/washing stations seeking to export directly.

Figure 1: Coffee trade flows in Ethiopia
Source: adapted from Neumann Kaffee Group (2018)

After revision of the coffee trade regulations in 2017 and 2018, coffee farm owners with at least two hectare and owners of washing stations can request a license to export coffee directly. Both groups can buy coffee from individual producers. In 2019, less than 400 farms exported coffee directly (USDA, 2019).

Exporters are required to sell coffee fast, i.e. within three months of purchasing coffee and the amount of coffee that can be stored without a sales contract is limited to 500 tons at any given time. As a result, especially coffee of higher quality may have to be sold below value. (USDA, 2019 & Hobby, 2019). For import-export businesses, trading coffee is reportedly about generating foreign currency to finance profitable imports. The high profitability of imports can offset losses of selling coffee below its actual value (Hobby, 2019).

In Illubabor, traders capture over 80% of export quality coffee. Cooperatives[7] and larger coffee growers choosing to market their production individually have approximately equal market shares (personal communication, Marketing Office, Illubabor zone, March 2020).

Almost all coffee produced in Illubabor is sold through the ECX. Sorgaba union channels washed coffee through the much larger Oromia Coffee Farmers Cooperative Union to access high-end markets.

Traders tend to use their own capital to buy coffee. Cooperatives, which commonly have very little own financial capital, rely almost exclusively on credits from the Cooperative Bank of Oromia (channeled through Sorgaba Union) to buy coffee.

Current ECX price and competition amongst buyers determine prices paid to producers. Cooperatives follow price trends set by traders within the boundaries set by the trade credit.[8] Between buying coffee and selling at the ECX lie several weeks to months, exposing traders and cooperatives to financial risk.

For coffee destined for sale through the ECX, quality is rarely reflected in producer price. Both cooperatives/union and traders have difficulties selling high quality coffee at a price premium. In the cases mentioned by interviewees, high quality lots were eventually sold at the same price as lower grade coffee to avoid additional cost for long-term warehousing and to ensure cashflow. As a result, traders and cooperatives are reluctant to invest in high quality coffee. Cleary, the absence of price premiums for high quality is a disincentive for producers to make an additional effort for producing higher quality.

Contract farming with smallholder coffee producers is not practiced in Illubabor. None of the interviewed exporters and traders with own farms in Illubabor work directly with other producers to create (larger) high quality lots that could be exported directly.

Reasons for not setting up contract farming are the inconsistent quality from smaller producers and high level of effort needed to improve quality of outgrowers. This is further compounded

[7] In 2019, 110 primary cooperatives had coffee transactions, about 90 of them selling through the union. (personal communication, Illubabor Cooperative Promotion Office and Sorgaba Cooperative Union, March 2020) About 20% of coffee farming households are estimated to be members of a cooperative (based on personal communication Illubabor Cooperative Promotion Office and Coffee Department, March 2020; CSA, 2017a)

[8] A minimum amount of coffee is required to be able to pay back the credit, essentially imposing a price ceiling. Cooperatives offering a higher price face the risk of failing to buy the required amount.

by the uncertainty created by global market price volatility and difficulty to engage with international buyers interested in long-term relationships with guaranteed prices. Positive examples for contract farming exist elsewhere in Ethiopia.

Regional branding can help to market coffee, but does not necessarily translate into better producer prices (Gelaw, 2018). Coffee from Illubabor is commonly grouped as Limu, together with coffee from Jimma region, i.e. has no specific brand name such as coffee from Sidama or Hararghe origins.

Stakeholders at various levels indicated that sustainability certification is an important requirement to access high-end markets. Certification of smallholder producers requires a clear contractual arrangement between producers and trading entity, currently only in place for cooperatives. However, to date very few cooperatives are certified with the Rainforest Alliance, Organic, and Fair Trade standards. These cooperatives were/are supported by international organizations (Farm Africa and GIZ).

A study by Minten et al. (2015) on the realization and distribution of price premiums for certified coffee shows that very little of the premium is transferred to the producer. Taking into consideration the high cost of certification, commercial farms or organizations working with smallholders require a secure market link before engaging in certification.

2.2 Good agricultural practices for sustainable coffee production

The project promotes a set of proven good agricultural practices (GAP) for coffee management and post-harvesting techniques, listed in Table 1. Most coffee in Ethiopia is of organic quality, i.e. farmers rarely use agro-chemicals for fertilization, and management of weeds, pests, and diseases. The organic quality of Ethiopian coffee can be an advantage when marketing coffee. Hence, the recommended practices do not include use of agro-chemicals.

Experiences from other projects show that participating farmers on average adopt about 50% of the GAP (personal communication HRNS, March 2020). However, the range of practices and degree of implementation varies between participants. Coffee yield and quality varies accordingly.

Farm economics, described in chapter 4, take into consideration different levels of GAP adoption and corresponding coffee yield.

Table 1: Recommended good agricultural practices

Practices		Details
Coffee management	Weeding	At least 2 times/year
	Pruning	Removing dead and unproductive branches or stems Opening the center of the coffee tree
	Nutrient management	Application of compost, manure, and mulch
	Rejuvenation	Stumping of coffee trees older than 20 years.
	Renovation	Uprooting of coffee trees older than 40 years (including stumping cycles) Planting of new improved varieties (2,500-3,000 trees/ha)
	Pest & disease management	Removing affected trees affected by CBD or CWD Sterilizing tools after each tree
	Harvest	Selective picking: ripe cherries only No collection of cherries fallen to the ground.
	Soil and water conservation	Different techniques can be used depending on terrain.
	Shade tree management	Gradually replacement of old or damaged trees Refer to chapter 4 for details.
Post-harvest	Drying	On cement floor, mats or tarpaulins, or drying tables
	Storage	In jute bags, off the ground, in a room not used by humans or livestock, and away from any chemicals

Source: HRNS

2.3 Shade coffee systems

Ethiopia's Afromontane forests are a hotspot of diversity, and provide a wide range of environmental services. Growing coffee under the shade of forest trees is a very common management system across south-west Ethiopia. While less densely stocked and diverse than primary forest, these managed "coffee forests" do not just provide income to farmers but contribute significantly to biodiversity conservation, carbon storage, and watershed protection.

However, the expansion of coffee production areas is also a key driver of forest degradation and deforestation (MEFCC, 2017a). Coffee cultivation is expanding into primary forests and the shade tree layer on existing coffee farms is gradually disappearing. While it can be assumed that most of the coffee farms were established several decades ago, conversion of forest into semi-forest coffee systems is still taking place in Illubabor.[9] The different coffee management systems common to Ethiopia (described in Box 1) illustrate the impact of the different management systems on the tree layer.

[9] According to the Illubabor Zone BoA (personal communication, June 2019) the majority of coffee farms were established in 1970ies-1980ies under the Coffee Improvement Program. In Nono Sale, the woreda with the highest forest cover in Illubabor, statistics compiled by the woreda indicate an annual increase of semi-forest coffee area of almost 10 % or 1,000 ha/year for the period 2015 to 2019 (personal communication, Nono Sale BoA, 2019). Ethio Wetlands and GIZ implement programs on sustainable forest management and resource use in Nono Sale.

Box 1: Definition of coffee management systems by the tree layer

Forest coffee system: natural forest with a natural population of coffee trees (between 1,500 and 1,900 m a.s.l.). Interventions are limited to harvesting of coffee from wild coffee trees. The forest comprises several layers of shrubs and trees, crown cover is dense (>80%), and succession tree species are common.

Semi-forest coffee system: The middle layer (smaller trees and shrubs) is removed and the upper canopy selectively thinned to make space for coffee and increase solar radiation. Additional coffee is planted. Herbs and emerging tree seedlings are removed annually. Tree crown cover is moderate to dense (>50%), the number of tree species is reduced (≤ 30), and few old growth trees of succession species remain.

Semi-plantation coffee system: The management is similar to the semi-forest coffee, but more intense. Planted coffee seedlings include improved varieties. Tree crown cover is open to moderate (≤50%), and tree species are limited to those highly compatible with coffee (e.g. *Albizia gummifera*, *A. schimperiana*) and some pioneer species (e.g. *Croton macrostachys*).

Garden or plantation coffee: The system has no shade trees or planted shade trees. The crown cover is open (<40%), tree species variety is very low and often limited to exotic/fruit species.

Source: Deribe (2018), Hundera (2012)

Coffee farms in the project area fall mostly into the categories semi-forest and semi-plantation coffee.[10] The shade tree layer is still quite diverse, with about 30 different species. It includes canopy trees of different age and size. The average number of shade trees is relatively high with 150 trees/ha.[11] However, the number of shade trees and crown cover is very heterogeneous within and between coffee farms. Few, individual coffee plots may have no or only dying shade trees. Young shade trees (seedlings and saplings), needed to replace the existing old trees over time, are often missing.

The regeneration gap of shade tree species on coffee farms is predicted to result in a gradual loss of trees and species diversity. This situation requires action to avoid a deterioration of coffee quality and loss of environmental services, and mitigate climate change related risks to productivity.[12]

At the same time, changes in the shade tree layer of coffee farms have to be monitored. The information thus generated would help decision makers to change measures or design new ones, and transfer measures with positive impacts to other coffee producing regions. However, monitoring of forest degradation is very complex, and, thus, often excluded from projects on Reducing Emissions from Deforestation and [forest] Degradation (REDD+).[13]

[10] In the following, references to semi-forest coffee include the semi-plantation system.

[11] Due to the relatively high crown cover, semi-forest coffee is commonly classified as forest. Ethiopia defines forests as: "land spanning more than 0.5 ha covered by trees […] attaining a height of more than 2 m and a canopy cover of more than 20% or trees with the potential to reach these thresholds in situ in due course" (MEFCC, 2017b).

[12] Both, coffee productivity and quality are influenced by the shade regime.

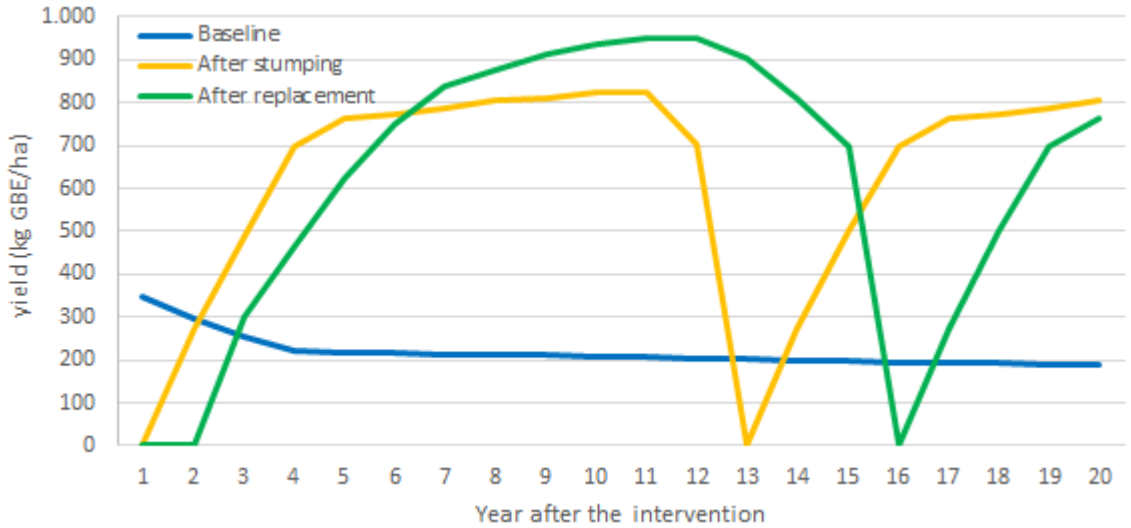
[13] Deforestation can be monitored with high accuracy and efficiency using remote sensing data, e.g. medium- to high-resolution satellite imagery. The technology is not suitable for large scale monitoring of forest degradation.

3 FINANCIAL VIABILITY OF SMALLHOLDER COFFEE FARMS

The financial viability of coffee production by smallholder farmers in the project area was assessed for a one hectare coffee plot managed in the semi-forest coffee system. Rejuvenation or replacement of old coffee plants are assumed to have the biggest potential for yield improvement. Accordingly, we analyzed three basic scenarios:

- **Baseline** reflecting the status quo (no project) with farmers implementing only minimal coffee management activities and without use of inputs. In combination with the aged coffee trees, yields are low (350 kg GBE/ha) and declining.
- **Rejuvenation,** i.e. stumping of old coffee plants, in combination with more intensive management and application of organic fertilizers. The maximum achievable yield is about 800 kg GBE/ha.
- **Replacement** of old coffee plants with new improved coffee varieties, in combination with a more intensive management and application of organic fertilizers. The maximum achievable yield is about 950 kg GBE/ha.

Stumped or new coffee trees start to yield in year two and three, and reach maximum yield after about four and seven years respectively. Thereafter, production remains high for about 7 years (Figure 2). Rejuvenation and replacement are assumed to be implemented in stages to avoid income gaps and keep the financial and labor investment at feasible levels. For the cashflow we assumed an average price of 52 ETB/kg GBE (1.52 USD). The input parameters used for each scenario are listed in Annex 7.



The yield curves are based on information provided by the Metu agricultural research station. Biennial yield fluctuation is common in most coffee management systems, but more pronounced for coffee grown without shade (Bote (2016) citing DaMatta (2004)). However, data for inter-annual variability for coffee grown in traditional shade management systems was not available. The curves reflect the mean values. To maintain high yields, coffee has to be stumped again when yield starts to decline (2-3 years after peak yield)

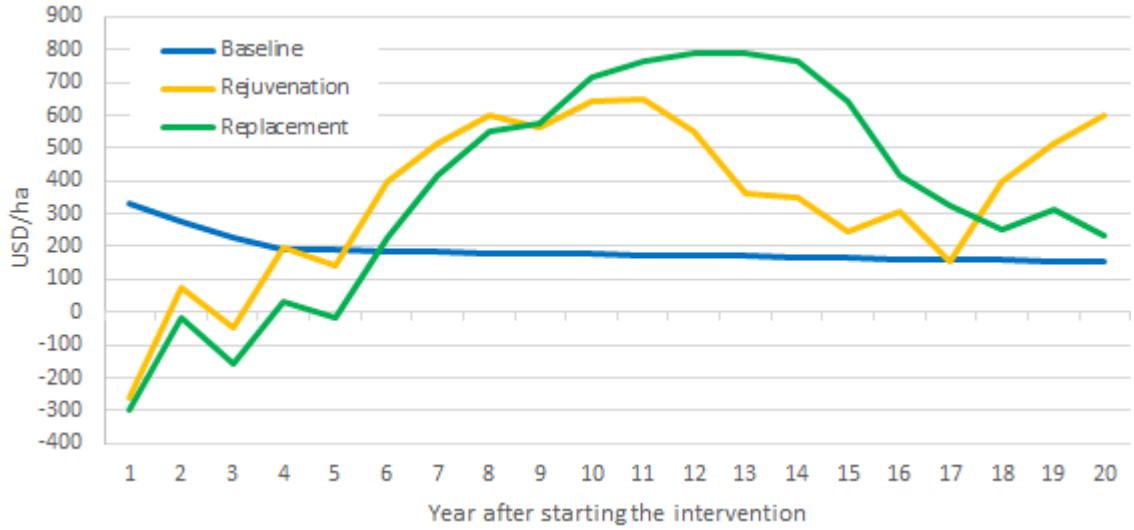
Figure 2: Development of yield in the baseline, rejuvenation, and replacement scenarios

3.1 Results

The cashflow, Net-present value (NPV), and Internal rate of return (IRR) were calculated for a 20-year period and applying a discount rate of 10%.[14] The average annual management cost in the baseline is ~ 150 USD/ha and ~ 550 USD/ha for the good practice scenarios. Weeding[15], harvesting, and drying are the biggest recurring cost items in all three scenarios. The additional investment in rejuvenation/replacement is substantial with 230 and 370 USD/ha respectively.

Coffee production in the baseline scenario is profitable because of the low management cost. The rejuvenation and replacement scenarios are initially negative. The quick return to bearing fruit after rejuvenation makes the scenario profitable from year 4 onwards despite the ongoing investment. With all coffee plants reaching maximum yield, the average annual profit is about 500 USD/ha. The IRR over 20 years is 55%. The gradual replacement of coffee plants becomes profitable in year 6 only, emphasizing the need for external funding to bridge the income gap. From year eight onwards, the average annual profit is 550 USD/ha, with an IRR of 33%.

Figure 3 shows the undiscounted cashflow for the three scenarios, with investments into stumping/replacement in year one, three, and five. The scenarios assume stumping of coffee plants about 15 years after the initial stumping/replacement causing the depression in cashflow.



Rejuvenating/replacing $^1/_3$ of a hectare in year 1, 3, and 5. Coffee plants are rejuvenated again/for the first time after 13 and 15 years in the rejuvenation and replacement scenario respectively.

Figure 3: Annual cashflow for coffee farms before and after rejuvenation/replacement

[14] The cashflow calculation excludes the cost of labor provided by household members. A cashflow including household labor cost is provided in Annex 8.

[15] Includes mulching, and pest and disease control.

Table 2: Financial cost and benefit of a smallholder coffee farm (1ha)

Parameter	Scenario		
	I. Baseline	II. Rejuvenation	III. Replacement
Average recurrent annual cost (USD/year)	145	500	500
Investment cost (USD)*	N/A	230	370
Break even	N/A	4	6
Average annual profit (USD/year)	190	N/A	N/A
During rejuvenation / replacement (year 1-7)	N/A	145	30
From year 8 onwards+	N/A	455	550
NPV at 10% discount rate (USD)	1,770	2,265	2,115
IRR (%)	-N/A	55	36

*Labor and inputs for the first round of rejuvenation/replacement (year 1-5)

+Includes recurrent stumping 13/15 years after the initial rejuvenation/replacement.

The incremental benefit of rejuvenation over the baseline is 160 USD/year (20-year average). For replacement, the average incremental benefit is 180 USD/year.

If households reflect their own labor, both scenario II and II will break even in year six only. The average annual profit after completing rejuvenation/replacement would be 165 and 250 USD/ha respectively. The IRR is similar for both scenarios with 13% and 12% respectively (refer to Annex 8). In the baseline scenario, annual profit would be only 25 USD/ha.

3.2 Sensitivity analysis

Adoption of good agricultural practices

Good agricultural practices are promoted by the project to ensure the sustainability of coffee farms by keeping soil and coffee plants healthy and productive, and the shade tree layer intact. GAP also contribute to the quality of coffee, an important factor to access high-end markets. However, GAP implementation is expensive, with the recurrent management costs for the GAP scenarios about 3.5 times higher than management cost in the baseline (Table 2, section 3.1).

The most tangible benefit changing management practices for farmers is the yield differential. While the yield development after rejuvenation/renovation is quite well understood, little evidence exists for yield development after rejuvenation/renovation but without or only partially adopting GAP. The yield difference assumed for farms managed with and without GAP application is in the range of 200 - 300 kg GBE/ha (Figure 4).

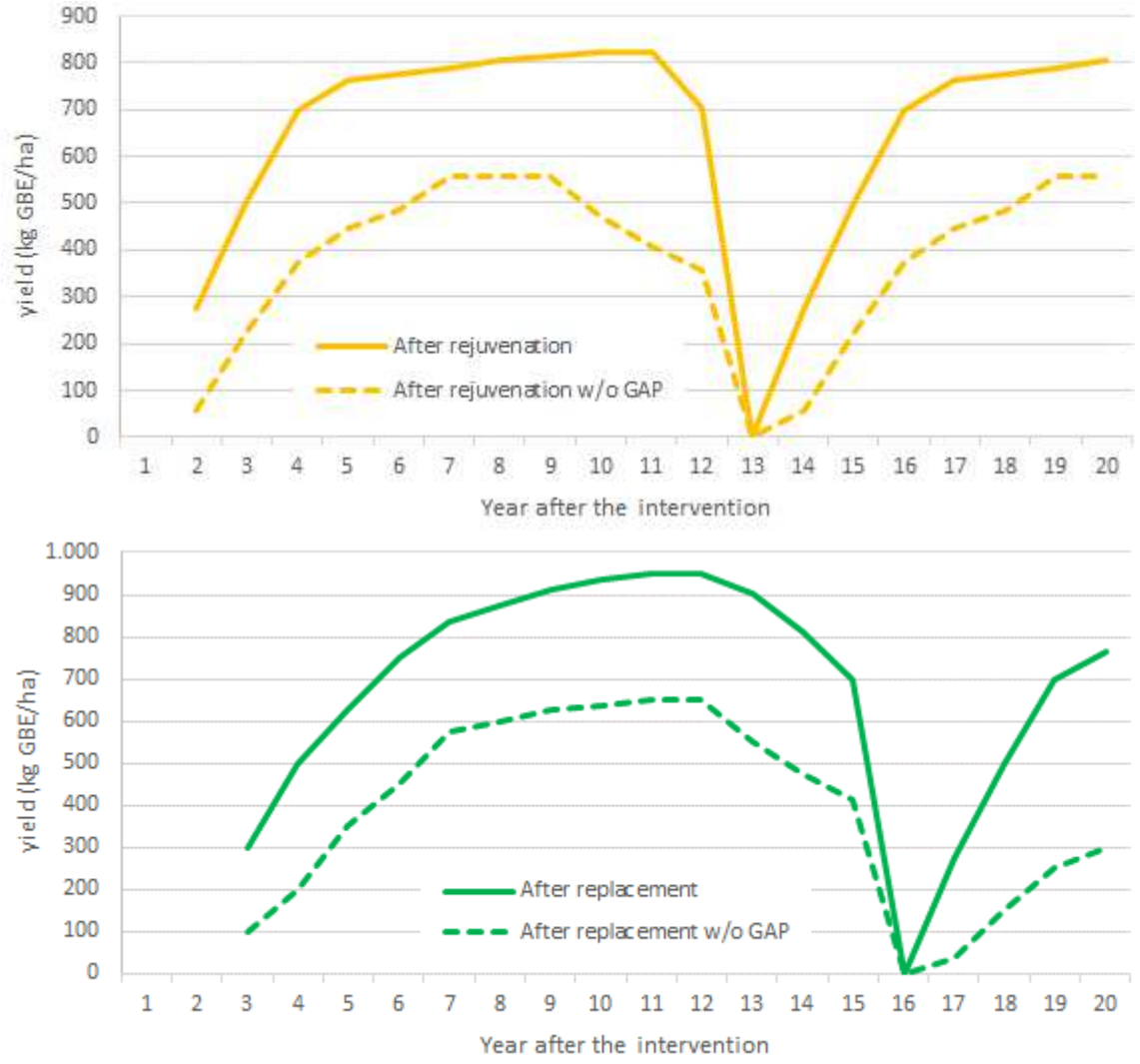
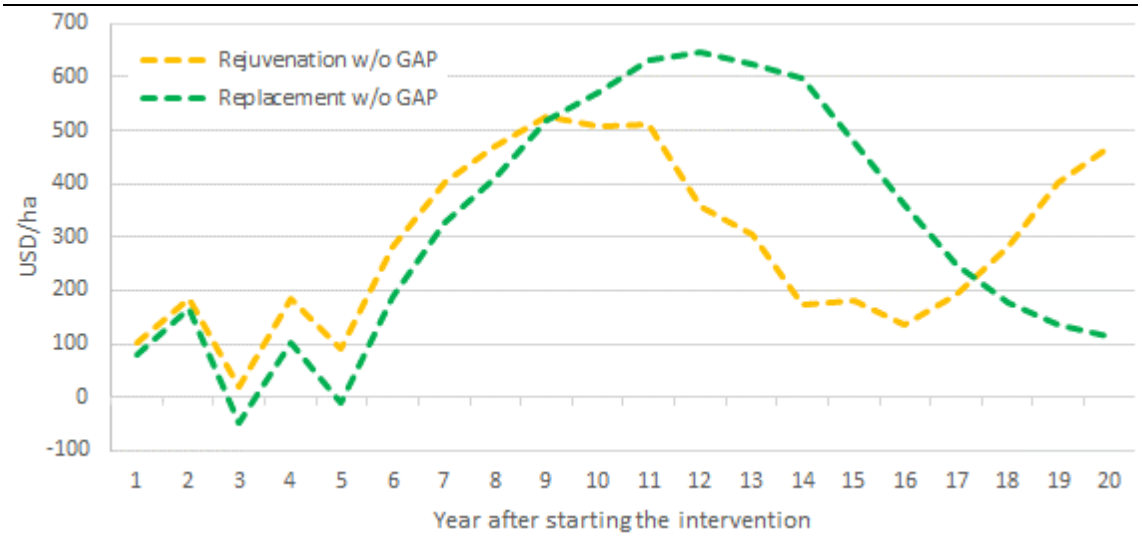


Figure 4: Yield development after rejuvenation/replacement with/without adoption of GAP
Source: Expert estimates (personal communication HRNS Ethiopia & Agricultural Research Inst. in Jimma and Metu)

If removing GAP from the cashflow presented in section 3.1, Figure 3, the investments in rejuvenation and replacement become more attractive especially during the investment phase and despite lower yields (Figure 5). The lower management cost in the first few years means coffee farms remain cash flow positive or become negative only over short periods. In other words, there is little incentive for farmers to invest in expensive GAP if looking at yield only. However, more research regarding the effect of minimal management on yield is required. This research should be incorporated into future projects.



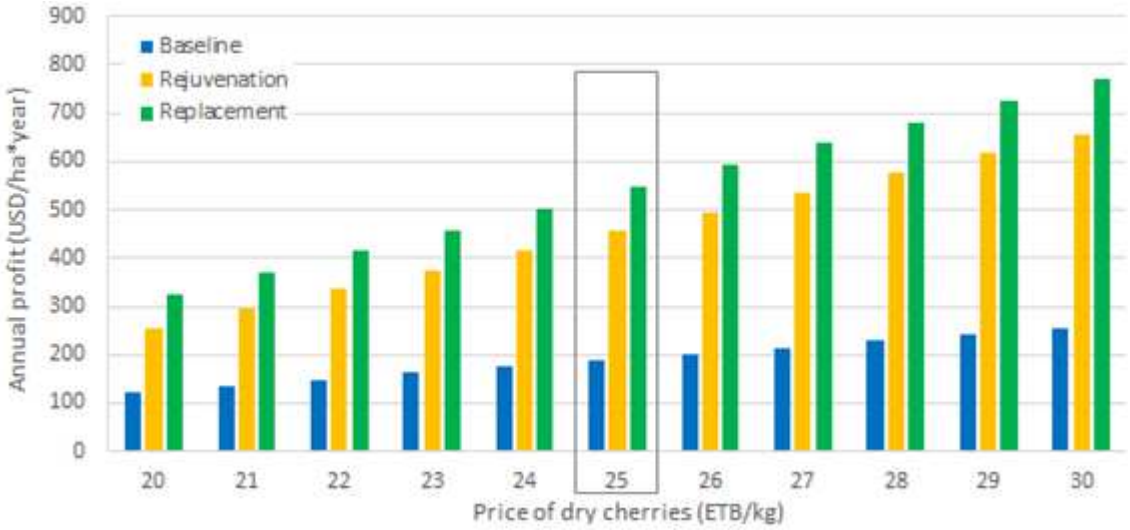
Average recurrent annual costs are for rejuvenation 195 USD/ha and for replacement 205 USD/ha - 40% less than with GAP.

Figure 5: Cashflow for smallholder coffee farms without adoption of GAP

Product price and labor cost

The sensitivity of the farm economics to product price and labor cost are illustrated in Figure 6 and Figure 7. Rejuvenation and replacement is profitable at current prices (25 ETB/kg dried cherry). Price changes have a significant influence on the profitability of coffee farming. With higher yields after rejuvenation or replacement, the effects of positive and negative price changes become more pronounced.

The IRR remains positive with lower prices. At 20 ETB/kg dry cherry the IRR for rejuvenation is 28% and for replacement 21%. This emphasizes the need to buffer farmers from sharp price drops, but also shows the profitability of coffee farms even without accessing high-end markets.

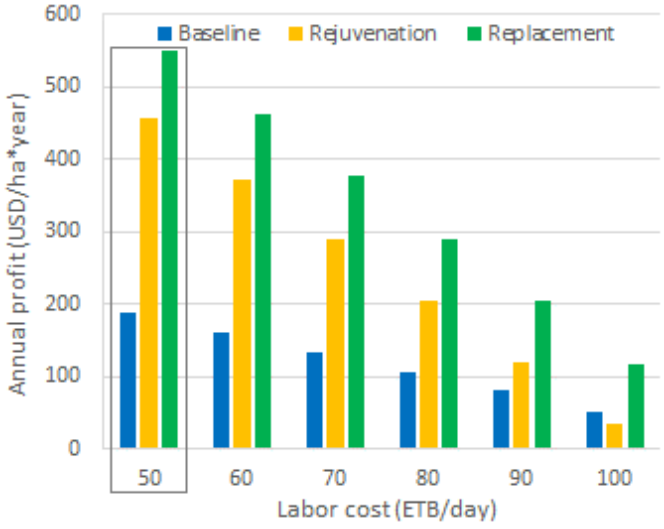


25 ETB/kg dry cherry was the average price in the 2019/20 buying season in the project area. All other input values remain the same as in the basic scenarios.

For rejuvenation and replacement, the average profit is calculated from year 8 onwards, i.e. after the investment phase. The subsequent rejuvenation (see section 3.1, Figure 3) is included.

Figure 6: Average annual profit with changing product price

The cost of hired labor influences the profitability of coffee farms, owing to its relatively large cost share.[16] Households not able to offset rising costs or lower coffee prices with a higher contribution of family labor may cease to be profitable.



Farmers in the project area paid on average 50 ETB/day for external labor in 2020. In Metu, the next bigger town, labor costs are as high as 100 ETB/day.

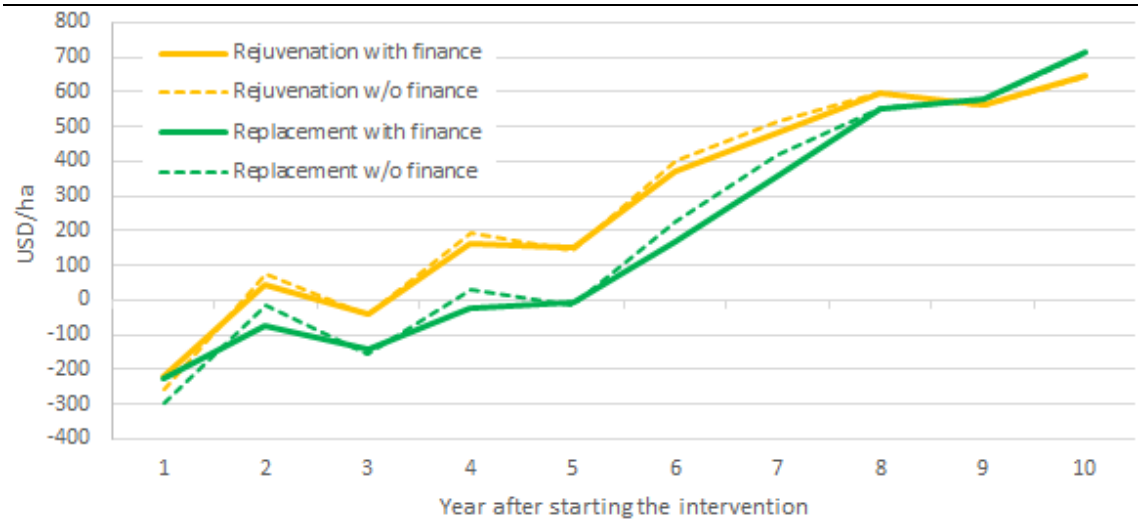
For rejuvenation and replacement, the average profit is calculated from year 8 onwards, i.e. after the investment phase. The subsequent rejuvenation (see section 3.1, Figure 3) is included.

Figure 7: Average annual profit with increasing labor cost

[16] Based on households interviews, hired workers are employed in all activities. Across all activities the share of hired labor is >50%. Paid work is especially important for regular activities like weeding, harvesting and the construction of raised coffee drying beds.

3.3 Financing farm level investments with credits

Loans can help coffee farming households to finance the investment in rejuvenation/replacement and cover the initial income gap. However, loans covering only the investment in rejuvenation/replacement cushion the initial investment only slightly and do not change the timing of breakeven nor overall profitability substantially Figure 8.

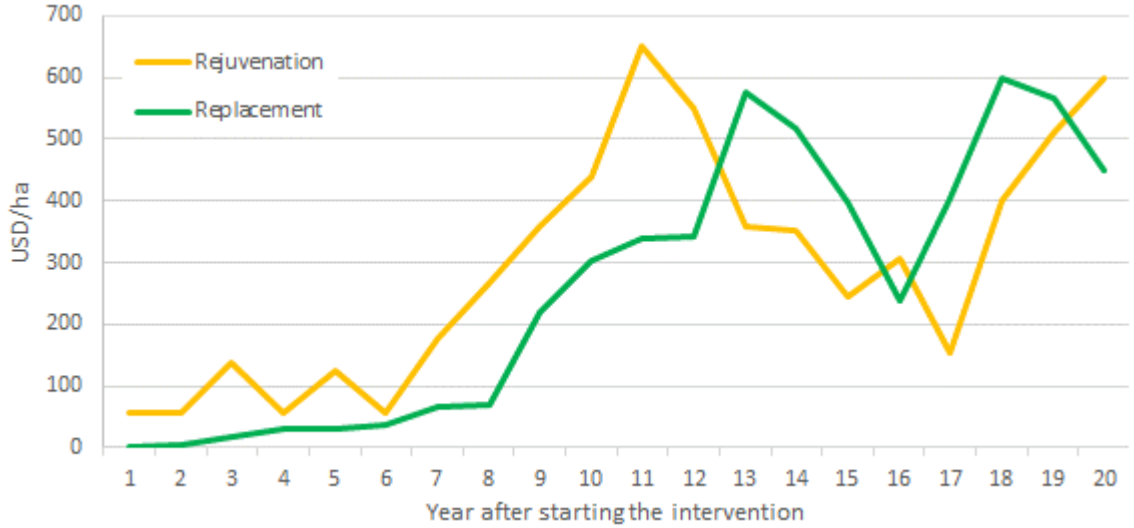


Three loans are taken in year 1, 3 and 5 to cover the investment cost for one third of a hectare each. The total loan size per hectare is 200 USD for rejuvenation and 370 USD for replacement. The payback period is 3 years, starting in year 1.

Figure 8: Annual cashflow of coffee farms with small loans for rejuvenation or replacement

To cover the cost of GAP implementation, much larger loans are needed. At the same time, larger loans require a more sophisticated lending approach. The period over which old coffee plants are rejuvenated or replaced might be longer in order to allow repayment of the initial loan.

In the scenarios illustrated in Figure 9, credits are in the range of 400 to 500 USD disbursed over two years for rejuvenation and four years for replacement. Further details are provided in Annex 7. These loans ensure that the farm income remains marginally positive despite the increased costs and temporary loss of income from coffee plants stumped or replaced. At the moment, micro-finance institutions (MFI) provide credit for up to USD 550 to farm households, but only for one year (see section 5.2). Hence, one target the future project would be to develop a lending product suitable for coffee farmers together with national financial institutions.



Rejuvenation & GAP: 3 loans for $^1/_3$ ha each in year 1, 3, and 5; indivudal loan size is 440 USD (1,320 USD/ha), payback 6 years

Replacement & GAP: 3 loans for $^1/_3$ ha each in year 1, 5, and 9; individual loan size is 515 USD (1.540 USD/ha), payback 8 years; the cost of SWC installation is distributed across the first three years.

Figure 9: Annual cashflow of coffee farms with medium loans for investments and adoption of GAP

4 SHADE TREE MANAGEMENT AND MONITORING

The following section describes the benefits of and challenges with shade trees in a semi-forest coffee system, and management practices suited to both coffee production and provision of environmental benefits. We then recommend a monitoring system for shade trees on coffee farms participating in the project. The last section focuses on accounting of carbon stock changes.

4.1 Management of shade trees in semi-forest coffee systems

Shade trees on coffee farms have multiple functions and benefits for the production of coffee. These, and additional benefits are listed in Table 3. Good shade is in particular important at elevations below 1,500m a.s.l., where daily average temperatures tend to be above the optimum for Coffee Arabica (19-22°C).

Climate change is expected to affect the suitability for coffee negatively in many areas in Illubabor.[17] Shade trees can help to regulate the microclimate, keeping temperatures at lower levels thereby increase the resilience of coffee farms against the effects of climate change.

However, shade is not by default beneficial for coffee production:

- Increased or full exposure to sunlight will increase coffee yield and, if combined with higher levels of fertilization, does not necessarily reduce quality (Bote & Struik, 2016).
- Higher humidity levels commonly found under shade are favorable for the coffee plants during the dry season, but can be problematic during the wet season, i.e. may increase the risk for fungal diseases (Liebig et al. 2019).[18]
- Shade trees may compete for water, especially in extended dry seasons (Ehrenbergerová et al. 2017).
- At very high altitudes (>2,200 m), with low temperatures, a further reduction of temperature by shade trees can reduce cup quality (Tolessa et al., 2016).

As a consequence, shade tree management must be site specific. A one fits all instruction will not be practical in many circumstances. Instead, farmers (and the extension service) should consider the following criteria when making management decisions:

- Altitude (average and maximum temperatures),
- the current shade trees (species, age distribution, spacing and crown cover), and
- potential additional uses/benefits of shade trees in a given area.[19]

[17] Refer to Annex 2 for a map of coffee growing areas likely affected by climate change.

[18] The development of conditions conducive to fungal diseases depend on many variables (season, altitude, and shade system amongst others). For example the formation of dew (facilitating infection) is more likely in unshaded conditions with lower minimum (night) temperatures, i.e. a higher diurnal temperature fluctuation.

[19] Some products may require marketing structures, e.g. those with a commercial potential (honey / wax, spices). Especially in remote areas or in areas where the total production is little (because few farmer engage in it) the effort of marketing may be too high to justify production.

Table 3: Benefits of shade trees in semi-forest coffee systems

Shade tree function	Benefits & details
Temperature regulation: provision of a micro-climate with lower maximum air and soil temperature	▪ Slower ripening of cherries resulting in increased screen size and weight of beans, and better cup quality ▪ Less fruit (no overbearing) increase quality, reduce the risk of biennial bearing, and ensure long-term productivity of plants ▪ Especially important at lower elevations (<1,500 m): moderate to dense crown cover reduces average temperatures
Reduced solar radiation	▪ Reduced growth of weeds, resulting in reduced labor for weed management (applicable to moderate to dense crown cover)
Protection against extreme weather	▪ Avoided damage from wind, heavy rain, and hail to flowers, fruit, and coffee trees
Maintenance of soil fertility	▪ Reduced need for fertilization ▪ Enabling organic production: Nitrogen-fixation by e.g. Fabaceae, nutrients from decomposing leaf litter
Reduced erosion	▪ stabilizing effect of tree roots, leaf litter covering the soil surface ▪ Reduced need for mulching and soil and water conservation
Provision of additional products	▪ Tall trees to install bee hives and staggered flowering of different tree species providing year round bee fodder ▪ Timber & fuel wood ▪ Fruit, fodder, Medicine and poisons (traditional methods to treat e.g. animal pest and diseases)
Provision of ecosystem services	▪ Carbon storage in above and below ground biomass, and soil ▪ Watershed protection (water quality and stream flow) ▪ Biodiversity (habitat for insect and other animals): reduces the occurrence and severity of pest and diseases.

Sources: Bote & Struik (2016); Tolessa et al. (2016) citing Bosselman (2009); Liebig et al. 2019 citing Avelino et al (2006) and Cerda et al. (2016)

Management recommendations are provided in Annex 3.

4.2 Monitoring shade trees on coffee farms

From the monitoring point of view, semi-forest coffee farms must be considered forests:

- They are classified as forest in existing land cover/use maps.
- On satellite imagery, they appear as forest (same reflectance as forests).[11]
- Coffee trees "visible" in gaps between shade trees are very difficult to distinguish from the tree canopy on satellite imagery (just like understory trees in natural forest).

As a consequence, the monitoring of shade trees on semi-forest coffee farms faces similar challenges as monitoring forest degradation:

- Remote sensing data or satellite imagery with mid to high resolution is not available or affordable for the large area.
- There is no historic data to derive a reference level for forest (shade tree) degradation.
- Long-term monitoring is required to even out short-term fluctuations related to shade tree replacement.

Additionally, the semi-forest coffee farms are scattered across a large area, it is unlikely that all coffee farmers participate in the project, and heterogeneity between coffee farms is high.[20]

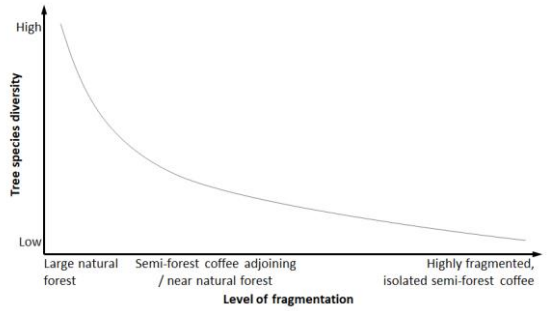
The situation requires a different monitoring approach, comprising two components (Figure 11):

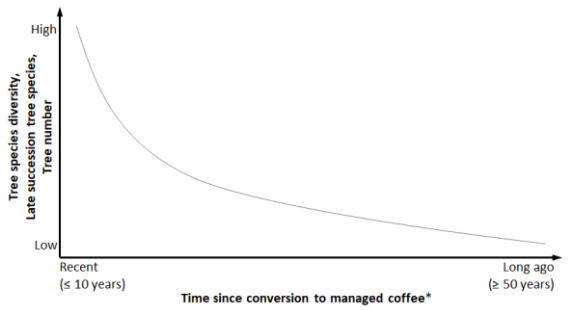
1. Establishing the reference level (baseline) for degradation on semi-forest coffee farms in the jurisdiction (Illubabor). In the absence of historic data, a first reference level is established based on differences between "old" and "young" semi-forest coffee farms. The reference level can be refined going forward.
   - Stratification of forest land into forest (no, or only wild coffee) versus semi-forest coffee farms based on expert opinion[21], with sub-strata for semi-forest coffee farms (Figure 10)
   - Establishment of permanent sample plots in semi-forest coffee farms distributed across the different sub-strata[22]
   - Derivation of the reference level for biomass (carbon) and biodiversity (species diversity) based on the differences between classes for "time since conversion to managed coffee"
   - Re-measurement of permanent sample plots in long time-intervals (e.g. 5 years) to refine the reference level over time.
2. Monitoring shade trees on semi-forest coffee farms included in the project requires:
   - Mapping of coffee plot boundaries
   - Annual to bi-annual reporting of shade trees by the farmers (number per size class, species, see Annex 6 for details) as a basis for incentive payments (see chapter 5)
   - Verification of reported tree counts (Annex 6).

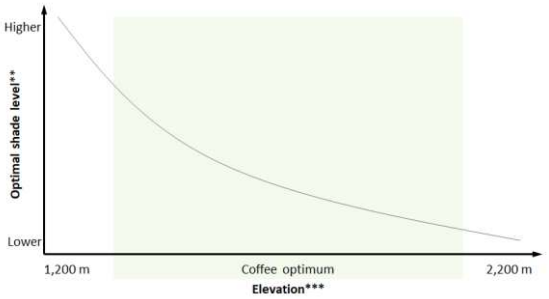
[20] Some farms may require restoration of shade trees (i.e. reforestation) while others merely have to maintain trees (which will occasionally result in a temporary loss of big (old) trees). Further details on monitoring challenges and corresponding solutions are provided in Annex 4.

[21] For example taking into account existing records for establishment of coffee farms (e.g. the Coffee Improvement Project, accessibility (forest size, terrain, infrastructure), and suitability for coffee (elevation).

[22] The survey can only include managed coffee farms, not forest or forest (wild) coffee, as changes in the latter two are not influenced by the project. Sample plots falling into forest (incorrect first level stratification) must be discarded.







* Using the time of conversion of the surrounding forest into farmland as a proxy indicator

** Influencing shade tree density and species choice

*** Influencing suitability of shade tree species (survival, growth)

- The number of shade trees may decrease with:
  - Time since conversion into semi-forest coffee farm, and
  - Increasing elevation, with shade becoming less important as a regulator of temperature at higher altitudes.
- Tree species diversity is likely to decrease with:
  - Time since conversion into semi-forest coffee farm, and
  - forest fragmentation (increasing distance of semi-forest coffee from large, natural forest blocks).

Figure 10: Stratification parameters for the survey of semi-forest coffee farms

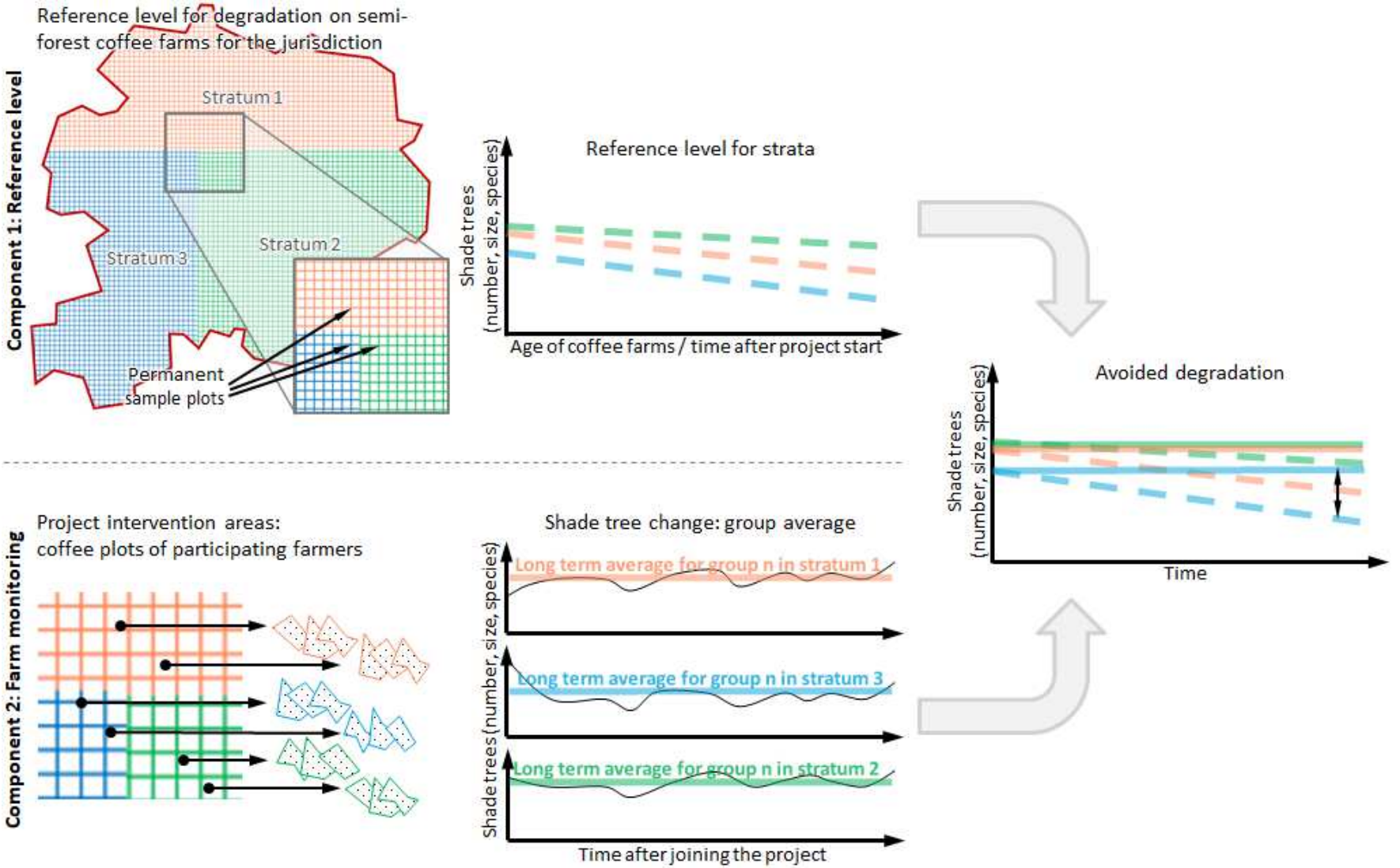


Figure 11: Monitoring shade trees on semi-forest coffee farms

4.3 Carbon stock accounting and benefit sharing

The potential to achieve significant GHG emission reductions can be an important incentive for project developers and investors.

In the semi-forest coffee system, significant changes in carbon stock occur only in the above and below ground biomass of shade trees.[23] Figure 12 provides an indication of the magnitude of change with loss of shade trees. Soil organic carbon becomes relevant if the baseline (reference scenario) indicates a shift to a very open or no-shade farming system.[24]

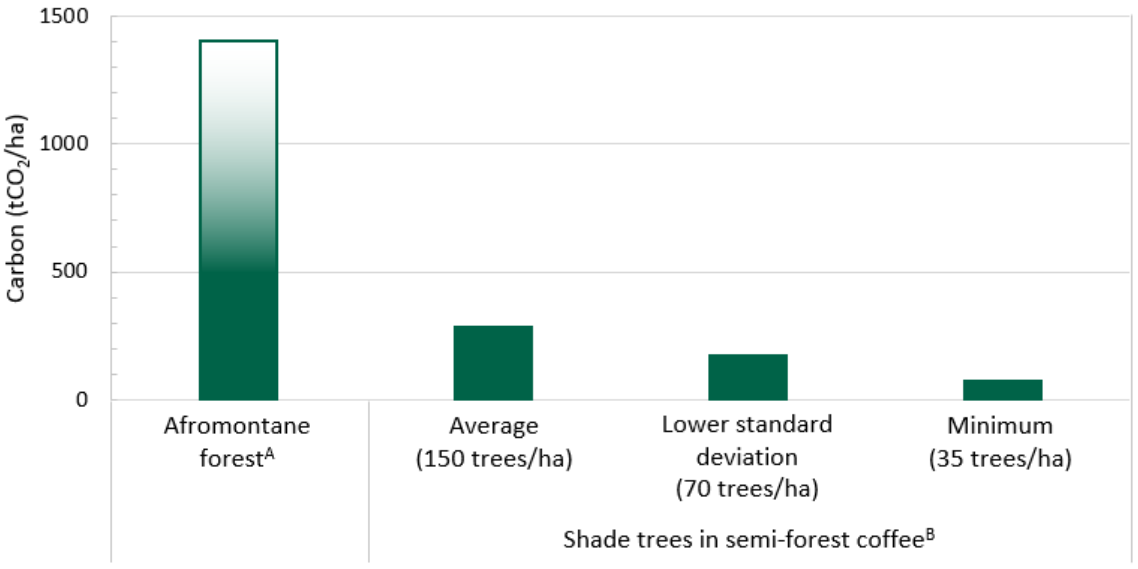


Figure 12: Carbon storage in the above and below ground biomass of shade trees in semi-forest coffee systems

[A] Values stated in publications are equivalent to 500 (Nesru, 2015), 1,060 (Abyot et al. 2019) and 1,400 tCO_2 (Kassaa et al. 2017).

[B] UNIQUE (2019); assuming a similar proporation of large (>40cm diameter, storing > 80% of the biomass carbon) and smaller trees.

The above described monitoring of shade trees permits the calculation of emission reductions from avoided degradation or restoration of shade trees on very open coffee farms. Changes in soil organic carbon can be derived from the level of shade and based on activities (soil management, crops).[25]

In Oromia, all land based emission reductions are covered by the Oromia Forested Landscape Program (OFLP). Individual (nested) projects can be developed under the umbrella of the OFLP[26]:

[23] This includes potential losses, avoided loss or gain.

[24] Soil organic carbon remains high in semi-forest coffee farms as long as the shade tree layer is intact (Kassaa et al., 2017). Other carbon pools (coffee plants, dead wood, litter) constituting altogether less than 5% of carbon are insignificant and would not be included in carbon accounting.

[25] For example using the Cool Farm Tool (https://coolfarmtool.org/).

[26] Refer to Annex 5 for details.

- Nested projects must apply the reference level, and the monitoring, reporting and verification methodology of the program. The program has developed a reference level and adopted a methodology for avoided deforestation and afforestation/reforestation, but not yet for forest degradation.
  - ➔ A project developer should engage with the OFLP as soon as possible to influence the choice of methodology for avoided degradation (baseline establishment, monitoring and accounting).
- Benefit sharing with nested projects is based on the net-emission reductions achieved across Oromia.
  - ➔ Financial benefits to a project focusing on avoided degradation would likely be very small and may not justify the development cost. However, carbon benefits could be used for insetting, i.e. the "use of avoided emissions" by e.g. the project developer/funding entity without trade or financial transactions.

5 SCALING UP THE PROJECT

The scaled project targets over 150,000 coffee farming households, equivalent to about 200,000 ha of coffee distributed across Illubabor's 13 woredas. The scaling requires the active involvement of the aggregating entities, which buy and process coffee (cooperatives, traders, and potentially outgrowers). Other important actors are government agencies and financial service providers.

The project will require different sources of funding, including investment by the public sector, impact investors, and private sector. The investment need over 20 years is estimated to be 45 million USD in the form of loans. To aid the implementation of the investments, matching grant funding in the range of 10 million will be required.

The responsibility of monitoring (coffee trade/traceability, compliance with sustainable management standards including avoided degradation, and financial transactions) can be carried to a large extend by the above-mentioned actors with support from the project.

The following sections provide a brief overview of institutions providing extension and their capacity (section 5.1), finance required and proposed lending (section 5.2), and incentives needed by coffee farmers to adopt sustainable practices (section 5.3). The proposed organizational set-up is described in sections 5.4 and 5.5, followed by an outlook towards the sustainability of the project (section 5.6).

5.1 Provision of extension services

In Illubabor, extension services are required at farm level and by aggregators/processors for coffee production, processing, storage, and trade. Currently, the Oromia Bureau of Agriculture and some projects provide these services to a limited extent. Farmer cooperatives receive basic support from the Cooperative Promotion Agency.

The key aggregating entities, primary cooperatives/cooperative union and traders, do not provide extension services to their members or supplying farmers.[27] Activities are limited to buying, processing (washing, hulling), short-term storage, and selling coffee.

The capacity of the **Bureau of Agriculture** to deliver extension services to coffee growers is very low. At zonal level, the Bureau has a small team of experts dedicated to coffee production. At lower administrative levels (woreda, kebele) agricultural officers have to cover all aspects of crop production and monitoring, and are not specialized in coffee. Usually, only one kebele development agent per topic group (e.g. crops) is available for all farm households in the kebele (around 800 to 900).

The **Cooperative Promotion Agency**, with offices at woreda level, supports cooperative establishment, issues licenses, and performs annual financial and performance audits of cooperatives. The Agency cannot provide additional support (i.e. building the organizational and technical capacity of cooperatives) due to the limited staff and budget of the Agency.

[27] The exception are cooperatives supported by development projects. A list of known coffee related projects implemented in Illubabor is provided in Annex 9.

The pilot project, and other organizations like Farm Africa, build the capacity of cooperatives and farmers to improve practices using methods like Farmer Field Schools. Improving market access is an important component of many projects and key incentive for farmers to adopt the good agricultural practices promoted by the project. Projects are usually restricted to specific kebeles and often only work with farmers that are members in cooperatives, limiting the number of households reached.[28]

To achieve scale, i.e. reach as many coffee farmers as possible in all relevant areas in Illubabor, the project must lobby for permission to have projects focusing on coffee production and trade to work in all relevant kebeles regardless of existing projects. The BoA should ensure that all organizations implementing coffee projects have a common minimum standard for agricultural practices and organizational capacity building.

The project, through a technical assistance facility and in close coordination with government extension services, should:

- Increase the use of low cost and effective methods like Farmer Field School,
- work through a wider range of aggregators, i.e. encourage the establishment of outgrower schemes and formal relationships between traders and farmers increasing their influence on coffee management practices[29], and
- build the capacity of the aggregating entities for the delivery of extension services to coffee farmers in the future.

5.2 Financing investments on coffee farms and in processing capacity

Investment needed

The scaling up of sustainable production requires investment at three levels:

- Coffee producers, to increase coffee productivity and quality,
- aggregators, into equipment for coffee storage, quality control, and traceability, as well as working capital, and
- processors, to increase processing capacity in Illubabor.

Table 4 provides estimates for the required investments. Assuming adoption of rejuvenation/replacement and GAP on about half of the current coffee area (115,000 ha) and a related increase in coffee production in Illubabor to about 135,000 tons GBE per year, the total investment needed is estimated to be 44 million USD over the lifetime of the project.[30] The assumed schedule for adoption and taking loans is provided in Annex 12. Assumptions for loan conditions are provide in Table 5.

[28] The government aims to distribute development projects equally across its jurisdiction. As a result a project may not be able to access targeted kebeles, because another (not coffee related) project is already active in a given area. Only about 10-20% of households are members of agricultural cooperatives (estimated based on cooperative membership in the pilot project and number of households in the kebeles). A similar value is stated by GCP (2016).
[29] For details, refer to chapter 2, section “Coffee processing and trade”.
[30] 15 years, refer to section 5.6 for details.

Adoption and investments will be spread out over several years, allowing the re-investment of early credit repayments and interest. As a result, only about 22 million USD are required to finance the loans to farmers and businesses.

Table 4: Investment needs

Entity	**Purpose**	**Volume single investment**	**Duration**[C]	**Quantity of loans**	**Total loan volume** (million USD)
Producers (Refer to chapter 3 for details.)	▪ Rejuvenation/replacement of old coffee plants ▪ Additional costs for labor and inputs for GAP	240 – 515 USD/ha	4 – 7 years	115,000 ha	39.7
Aggregators (primary cooperative, trader, outgrower)	▪ Working capital for trade ▪ Storage ▪ Basic tools for quality control[A] ▪ IT hardware[B]	10,000 USD/ aggregator	4 years	130 new / improved aggregation facilities	1.3
Processors (cooperative / union, larger traders / exporters)	▪ Processing - Washing station - Hulling mill	65,000 USD/station 20,000 USD/mill	4 years	34 33	2.9
			Total investment needed		**43.9**

[A] E.g. moisture meter, hand huller

[B] For accounting, monitoring, traceability

[C] Loan durations required are longer than current practice (see Annex 11). Periods stated are deemed feasible for loan takers but require adjustments by banks and micro-finance institutions working with the project and receiving international loans / guarantees to finance the new loan products.

Sources: Cost assumptions are based on interviews with farmers, traders/processors, cooperatives and Sorgaba Union in Illubabor, and Nkurunziza (2018).

A possible scenario for lending to coffee farmers, aggregators and processors is illustrated in Figure 13. By year ten, all interested farmers have at least started to take loans, and aggregation facilities have been upgraded or newly installed. Lending for additional processing capacity is needed from year six onwards, when improved on-farm practices result in higher yields. Lending to processors may last beyond the anticipated live time of the project (15 years, refer to section 5.6).

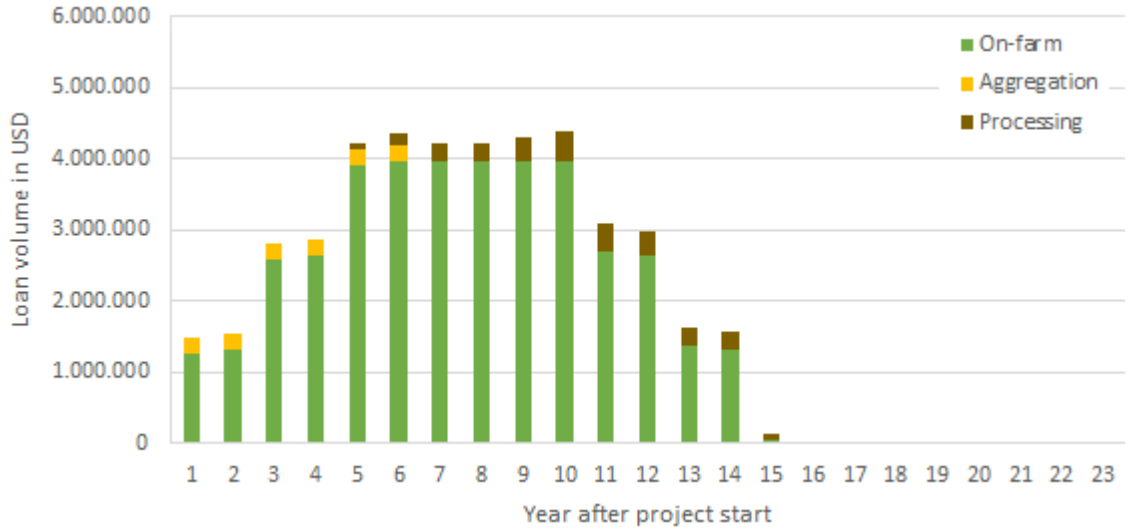


Figure 13: Lending to coffee farmers, aggregators, and processors

Current lending practices and barriers to lending

Currently, well-established businesses (cooperative union, large traders/exporters) can access credit to finance coffee trade and to purchase equipment. However, producers and primary co-operatives have very limited access to credit.

National banks and MFIs provide credit to businesses only against collateral. Traders interviewed claimed that collateral requirements are a barrier and loans too small and expensive.[31] As a result, traders rely mostly on their own capital to buy coffee or invest into production assets.

Primary cooperatives and farmers rarely have collateral. Cooperatives can get credit from the Oromia Cooperative Bank to finance coffee buying throughout the season. In most cases, the Sorgaba Cooperative Union is the borrower, passing on credits to the primary cooperatives based on previous coffee turnover. A very small loan volume is available for onward lending to the members of primary cooperatives.

Farmers can get very small, short-term loans from cooperatives or traders. Given the very small loan volumes available, farmers often rely on micro-finance institutions (MFI) despite their less favorable interest rates. MFI are much more accessible to the rural population then banks[32] and have special lending products which do not require collateral (e.g. group loans), albeit with short loan duration. The government subsidizes microfinance loans for businesses implemented by youth groups.

Both banks and micro-finance institutions finance (MFI) provide loans from shareholder capital, customer deposits, and with finance from the Central Bank of Ethiopia. MFI also use loans from larger national banks. However, overall, both commercial banks and MFI do not own enough

[31] Ethiopian small and medium enterprises reported access to finance as a key constraint even if holding owning an account with a bank or microfinance institution. In particular small enterprises (5-20 employees) have difficulties to get a credit. (NBE, 2017 citing International Finance Corporation Finance Gap Data Base).

[32] With branch offices in larger kebele towns and/or working with kebele government and agents visiting smaller population centers to promote their products and assess borrowers. According to CSA (2017b), MFI are the primary source for formal loans in rural areas.

loanable funds to satisfy demand (NBE, 2017) and cannot directly access foreign finance to increase lending. Foreign capital can be used as guarantee for onward lending, but guarantees are bureaucratic to set up.

The government promotes Savings and Credit Cooperatives (SACCO) to increase access to financial services in rural areas. However, while more accessible than banks and MFI, SACCOs are reported to have weak technical / management skills and systems, leading to poor governance (NBE, 2017).

An overview of national and local lenders, relevant products and conditions is provided in Annex 11.

To enable investments into sustainable production of high quality coffee the access to loans must be increased, by:

- Increase capital available for loans to the coffee sector: provide additional capital to banks and MFI willing to offer loans catering to the specific needs of the coffee sector
- Reduce barriers for borrowers:
  - lower the need for collateral and cost of loans by providing e.g. guarantees to national lending institutions and/or offtake guarantees for coffee, and
  - make information about borrowers for due diligence accessible to lenders (e.g. trade track record)
- Increase the duration of loans for specific investments: renovation of coffee farms and investments into production assets using similar tools as above
- Increase the borrowers' ability to access loans: improve financial literacy and accounting.

Lending and on-lending

A bank or MFI would lend to businesses and farmers for on-farm and processing investments. Loans covering rejuvenation and replacement cost only require three years to be repaid. Loans covering the additional cost of GAP are paid back over 7 years. An interest rate of 17% is assumed for farmer loans. Businesses would receive loans with 4-year repayment period at an interest rate of 13%.

This lending to farmers and businesses could be supported by an international investor via two financial instruments: loans and credit guarantees to overcome the barriers mentioned above.[33] Table 5 lists assumptions for a potential lending and on-lending scenario or guarantee.[34]

In the case of the international investor investing via a loan, the bank and/or MFI would receive loans of about 1.8 million USD/year over the course of 11 years, enabling them to upscale lending to farmers and businesses. Loans to support farmer on-lending would be provided on a 10 year tenor basis.

[33] Current policy restricts foreign investment into financial institutions. However, the regulatory environment is under review and this barrier may be lifted in the future.

[34] A mixed loan/guarantee approach is possible, but not reflected here.

Table 5: Lending and on-lending conditions

	National institutions	International institutions	
Lender	Commercial banks and micro-finance institutions	Impact investor	Development finance institution or bilateral investment program
Product	Small to medium loans to farmers and businesses	Large loans to national financial institutions	Loan guarantees for national financial institutions
Loans issued / guarantee provided for (million USD)			
Total Annual average Range per year	43.9 2.3 0.9 – 4.4	22.0 1.8 0.8 – 3.0	43.9 2.3 0.9 – 4.4
Loan conditions			
Period with active loans / guarantee (years)	23	23	23
Interest rate / guarantee fee	Businesses: 13% Farmers: 17%	7%	5%
Duration	Businesses: 4 years Farmers: 4 – 8 years	4 – 10 years	N/A
Default rate / 1st loss coverage	Businesses: 2% Farmers: 4%	-	25%

*Period until all loans are fully recovered.

The international investor breaks even 12 years after the start of lending and would achieve a return on investment (ROI) of 64% and internal rate of return (IRR) of 10%. The IRR is relatively low, highlighting the need to identify an investor that prioritizes development outcomes over profitability. The loan to the national lender is structured to ensure continuous net positive cash-flow. The national lender starts to accumulate profits from loans to farmers after year 15.

Figure 13 illustrates the cumulative cashflow for the international and national lenders in the case that the international investor provides a loan.

If the 44 million USD loan is covered by guarantee, the guarantor would achieve a return on investment of 59% and internal rate of return (IRR) of 4%.

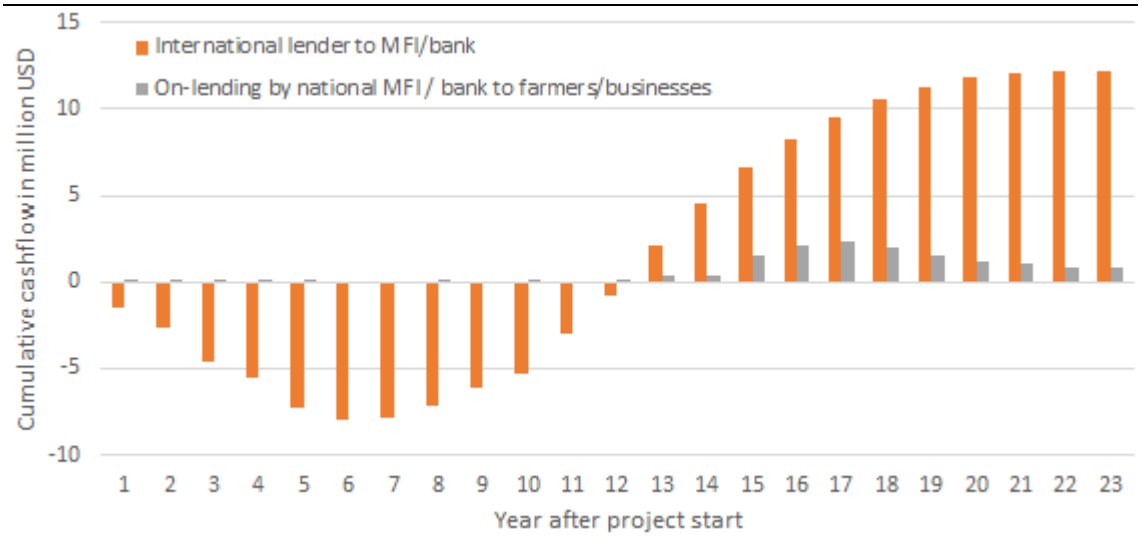


Figure 14: Cumulative cashflow international and national lenders

5.3 Incentives for sustainable management

The described coffee management practices and investments directly influence coffee productivity and quality. The related anticipated increase in income provides an incentive for farmers to engage in better management and invest in inputs, rejuvenation, and/or replacement of old coffee plants. These activities can at least be partially financed as described above.

Maintaining (or restoring) a diverse shade tree layer is a very important component of environmental sustainability but has little to no very tangible financial benefit (i.e. in terms of yield) for coffee farmers unless these trees provide additional income (e.g. from beekeeping).

To maintain and improve the existing shade tree management system an option would be to establish a compensation mechanism, e.g.:[35]

- **Payments for emission reductions**

  Carbon storage is still the only ecosystem service with a functional market place (voluntary carbon markets).[36] For watershed protection and biodiversity very few examples for payments for ecosystem services exist.

  However, the challenges of carbon monitoring, accounting and benefit sharing outlined in section 4.3 make carbon trade as a way of compensation unlikely. Insetting[37] could be an option if the investor decides to pay participating farmers directly.

[35] Regardless of the payment mechanism selected, farmers must be free to remove old trees to make space for new shade trees. To even out the resulting fluctuation of shade trees on any given farm, the intactness of the shade tree layer should always be considered for a larger area encompassing many participating coffee farms (e.g. for a cooperative or administrative unit such as kebele).

[36] To access the carbon market, projects have to comply with the standard regulation (eligibility and additionally of the project and use of the appropriate accounting and monitoring methodology). Carbon project development and certification has high transaction cost, which may not always be justified by the actual income from carbon credits.

[37] The use of the achieved emission reductions by an investor into the project to compensate for the organization's emissions.

- **Higher prices for "sustainable shade" coffee**

  With targeted marketing, the project could help identify coffee buyers willing to pay a price premium for sustainable coffee. The price premium can be transferred to growers complying with the higher production standard.

  Above average quality and consistent supply are likely pre-conditions to access specialized high-end coffee markets. This market segment is very small in comparison to coffee traded as commodity, i.e. few farmers are likely to benefit from such a scheme. Buyers may require third party certification, increasing costs.

  The aggregating and trading organizations (cooperatives, traders, or farmers with outgrowers) would have to separate "sustainable shade" coffee from other, conventional coffee and ensure traceability throughout the value chain.

5.4 Proposed organizational structure for upscaling

The project will have two main components:

- Providing access to finance for sustainable coffee production and
- Technical support to producers.

Access to finance

Funding sources and flows are illustrated in Figure 15. **Public investors** (e.g. development partners) and **impact investors** (e.g. green funds) provide concessional loans/guarantees to national commercial banks and micro-finance institutions (MFI), and grant funding for the technical assistance facility.

National banks and micro-finance institutions lend to organizations that participate in the project, processing and trading sustainably produced coffee. The loan products will include short-term finance for trade (1 year) and mid-term finance for investments into processing equipment, storage facilities and the like.

Micro-finance institutions will additionally target coffee producers. Loans with a duration of 3-4 years will be provided to farmers replacing (stumping) old coffee trees. Shorter loans (1-2 years) will be available to buy materials and tools. To strengthen the assessment of borrowers (and repayment rate) the micro-finance institutions can request basic information from the principal buyer of coffee (i.e. cooperative or larger farmer) showing the performance in terms of quantity and quality.[38]

International private sector (e.g. roasters) can provide loans to targeted producers (e.g. large farmers with outgrowers), cooperatives or independent traders, which fulfill specific criteria of the investor. These investments can be in-kind, e.g. paying for certification by a sustainability

[38] Quality here refers to adopting GAP promoted by the project (possibly also participation in a sustainability certification scheme). Both are related to better market access and prices. Sales track records can be combined with existing approaches, in particular group lending to ensure high repayment rates in the absence of collateral.
Lending contracts must include the permission to access such information. The technical assistance facility will support the national financial institutions in achieving compliance with international financial standards, by e.g. developing templates for lending contracts with coffee farmers.

standard or equipment that enables the local partner to produce the right quality. Repayment would be in the form of coffee.

A list of potential organizations to be involved in financing of the project is provided in Annex 11. These and other organizations will be interviewed in the second half of 2020 to concretize the list of investors and financial intermediaries participating in the planned project.

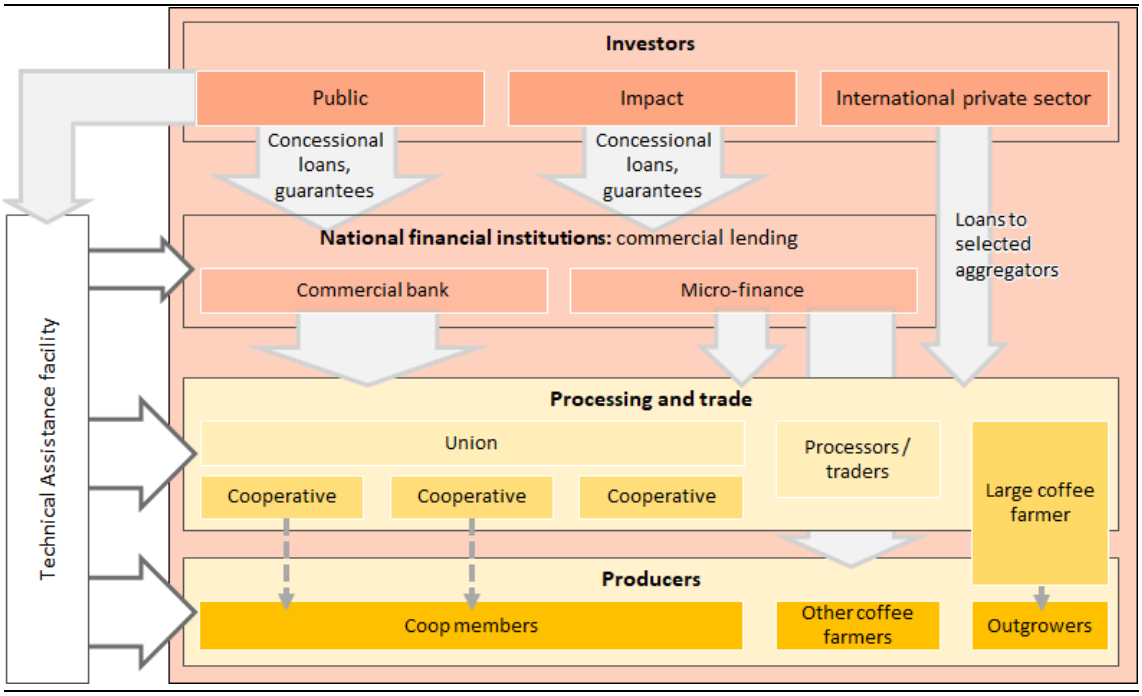


Figure 15: Funding entities and financial flows

Technical assistance facility

The technical assistance facility (Figure 16) will provide extension services to farmers, support the organizational development of cooperatives and farmers engaging outgrowers, aid all participants in adopting digital tools for accounting and coffee traceability, further develop and implement the monitoring system, and assist the financial institutions in product design and distribution. The technical assistance facility will require a consortium of different organizations able to deliver the services listed above.

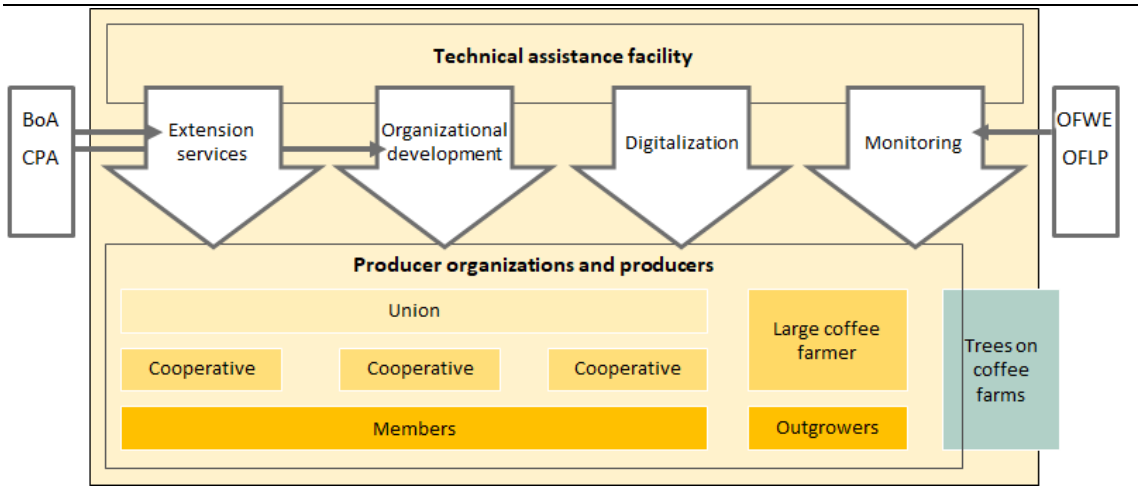
An organization with expertise in coffee management and value chain, organizational development of smallholder producer organizations will be responsible for the delivery of extension services and establishment of market linkages to trading houses and roasters. The organization will coordinate closely with the relevant government agencies at local level, the **Bureau of Agriculture** (BoA) and the **Cooperative Promotion Agency** (CPA). With growing technical and financial capacity of the cooperatives/union and farmers working with outgrowers, extension will be gradually handed over to these entities.

A digital service provider will lead the development of the project Management and Information System (MIS)[39] and ensure compatibility and exchange with third party systems (refer to section 5.5). This includes the use of digital tools by the extension service, and support the gradual shift from paper based records to digital systems by cooperatives, farmers with outgrowers, and traders. Guaranteeing data security will be an important aspect.

A specific activity of the facility will be to set up the monitoring of shade trees on coffee farms, including the baseline and reference level. The technical assistance facility will work closely with the **Oromia Wildlife and Forest Enterprise** (OFWE) and **woreda forest departments** implementing the **Oromia Forest Landscape Program** (OFLP). It is envisioned, that the agencies take on full responsibility for the monitoring of trees on coffee farms mid- to long-term.

Last but not least, the technical assistance facility will provide support to the bank and microfinance institution, helping them to access customers and refine their loan products.

The cost of the technical assistance facility is estimated to be in the range of 10 million USD over 15 years (based on the cost of the pilot project).



BoA: Bureau of Agriculture, CPA: Cooperative Promotion Agency, OFWE: Oromia Forest and Wildlife Enterprise, OFLP: Oromia Forest Landscape Program

Figure 16: Structure of and support provided by the technical assistance facility

5.5 Monitoring system

The monitoring system will have to cover a wide range of aspects to fulfill the information requirements of the key stakeholders. The following components address these requirements:

- Project implementation, outcomes, and impact: promotion of good practices resulting in increased coffee yield and quality, farm income, and environmental benefits
- Financial services: Loan disbursement and payback
- Chain of custody (CoC): tracing coffee from the producer to the international buyer, and provision of market information.

[39] Building on the MIS developed for the pilot project.

Each component will be an autonomous Management and Information System implemented by different entities. All three components rely to a large extend on data generated by the project participants. The data and information flow is multi-directional, i.e. the MIS provide information to the project participants and, in anonymized/aggregated format, to each other (see examples in Figure 17).

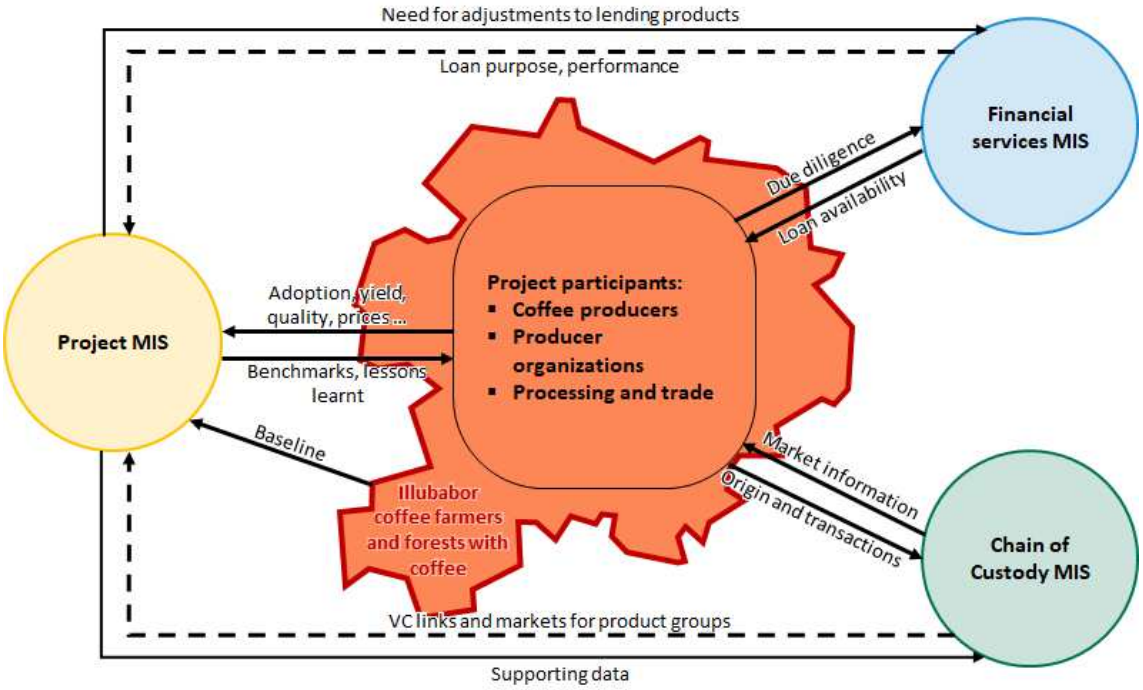


Figure 17: Components of the monitoring system and information flow

The already existing project MIS can be scaled up. The MIS was set up during the pilot project. It contains the farm register, baseline survey data (including shade tree inventory), basic information for the cooperatives, and project activity data (e.g. trainings). Data is entered by the project extension officers. The baseline data was recorded with mobile devices and data uploaded directly. Currently, the MIS provides simple query functions to authorized users. Specialized service providers can support or provide the implementation of the financial services and CoC MIS (refer to Annex 10).

Additionally, the involvement of certification bodies is needed if international buyers require verification of compliance with sustainability standards or if the project's investors want to generate carbon credits for trade.

The entities responsible for the MIS do have the relevant expertise to implement the individual systems, and can expand and create the required structures as needed. However, efficient implementation is expected to face two bottlenecks, which have to be addressed in the first phase:

- **Alignment of the monitoring systems:** The primary aims and origins of system to be adapted to this project are different for the three MIS components. To avoid redundant data collection and allow easy harmonization of information, managing entities need to identify common data needs, and adjust digital formats and communication structures correspondingly.

- **Creating digital infrastructure and knowledge at grassroots level:** Primary digital, sufficient and reliable data is essential for successful implementation. However, the use of information technology (IT) by cooperatives, but also traders and local level government agencies, is non-existent to low. A key task will be to develop the digital literacy and facilitate the purchase of IT infrastructure. Initially, some records can be transferred into digital formats for aggregated data sets by the project extension staff (e.g. self-reporting by Farmer Field School members (Annex 6). With increasing proficiency and confidence in IT-based data collection and storage, farmer organizations and traders can gradually shift to using IT for data collection.[40]

Table 6 provides an overview on the purpose of and the leading entities for each MIS.

Table 6: Monitoring components

	Information	Responsible organizations	Monitoring methods
Project	▪ Baseline ▪ Activities and outputs ▪ Outcomes (e.g. GAP adoption rate, area rejuvenated / replaced, coffee yield & quality, sustainable shade tree management) ▪ Impact (e.g. household income, transparency along the coffee value chain, mitigation / adaptation, biodiversity)	▪ System and data management, verification: – Technical assistance facility ▪ Data collection: – Project extension system – Participants (farmers, farmer organizations) – OFWE for forest data – BoA	▪ Self-reporting ▪ Semi forest coffee farm / forest inventory ▪ Remote sensing data analysis ▪ Questionnaires
Financial	▪ Client statistics (purpose, socio-economic status) ▪ Loan disbursement ▪ Loan payback	▪ System, data collection and data management: – Bank – MFI	▪ Client due diligence ▪ Account data
CoC	▪ Batch source ▪ Movement of coffee along the value chain – Identity preservation (individual batches) – Segregation (production according to a standard) ▪ Markets	▪ System and data management, verification: – Service provider (Annex 10) ▪ Data collection: – Producer organizations – All handling agents along the value chain	▪ Labelling of batches (producer and production standard) ▪ Transaction records

Monitoring and system management costs for the project and setting up the CoC component would be covered initially from the project budget. Over time, the responsibility for monitoring of memberships, coffee transactions, and CoC will be transferred to the cooperatives, outgrowers, and traders. Related costs will be covered from the revenues of coffee traded. The MIS users will decide the modalities for system management (responsible entity and financing) at a later stage, i.e. towards the end of the project. The financial services MIS could be financed from the income from loans.

[40] Mobile money and e-payment solutions remain uncommon in rural areas throughout Ethiopia. However, the Ethiopian government is now pushing financial inclusion by letting telecommunication service provide mobile money services. Improving IT and accounting skills of value chain agents will benefit the adoption of cashless payment in the future.

5.6 Project duration and long-term sustainability

The scale of the project and holistic approach along the coffee value chain require a programmatic approach to deliver sustainable results and impacts. The technical assistance components of the project can be implemented in three phases of five years. The key targets of each phase are outlined in Table 7. Time until full recovery of loans would be 23 years (see section 5.2).

The gradual transfer of responsibility for extension services and monitoring from the technical assistance facility to the producer organizations (including primary cooperatives, the cooperative union, and larger farmers engaging outgrowers) and government is key to the sustainability of the project. Accordingly, a focus of the project will be to build the corresponding capacities and support the development of suitable financing mechanisms.

The provision of loans will initially target project participants only (phase 1 – 2), but can be gradually expanded to other coffee farmers within Illubabor and eventually elsewhere. The financial institutions must secure the additional capital required for rolling out loans beyond Illubabor.

Table 7: Project implementation in three phases

Phase	Target
1	▪ Establishment of the technical assistance facility ▪ Agreements with national financial institutions and creation of targeted loan products ▪ Recruitment of producer organizations and members in the key producing woredas (Annex 1) ▪ Establishment of new cooperatives and outgrower schemes ▪ Provision of organizational development services to the producer organizations and extension services to the associated coffee farmers ▪ Support the more advanced producer organization in digitalization ▪ Link participating producer organizations and international private sector for direct investment and marketing of coffee ▪ Establish permanent sample plots in semi-forest coffee areas and define the reference level for semi-forest coffee farms in Illubabor ▪ Engage a service provider for Chain of Custody ▪ Develop the project MIS and align the three MIS (project, financial service providers, CoC)
2	▪ Roll out implementation to the remaining coffee producing woredas ▪ Transfer the responsibility of extension services to the producer organizations included in phase 1 (financed from coffee trade) ▪ Re-measure the permanent sample plots in semi-forest coffee areas and determine the effect of the project on shade trees for coffee plots included in phase 1
3	▪ Consolidate and hand over extension and financial service provision to local service providers ▪ Re-measure the permanent sample plots in semi-forest coffee areas and determine the effect of the project on shade trees on coffee farms across Illubabor ▪ Transfer all relevant parts of the project MIS to a service provider ▪ Transfer the monitoring of shade trees fully to the government

6 RISKS AND RISK MITIGATION STRATEGIES

Risk factors, if not addressed appropriately, can compromise the effectiveness and efficiency of project implementation, or create unintended negative effects. Safeguard standards provide a set of criteria against which projects can be evaluated to ensure sustainable development and avoid any negative impacts for the local population and environment.

Potential risks, mitigation strategies and a preliminary safeguard assessment are presented in the following three sections. Risks were differentiated in:

- Internal risks, which can be directly influenced by project design and during implementation.
- External risks, which are caused by factors outside of the project's influence. The project can seek to minimize the potential effects of these risks.

6.1 Internal risks

Internal risks are related to the possible difficulties in recruiting coffee farmers and uptake of loans, handing over responsibilities to the local actors, secure data management, and stimulating private sector investment.

Overall, the jurisdictional approach – aligning the interests of the wide range of stakeholders and monitoring across minor administrative boundaries – will help to reduce risks and recognize any negative trends early on. The implementation in phases allows integration of lessons learnt and to adjust specific measures and activities as needed.

The internal risks and key mitigation strategies are listed in Table 8. A more detailed explanation is provided in the paragraphs below the table.

Table 8: Project internal risks and mitigation strategies

Risk	Mitigation strategy
The project cannot recruit enough farmers because of lacking density of and trust in producer organizations.	▪ Support the establishment of new producer organizations (cooperatives, outgrower schemes) in underserved areas ▪ Build capacity of producer organizations, making them more attractive for farmers
The lending component of the project does not succeed at scale because of existing barriers at both lender and loan taker sides.	▪ Improve the financial literacy farmers and accounting capacity of producer organizations ▪ Stimulate lending by providing loan guarantees to financial intermediaries and subsidize selected loan products ▪ Improve the access to information (lending products and conditions, and for due diligence of loan takers)
The project has limited impact because stakeholders do not continue the practices and systems promoted by the project after the project lifetime.	▪ Foster active participation of various farm household members, i.e. including youth and women ▪ Involve government and producer organizations in relevant project activities and gradually transfer responsibilities. ▪ Develop sustainable business models to finance extension service provision by producer organizations. ▪ Design loan products fitting the needs and capacities of both lending organizations and loan takers.

Table 8: Project internal risks and mitigation strategies

Risk	Mitigation strategy
Project participants and implementing organizations are exposed to financial and reputational risks because data is not stored safely.	▪ Application of a common standard for data storage and management by implementing organizations based on the Data Protection Regulation of the European Commission ▪ Capacity building of producer organizations to safely collect, store and manage data
Increased profitability of coffee may provide an incentive to expand the area under coffee causing forest degradation/deforestation, and threatening food security and resilience.	▪ The jurisdictional approach allows to recognize such trends and design counter measures early on ▪ Implementation of the OFLP and REDD+ investment program in key forest areas in Illubabor
Investments by international private sector remain limited because of institutional barriers and failure of local partners to meet investor specific requirements.	▪ Capacity building for producer organizations, traders, and processors enabling them to comply with investor requirements ▪ Project to act as a matchmaker between potential investors and promising local partners

Recruitment of project participants

The project requires aggregating organizations to reach farmers. Currently, cooperatives are the only institutional vehicle to aggregate coffee farmers. However, only about 20% of coffee farming households are members of cooperatives and loyalty to the cooperatives is low (with most farmers selling coffee elsewhere as well). Other avenues to reach farmers efficiently do not yet exist (e.g. outgrower relationships). To overcome this constraint, the project will have to adopt a diversified approach to recruit farmers:

- Build the capacity of existing cooperatives and the union to make them more attractive to farmers, thereby encouraging more farmers to join cooperatives and sell a larger share of their coffee to the cooperative.
- Support the establishment of new cooperatives and outgrower schemes, especially in areas where currently are no producer organizations.
- Explore the options for reaching out to producers through coffee traders.

Disbursement of loans and loan repayment

Lending is an important component of the project, needed for investments at different levels. While trade finance is well established, experience with lending to producer organizations and farmers for mid- to long-term investments is limited and faces some barriers on both sides:

- Lender: lack of information about loan takers, limited infrastructure of banks and MFI in rural areas to advertise products and for due diligence, and related high transaction costs for relatively small loans.
- Loan takers: low financial literacy, no/low collateral, high cost of loans, no/limited confidence to pay back the loan.

The project can overcome these challenges by:

- Improving the accounting practices of producer organizations (in close cooperation with the Cooperative Promotion Agency) and provide financial training to project participants,

- providing loan guarantees to the financial intermediaries and subsidizing selected loan products,
- designing well targeted loan products and advertising them through producer organizations and kebele administration,
- using proven approaches, such as group lending schemes for loans to farmers, and
- improving the availability of information for due diligence by setting up safe platforms for exchanging information between producer organizations and MFI/bank.

Sustainability and exit strategy

One of the aims of scaling the project across an entire jurisdiction is to create measurable socio-economic and environmental impacts at landscape level. However, if the stakeholders in the zone are not able or willing to continue activities or maintain the management, financial, and monitoring systems beyond the lifetime of the project, impacts may be limited or fade over time. To avoid this, the project will:

- Make women and young people key target groups in trainings, ensuring broader and lasting adoption of GAP.
- Involve government agencies actively from the very beginning, build capacity, and gradually transfer responsibilities as part of the project's exit strategy.
- Transfer the responsibility for the delivery of extension services, marketing of coffee, and related monitoring and accounting to producer organizations as their capacity increases. Together with producer organizations, sustainable business models will be developed to finance these services.
- Emphasize the importance of a diverse shade tree layer for sustainable coffee production in trainings and strive to give a permanent financial value to the shade trees (see section 5.3) to avoid degradation later on.
- Design loan products carefully, keeping in mind the requirements of loan takers, banks, and MFI to ensure successful investments and high repayment rates – preconditions for banks and MFIs to scale lending to other areas and commodities.

Data safety

The project, producer organizations, and financial institutions will collect, store, and share data of project participants for monitoring and evaluation, accounting, traceability, and financial due diligence. Data leaks would expose the project participants to financial and reputational risks, and destroy their confidence in the project and the implementing organizations. The project would have to make additional efforts to repair the resulting damage and/or may not be able to reach its targets.

Data safety will be a primary concern in the design and development of the different Management Information Systems (see section 5.5), interfaces between them, and data sharing between participating organizations and third parties.

In the absence of an Ethiopian regulation for the protection of personal data, the project will apply the rules of the European Commission (adjusted to the Ethiopian context) and support project partners to apply similar standards. A special focus of the project will be to build the

capacity of producer organizations to safely collect, store, and manage data as they gradually transition to the use of digital systems.

Perverse incentives

The project has two key objectives: to (i) improve the income from coffee and (ii) avoid degradation of forests.

Success with the first objective may create an incentive for coffee farmers to expand the now much more profitable coffee crop to other land (primary forest or replacing other crops). The resulting threat of forest degradation/deforestation and potential threat to food security and resilience[41] can be mitigated by:

- Landscape level monitoring across the jurisdiction and implementation of the Oromia Forested Landscape and REDD+ investment programs in the key forest areas of Illubabor will show/counteract any negative trends on forests early on.
- Monitoring of food crops and crop production by the BoA will show any sharp increases of coffee at the expense of food crops, allowing the design of measures guaranteeing food security.

Lack of international private sector investment

Direct relationships between international buyers and producer organizations are an important avenue to improve market access and stabilize prices for producers. However, the capacity of producer organizations to deliver consistent quantity and quality is low, and lead-time to build the necessary capacities relatively long. The highly regulated coffee trade poses an additional barrier for foreign investment. International buyers may have specific requirements, e.g. certification with a sustainability standard. However, to date only a handful of cooperatives are certified in Illubabor.

Capacity building of producer organizations and farmers for the production of high and consistent quality and quantity is at the core of the project. The technical assistance facility will be able to link potential investors to the more advanced producer organizations to jump-start direct investment and marketing.

The project activities will also lay the foundation for certification (good agricultural practices, monitoring), although the cost for certification would have to be carried by the buyer.

6.2 External risks

Some risk factors are outside the project's control, but the project can mitigate the potential effects to some extent. These external risk factors include civil unrest, climate change, the market environment, especially global price fluctuations and the high transaction cost to access export markets.

[41] Increased household income from coffee versus other crops would increase food security and resilience. However, factors outside the control of farmers, especially coffee prices and occurrence of new pest and diseases can reduce income from coffee drastically. By not relying on one crop only, farm households maintain fallback options for loss of income from coffee.

The GAP promoted by the project will also contribute to make coffee farms more resilient. Building the capacity of producer organizations will enable them to overcome challenges posed by the market environment.

The internal risks and key mitigation strategies are listed in Table 9. A more detailed explanation is provided in the paragraphs below the table.

Table 9: External risk factors and mitigation strategies

Risk	Mitigation strategy
Periods of civil unrest may pose a danger to staff members and project participants. Project implementation may slow down temporarily.	Project management will be attentive to the political situation and advise staff accordingly.
Climate change reduces the suitability for coffee production and/or can increase other problems (e.g. pest and diseases, severe weather).	GAP promoted by the project also help to increase resilience against climate related stress factors.
Coffee prices in the global coffee market are subject to substantial fluctuations. Low prices may be a disincentive to invest in coffee farms or limit cashflow at farm level.	▪ The economic analysis used conservative values for yield and producer prices. The recommended investments are profitable even with these conservative values and would temporarily buffer lower yield and/or prices.
The Ethiopian coffee market is highly regulated, restricting trade relationships and modalities. Transaction costs to access international markets are high. As a result, producer organizations are unlikely to get good prices for high quality coffee, which may discourage investment in quality at producer level.	▪ Capacity building of producer organization will create the basis for direct engagement with international buyers outside the mainstream commodity markets. ▪ The project can support the establishment of linkages between international buyers and producer organizations.

Civil unrest

Civil unrest, related to political decisions, can turn very violent and pose a danger to project staff and participants. Travel and internet communication may be interrupted in such events. Illubabor has been remained secure during the periods of political turmoil in the past five years. However, other events such as the current COVID 19 pandemic may impose restrictions across the country/globally. Ultimately, such events may cause a slow-down/delay of project activities and reduce project performance temporarily.

Project management will by attentive to the political (or any other potentially dangerous) situation and advice project staff and partners accordingly. Delays in project implementation may lead to an extension of the project.

Climate change

Climate change is expected to make some areas unsuitable for coffee cultivation, while others will be less suitable to varying degrees. Especially coffee production areas at lower altitudes are threatened by rising temperatures. Other, potentially negative effects of climate change are increasing pest and diseases pressure, increasing incidence of severe weather events, and changes in the on/offset and reliability of the rainy season.

Project interventions will focus on areas expected to remain suitable for coffee. The GAP measures promoted by the project (adequate shade, use of pest/disease resistant varieties, soil

management) will help to make the coffee farms more resilient against climate (related) stress factors.

Farmers growing coffee in already marginal areas may have to change to other crops compatible with the changing climate eventually.

Changes in the global coffee market

Prices at producer level are strongly influenced by global supply and demand. Demand for Arabica coffee is expected to grow and Ethiopian coffee is – generally speaking – a sought after provenance indicating a positive outlook for coffee farmers. However, in reality global coffee prices were at an all-time low in the second half of 2019 and tend to fluctuate considerably. Furthermore, coffee from Illubabor is perceived to be of inferior quality, i.e. does not get the best prices in the country.

Low prices and price volatility may reduce the willingness of farmers to engage in costly investments in rejuvenation / renovation of coffee farms.

The economic analysis shows that a substantial increase of productivity at prices achieved by farmers in the 2019/20 season covers the investment within four to six years and creates substantial profits thereafter. That is, the predicted yield increase will ensure profitability even if prices are at the lower end of the range.

Other options to buffer farmers from price fluctuations are:

- Direct engagement of international buyers willing to offer forward contracts to producer organizations,
- Certification with sustainability standards to ensure market access and potentially getting a small price premium over non-certified coffee, and
- Accessing specialty coffee markets with substantially higher and more stable prices.

The latter two options can be part of the answer, but are unlikely to be standalone solutions given the relatively small market share and additional investments required. Individual buyers, ready to finance certification and specialty development, should drive such investments.

The project will help to create the necessary basic conditions for investors/buyers to engage producer organizations directly (capacity of producer organizations, adoption of GAP).

National environment for coffee marketing

Ethiopian coffee producers and traders are legally required to sell all high quality coffee through the Ethiopia Commodity Exchange or directly to international buyers. However, especially the more valuable, highly graded coffee does often not find buyers at the ECX and directly accessing international buyers is difficult for Ethiopian trade entities. At the same time, producers/traders cannot legally sell high quality coffee to local buyers willing to pay a price premium.

As a result, the investment in GAP resulting in high quality coffee beans may not result in the anticipated higher income for the farmer, discouraging them from doing so in the future.

Building capacity of producer organizations (especially at union level and larger farmers with outgrowers) will enable them to reach out to international buyers to market coffee directly. Additionally, the project can to some extent support the establishment of linkages between producer organizations and international buyers (see international private sector investment in section 6.1) to mitigate this risk further.

6.3 Safeguards

The WB (2016) Environmental and Social Framework (ESF) has ten standards against which projects are assessed. The GIZ (2019) safeguards guideline defines five areas that are covered by the more detailed WB ESF. The preliminary assessment focused on items of the ESF that are of particular relevance for the envisioned project.

The project aligns well and/or can comply with the ESF. The results of the assessment for the standards two to nine are presented below. [42]

S2 Labor and working conditions

The standard applies to all workers involved in a project, be it direct or indirect. Of particular relevance for the project are:

- Nondiscrimination and equal opportunity – the project and project partners must commit to employ persons regardless of gender, origin, or ethnicity. Women[43], youth and people with disabilities may be given priority when filling positions to address existing imbalances.
- Child labor and minimum age – the project and project partners will not employ any person below the age of 15 years. For persons age 15-18 restrictions on the type of labor and working hours and days apply.

  Children often participate in the family business, including coffee production. However, neither Ethiopian law and policy nor the WB ESF provide any guidance on the legality of young children contributing to farm and domestic activities. However, the project should encourage household heads to limit child involvement to levels that do not impede school attendance or performance, and exclude them from any potentially dangerous activities.

S3 Resource efficiency and pollution prevention and management

The standard refers to the efficient consumption of resources and the avoidance or minimization of releasing any pollutants.

Farmers in the region rarely use agro-chemicals on their coffee plots. The good agricultural practices promoted be the project rely on organic fertilization and integrated pest management with minimal use of pesticides.

Wet mills require large amounts of water and release the wastewater into the environment. At the moment, the share of washed coffee in Illubabor is small (< 5% of the total production) and the project will not actively promote an increased share of washed coffee. However, credits for processing can also be used for wet mills. To avoid damage to the environment, the project should support the government to control the correct installation of new mills or expansion of existing ones.

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[42] Standard # 1: the "Assessment of the environmental and social risks and impacts" is not covered here. The in-depth assessment of likely risks and impacts must be done in the project design and/or project appraisal following the guidance of the financing partners.

[43] Giving preference to women is explicitly stated in the Labor Proclamation (FDRE, 2019). Minimum age and age of "young" persons is stated as in the proclamation.

The GIZ guideline identifies climate change as an individual safeguard as it may restrict the development potential or reverse progress made. The project incorporates both mitigation and adaptation aspects. It contributes to carbon retention and sequestration in soils and shade trees, enables continued coffee production in the face of climate change, and makes households resilient to shocks by improving on-farm income.

S4 Community health and safety

The standards seeks to avoid any potential health, safety, and security risks and impacts on project-affected communities. The practices and investments promoted by the project do not expose the communities to any of the specific risk groups mentioned in the standard.

S5 Land acquisition, restrictions on land use, and involuntary resettlement

The standard refers to any project-related land acquisition or restrictions on land use, which may cause physical or economic displacement. The project works with smallholder farmers and potentially larger farmers wishing to set up outgrower schemes. The project does not require any transfer of land ownership or a change from coffee to another land use (e.g. strict conservation).

S6 Biodiversity conservation and sustainable management of living natural resources

The standard requires sustainable management and use of the living natural resources. It distinguishes between categories:

- Modified habitat, where a project should avoid / minimize impacts on biodiversity and implement mitigation measures as appropriate
- Natural, critical habitats, and legally protected and internationally recognized areas of high biodiversity value, where a project should not implement any potentially damaging activities.

The project focusses on existing semi-forest coffee farms, i.e. modified habitat. It promotes the conservation and, if necessary, improvement of the shade tree layer, as well as good agricultural practices in general.

The remaining natural forests in Illubabor are considered to be of high conservation value and are partly included in the Yayu Coffee Forest Biosphere Reserve. The aim of the project is to reduce pressure on these areas by increasing income from the existing coffee farms. It will work with the local and regional authorities implementing the Oromia Forested Landscape Program, which seeks to protect and restore forests and forested landscapes.

S7 Indigenous peoples/Sub-Saharan African historically underserved traditional local communities

The standards seeks to enhance opportunities for indigenous peoples in ways that do not threaten their unique cultural identities and well-being.

Stakeholders interviewed to data provided no indication of any indigenous peoples living in the Illubabor zone. The topic will be assessed at depth in the project design phase and the environmental and social impact assessment. If and where indigenous peoples exist, the project will not differentiate between indigenous and any other people engaging in coffee production. If needed, the project design will include special measures to improve access to services provided by the project.

S8 Cultural heritage

The project is not expected to affect any tangible or intangible cultural heritage.

S9 Financial intermediaries

The standards defines financial intermediaries as public and private financial services providers, which channel financial resources to a range of economic activities. Financial intermediation also includes provision of financing or guarantees by financial intermediaries to other financial intermediaries.

The financial intermediaries have to have an Environmental and Social Management System in place. At minimum, the financial intermediaries have to comply with Ethiopian laws. An assessment of the Environmental and Social Management System of financial intermediaries likely to participate in the project must be done in the project design phase.

S10 Stakeholder engagement and information disclosure

According to the standard, stakeholders must be engaged for the project's environmental and social assessment and for project design and implementation.

A wide range of stakeholders was engaged for the implementation of the pilot project and this feasibility study. This stakeholder engagement must continue in the design and implementation of the scaled project.

7 CONCLUSIONS AND NEXT STEPS

The project outlined above would contribute to socio-economic development and support the sustainable management of natural resource and biodiversity conservation in the region by

- increasing on-farm income, while maintaining the traditional semi-forest coffee management system,
- increasing coffee production in the zone without expanding coffee area into forests or land used to cultivate food crops, and
- improving market access for sustainable incomes.

In doing so, the project would contributing to the implementation of Ethiopia's Climate-Resilient Green Economy strategy.

To make these impacts tangible, the project has to work in a large, but well-defined area, seeking to reach as many coffee farmers as possible. Illubabor zone, with currently about 230,000 ha of coffee belonging to about 180,000 households is considered a suitable project area. For the assessment, we assumed that 50% of coffee farmers would participate in the project, resulting in 115,000 ha of coffee under sustainable management and increasing Illubabor's coffee production to 150% of the current level.

7.1 Investments in coffee production

On-farm

The necessary investments by coffee farmers include rejuvenation or replacement of old, unproductive trees, and a switch to good agricultural practices to ensure sustainable production and good coffee quality. The implementation of GAP requires substantially more labor than current practices, increasing the recurrent expenses additionally to the one-off cost of rejuvenation / replacement. In total, the financial investment for on-farm interventions is estimated to be 40 million USD.

Especially rejuvenation or replacement has a very tangible, positive impact on farm income due to the expected yield increase per hectare of about 250% against the baseline. However, despite the known benefit of rejuvenation / replacement and improved practices, farmers are reluctant to invest because:

- They fear that they may not be able to market their coffee at a reasonable price in the future;
- Lack access to finance with payback periods suited to achieving profitability in year two to three only.

Additionally to the provision of extension services to farmers, the project has to address market and finance constraints:

- Build the capacity of producer organizations and other coffee aggregators to market coffee
- Foster the establishment of long-term linkages between producer organizations and off-takers, both national and international ones
- Support the provision of small-scale commercial loans with a mid-term tenor by providing finance and/or loan guarantees to banks and micro-finance institutions.

Aggregation and primary processing

Producer organizations and small and medium sized traders play an important role in the coffee value chain. Their activities are currently limited to the aggregation, and in some cases processing of coffee. They do not provide services to producers, which could greatly influence productivity and quality. Outgrower schemes are another option linking farmers to markets, but do not yet exist.

Financial investment is needed at aggregator level to permit quality control, and adequate storage of coffee. With the increasing production of coffee after on-farm investments, additional processing capacity is required. The estimated total investment volume of 5 million USD is minor in comparison to on-farm investments.

- Investments can be financed with regular commercial loans, especially if backed by international lenders/guarantors as described above.
- The project should support the organizational development of all producer organizations, traders, and farmers with outgrowers interested in providing stable markets and services to producers.

7.2 Financing investments

The 45 million USD channeled to producers, aggregators and processors via commercial banks and MFI are estimated to generate an internal rate of return of about 10%. Traditional aid and financial reform partners are the most likely investor group for such investments as they prioritize development outcomes over profitability. Some impact investors may also be interested.

Current policy does not permit direct foreign investment in domestic financial intermediaries. However, there are expectations that the government will revise this policy to overcome foreign currency constraints for the country and limited access to refinance of banks and MFIs.

Loan guarantees are an alternative option, but somewhat bureaucratic to set up. Smaller, direct investments by private sector entities in producer groups or domestic firms are possible, e.g. to secure their supply chain and/or as part of their corporate social responsibility strategy.

Additional to the loan financing, the project will require about 10 million USD grant finance to fund the technical assistance component of the project.

The results of this feasibility study will be compiled in a business case paper for presentation to potential international and national investors.

7.3 Organizational set-up

The project will be structured in a financial assistance and a supporting technical assistance facility. Financial assistance by public of impact funds is provided as loans/guarantee for on-lending by banks and MFIs to farmers, aggregators, and processors. Private sector investors can be part of the overall financial assistance or directly finance complementary investments.

The technical assistance facility will provide support to the domestic lending institutions, producer organizations, local private sector, and coffee farmers. It will be responsible for the coordination of all activities and involvement of regional and local stakeholders, especially government institutions.

The project design assumes that the technical assistance facility will be implemented by service providers with complementary expertise. The Bureau of Agriculture, Cooperative Promotion Agency, and Oromia Wildlife and Forest Enterprise, and forest departments are the key government agencies involved.

7.4 Monitoring

The monitoring for the project has four key components. Monitoring:

- Implementation, results and impacts of the technical assistance to farmers and aggregators
- (avoided) forest degradation and deforestation
- Financial services provision and repayments
- Chain of custody control to trace coffee origin from the producer to the international buyer

Primary data will be collected and held by different entities participating in the project, i.e. the technical assistance facility, producer groups, banks/MFI, and service provider for the CoC. Secure exchange of information between the different entities/monitoring systems is crucial for the success of the project.

- To avoid redundant data collection and allow easy harmonization of information, the managing entities will have to identify common data needs, and adjust digital formats and communication structures correspondingly.
- The technical assistance facility will support the development of the digital infrastructure and knowledge at grassroots level, specifically developing digital literacy and facilitating the purchase of IT infrastructure.

Forest degradation monitoring includes the establishment of a reference level for shade trees on semi-forest coffee farms and the monitoring of shade trees on participating coffee farms. Over time, monitoring will provide evidence on the (positive) impacts of investments in coffee farms on avoiding deforestation and forest degradation.

- The monitoring design must follow carbon accounting standard methodologies and be fitted into the framework of the Oromia Forested Landscape Program and monitoring approach.
- The OFLP does not yet have a reference level for forest degradation. The project should closely engage with the forest authority to develop the methodology for forest degradation monitoring.
- To make the degradation monitoring as cost efficient as possible, different methods will be combined, including self-reporting by coffee farmers, verification by extension officers, and shade tree inventories in permanent sample plots distributed across semi-forest coffee farms in Illubabor.

7.5 Holistic approach to sustainable coffee landscapes

This study focused on the potential for improving coffee production by giving farmers access to technical assistance and finance. However, other aspects will have to be incorporated in the project design to achieve the vision of a sustainable coffee landscape and livelihoods.

Access to markets: Strong market linkages would provide a key incentive to producers and aggregators to invest in more sustainable production methods and monitoring thereof. The improvement of the market environment requires policy and project level interventions to:

- improve the restrictive environment for coffee trade and foreign direct investment,
- set-up a sustainable sourcing area in line with the increasing commitment of international buyers for responsible sourcing, and
- create direct, long-term linkages with coffee trading houses and roasters.

Living income and drivers of deforestation and forest degradation: Crops other than coffee and livestock contribute to the income of rural households in Illubabor and may contribute to deforestation and forest degradation. A deforestation/degradation driver study was conducted for the Oromia Forested Landscape Program, but is not detailed enough to identify the importance of specific deforestation/degradation drivers in Illubabor.

- ➢ In the run-up to the project, the contribution of other income sources to household income but also deforestation/degradation should be assessed, and findings reflected in the project design.

Inclusion of youth: Few young coffee farmers are participating in the pilot project, indicating that farming is perceived as unattractive and/or land is not available to young people interested to establish (coffee) farms. The trend of rural to urban migration of youth and lack of generational change are common throughout Ethiopia as well as neighboring countries. At the same time, youth is more likely to invest and adopt new technologies – making young people a driver of change that would be beneficial for the project. Building on lessons learnt throughout the region, the project design should include activities specifically targeting youth.

7.6 Risks and risk mitigation

The risk assessment identified a range of internal and external risk factors potential threatening the successful implementation of the project.

Internal risk factors are recruitment of coffee farmers and uptake of loans, handing over responsibilities to the local actors, secure data management, and stimulating private sector investment. These risk factors can be addressed in the project design, adjustments for phase 2 and 3, and during implementation.

External risk factors include civil unrest, climate change, and the market environment. Maintaining and improving the resilience of the coffee production system, increasing productivity of coffee farms, and building the capacity of producer organizations will help farmers and producers to face climate change and price fluctuations. Politically motivated unrest may lead to temporary delays of implementation that can be compensated later on.

- ➢ The project will be assessed against the World Bank's Environmental and Social Framework (2017) or other, similar standard specified by the financing partners. The assessment and corresponding adjustments to project design will help to avoid the above-mentioned risks or mitigate their potential effects on project implementation and results.

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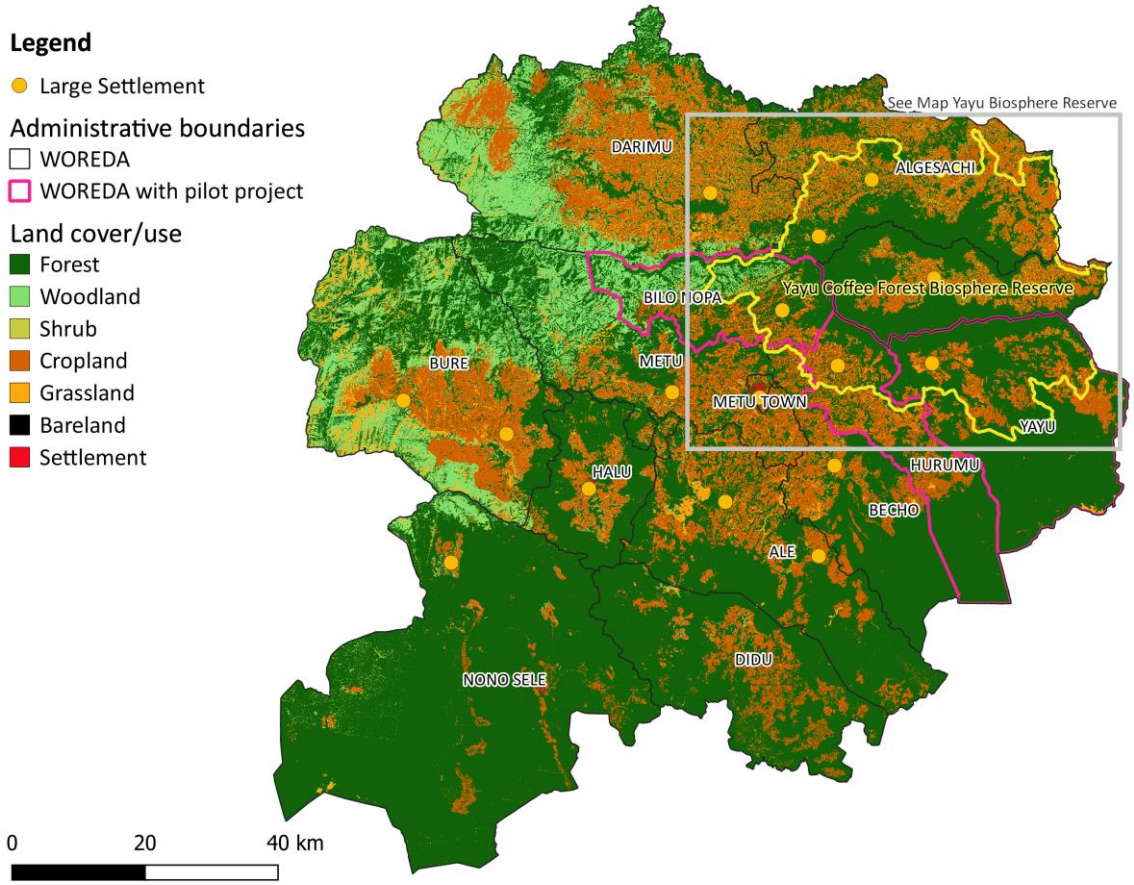
ANNEXES

Annex 1: Land use and coffee production statistics for Illubabor

Land cover and use in Illubabor

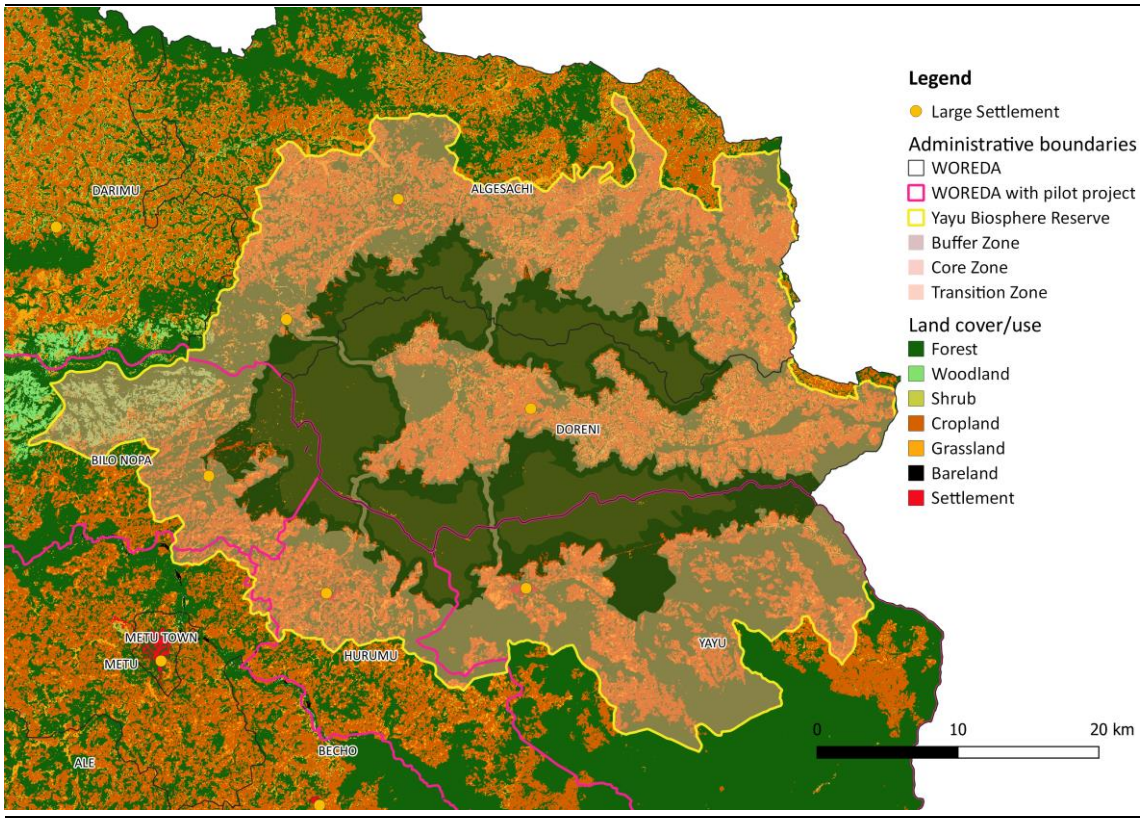
Land cover/use class	Area	
	ha	%
Forest	667,000	64
Cropland	218,000	21
Woodland	92,000	9
Grassland	55,000	5
Shrubland	13,000	1
Settlement	1,000	0
Total	**1,046,000**	

Source: WLRC (2016)



Land cover and use in Illubabor

Source: WLRC (2016)



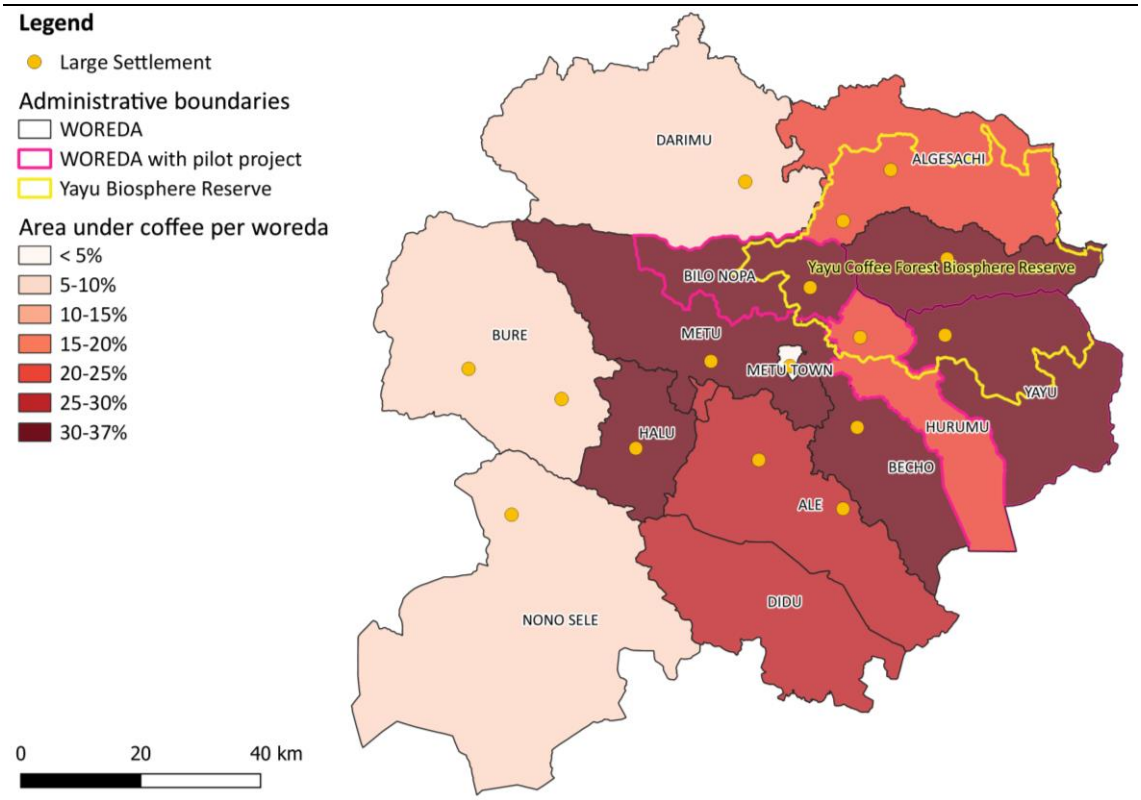
Yayu Coffee Forest Biosphere Reserve

Source: WLRC (2016)

Area cultivated with coffee in Illubabor

Woreda	Area under coffee		
	Total	Productive	
	ha	ha	%
Ale	22,036	17,128	78
Alge Sachi	20,035	13,638	68
Bacho	17,000	7,364	43
Bila Nopa	13,840	9,083	66
Bure	7,171	3,753	52
Darimu	13,215	11,327	86
Didu	19,048	11,524	61
Dorani	15,521	11,189	72
Halu	11,201	6,996	62
Hurumu	14,893	11,818	79
Mettu	24,892	13,691	55
Nono Sale	13,667	9,732	71
Yayu	37,006	29,493	80
Mettu town	0	N/A	N/A
Total	**229,524**	**156,735**	**68**

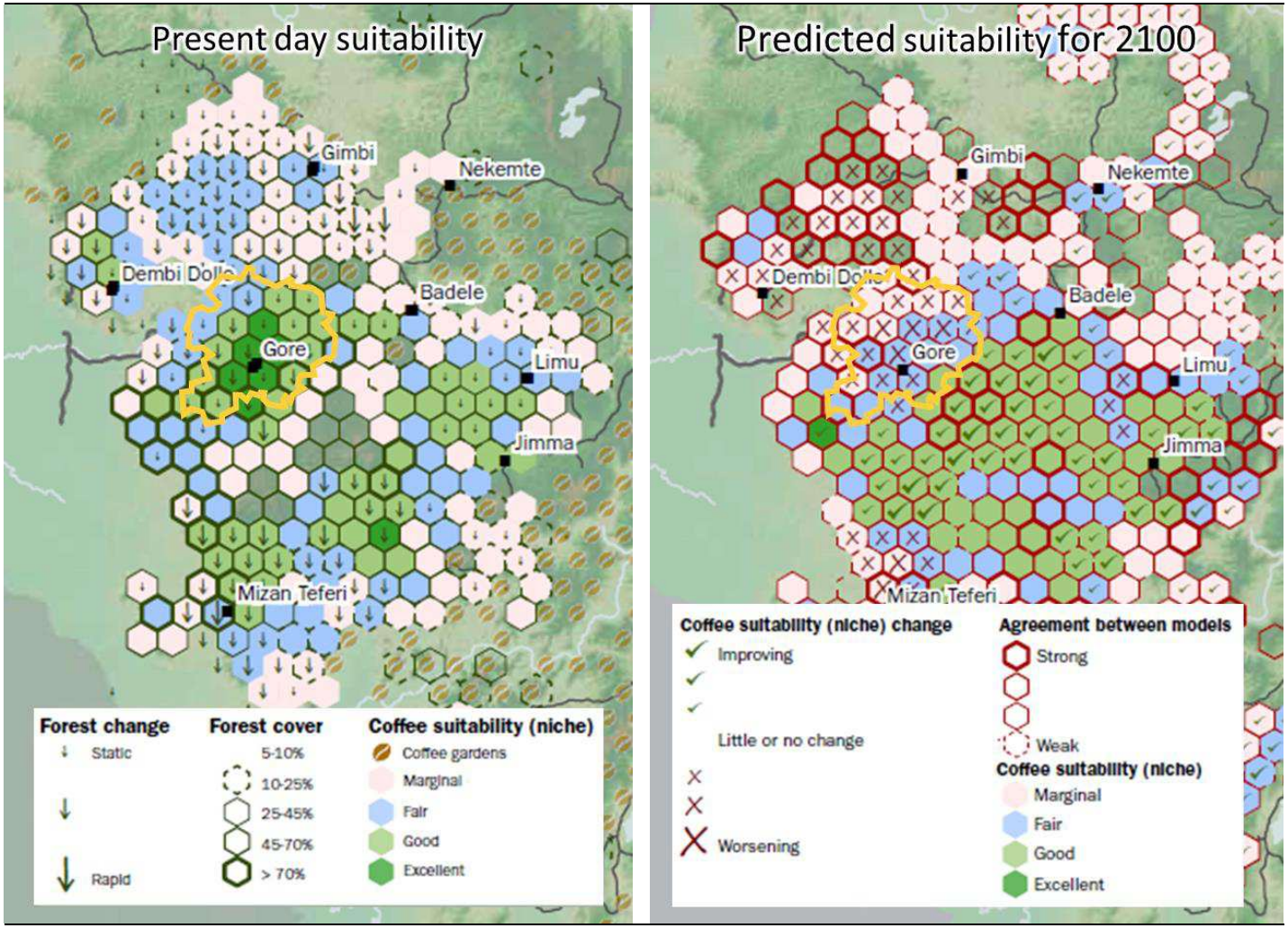
Source: Illubabor BoA, Coffee department (2020)



Area under managed coffee for woredas in Illubabor

Source: Based on production statistics for the year 2020 from Illubabor BoA, Coffee department

Annex 2: Changing suitability for coffee growing areas with climate change



Source: Moat et al. (2017)

Annex 3: Shade tree management

The objective of shade tree management is to have a vital coffee farm, which maximizes yield without compromising coffee quality and sustainable production.

Farmers can manage the shade on their coffee farm by:

- Promoting suitable native shade tree species;
- Gradually replacing old or damaged shade trees;
- Adjusting the spacing of shade trees over time; and
- Managing the tree crown.

Suitable shade tree species

Not all species commonly found on semi-forest coffee farms are equally suitable for coffee production. Although many of them have other benefits, e.g. providing bee fodder, medicine, fruit, or fix nitrogen. Taking into consideration the recommended shade tree species and other benefits, farmers can decide which trees are best suited to cover all household needs and help to diversify income.

It is important to have many different tree species in the coffee farm. This will help to avoid losses of shade trees caused by pest and diseases, provide a diverse range of additional benefits/uses, and help to ensure good presence of pollinators. Ideally, the shade trees comprise a mix of those highly compatible with coffee (Table) and others, which provide a range of additional products.

Favorable characteristics of trees for coffee specifically are:

- Perforated canopy (small leaves)
- Wide crowns
- Deciduous
- Medium height
- Deep roots (few surface roots)
- Good for soil fertility (N-fixing, good decomposition of leaves)

Tree species very compatible with coffee production

Tree species		Characteristics
Acacia abyssinica	Sondi / Laaftoo	Large crown Products: fuel wood, timber, bee forage, medicine, fodder Nitrogen fixation
Albizia gummifera	Ambabessa / Anbabesaa	Medium crown Products: Fuel wood, timber, medicine Nitrogen fixation & soil improvement
Cordia africana	Waddeessa	Medium crown Products: food, fodder, bee forage, fuel wood, timber, medicine Soil improvement
Erythrina abyssinica	Korichi	Medium crown

Tree species very compatible with coffee production

Tree species		Characteristics
		Products: Fodder, bee forage, fuel wood, timber, tannin / dye, medicine Nitrogen fixation & soil improvement
Erythrina brucei	Walleensu	Large crown Products: fuel wood, medicine, fodder, bee forage Nitrogen fixation, mulch
Millettia ferruginea	Sotellu	Medium crown Products: Fodder, fuel wood, timber Soil improvement
Pouteria adolfi-friederici	Kararo	Large crown Products: fuel wood and charcoal, timber, food, medicine
Sesbania sesban	Ambalta	Products: fuel wood, fodder, mulch Nitrogen fixation & soil improvement
Tephrosia vogelii	Birressa	Small crown Products: medicine Nitrogen fixation
Vernonia amygdalina	Aebicha	Small crown Products: Fodder, fuel wood, timber, bee forage, Medicine, essential oil

Filling large gaps

In a few cases, coffee farms are very open, with large gaps between shade trees and/or because crowns are very irregular. In such cases farmers can plant fast growing species first, even if they are not ideal for shade, to close the gaps. Possible pioneer species are:

- *Sesbania sesban*,
- *Vernonia amygdalina*, but also
- *Croton macrostachyus, Teclea nobilis, Mayentus senegalensis,* and *Beresema abyssinica*.

Other, slower growing tree species should be planted within a few years to replace the pioneer trees later on.

Replacement of old shade trees

Shade trees on many farms are very old, especially on farms established during the Coffee Improvement Project 30 or more years ago. Old, damaged trees provide insufficient shade, and falling branches can cause harm to people and damage the coffee plants.

Farmers can identify trees requiring replacement over the next years based on the following criteria.

- Trees are commonly very thick (diameter > 40cm) and show one or all of the following signs
- Dying branches: many branches are dry (have no leaves);
- Hollow stems: stems have large holes or cracks;

- Dying trees: large part of the tree crown is dry or broken; the crown is very small and/or irregular.

Thickness alone is not a criterion for replacement if the tree is otherwise healthy.

Shade tree spacing

Regularly spaced shade trees help to ensure equal protection of all coffee plants from sun, heat and wind.

In an optimal setting, tree crowns of adult neighboring trees come close to each other, but don't touch each other. Different species have very different crown diameters ranging from about eight meter for *Milettia ferruginea* to about 20 meter for *Acacia abyssinica* (see Table 1 above).

The optimal number of **mature** shade trees per hectare is in the range of 80 to 120, depending on the combination of species, and their crown size and shapea. The trees should be roughly in the same distance to each other, i.e. at a distance of about 10 to 15 meters between stems.

The spacing of shade trees can be adjusted gradually, as old trees are replaced with new ones.

Manage the crown of individual shade trees

In some cases, it can be necessary to reduce or shape the crown of shade trees:

- Larger saplings still under the canopy of the old shade tree may provide excessive shade. In such cases, the lower branches of the sapling can be cut. The removal of branches should only be up to half of the total height of the tree. To take more branches will weaken the tree and may cause death.
- Some tree species (less suitable for coffee farms) may provide too much shade. Rather than removing the tree, farmers can remove some branches selectively to open the canopy. Farmers should carefully assess the need for such activities – it is dangerous and cannot be reversed.

Planting or promoting seedlings

Farmers can use natural regeneration or plant trees:

- Where young seedlings of the right species exist and are in the right place, farmers can select two to three seedlings to be protected during weeding and from browsing animals.
- Alternatively, farmers can plant one to two seedlings raised in a nursery or wild seedlings collected nearby. Seedlings should be planted with the final distribution of trees in mind. One slopes and if planting next to an existing tree, seedlings should be planted slightly uphill from the old tree avoid damaging the young tree when felling the old tree later on.
- After two to three years the most promising (healthy, vital, straight) sapling can be selected. The other one(s) can be cut.

Management of tree seedlings

In the first year, apply compost around the seedling.

The seedlings must be regularly weeded together with the coffee and climbers removed.

Care must be taken not to damage tree seedlings during regular weeding.

Especially in the first year, farmers should consider watering the seedlings in extended dry spells.

Removing old trees

Only remove the old trees when the saplings are ready. Do so gradually, not all at once!

- When the sapling has a diameter of about 10 centimeter, the old tree can be removed. Depending on the size, shape, and utilization of the old tree, it can be debarked to slowly die or felled.
- On farms where several old trees close to each other have to be replaced, removal of the old trees should take place over five to 10 years to avoid excessive gaps.

Annex 4: Monitoring avoided degradation on semi-forest coffee farms - challenges and solutions

Table: Monitoring avoided forest degradation – challenges and proposed solutions

Challenge	Proposed solution
Suitable remote sensing technologies for forest degradation monitoring at scale do not exist: ▪ High-resolution imagery to identify individual trees in forests is very expensive. To date, its application is limited to small-scale (research-type) projects. ▪ Loss of individual trees is visible on satellite images for a very short time only (weeks), i.e. data is required at very high frequency. ▪ Very large storage and processing capacity is required for data of such high spatial and temporal resolution. ▪ Crown cover cannot be directly related to tree biomass to estimate carbon storage.	Application of self-reporting combined with verification by the project extension staff and external verification at longer time-intervals. Positive experiences with this methodology exist for agroforestry carbon projects: ▪ Farmers count trees planted on farm using broad diameter classes to distinguish trees by size. ▪ Extension staff verifies the number and size of trees at the same frequency applying a randomized sampling approach. ▪ Every 5 years the tree count is verified by a 3rd party provider to verify the emission reductions. The methodology can be adapted to the semi-forest coffee farms.
A large scale project at jurisdictional level aims at system level changes, i.e. the widespread adoption of sustainable shade tree management. In the absence of remote sensing based monitoring (relying on self-reporting), measurable results are limited to the coffee farms participating in the project.	The project area has to be defined at two levels. ▪ The jurisdiction were interventions take place (i.e. Illubabor zone or specific woredas within the zone) ▪ The boundaries of participating coffee farms have to be mapped to differentiate: ▪ Semi-forest coffee from other forested areas and ▪ Participants' farms from other coffee farms. Monitoring of shade trees will be limited to participants' coffee farms.
"Big tree dilemma" on small farms: The removal of big trees and replacement by much smaller ones is a requirement for the long-term sustainability of the shade tree layer. The removal of one big tree on a small farm will have a disproportionate effect, i.e. appear as severe degradation or even deforestation in that moment and for this farm.	Accounting of tree change has to take place across the entire project area (participating farms) and over longer periods. The resulting long-term average for tree loss/gain will be more suitable to account for the sustainability of shade trees on coffee farms.
For a REDD+ type project the baseline must be based on historic degradation (reference scenario). Due to the technological limitations (point 1) the historic degradation cannot be quantified.	In contrary to a classic REDD+ project the baseline degradation (reference level for participants) will be established going forward by establishing permanent sample plots in semi-forest coffee farms.

Annex 5: Potential and constraints for development of forest carbon projects in Oromia

Deforestation and forest degradation combined are the second largest source of GHG emissions in Ethiopia, contributing 37% of the total emissions.

The Oromia Regional State has the largest forest and agroforest[44] cover in Ethiopia. Moist Afromontane forest (the origin of Coffee Arabica) is common in the western parts of the region, e.g. in Illubabor, Jimma, and Wollega zones. The Regional State experiences deforestation and forest degradation on a wide scale and is the main contributor of forest related emissions in Ethiopia. Crop farming, including coffee cultivation, has been identified as the main driver of deforestation and forest degradation in Oromia.

To counter the environmental and climate effects of deforestation and forest degradation, the Oromia Region is implementing the jurisdictional REDD+ program called Oromia Forested Landscape Program (OFLP). The World Bank Group is supporting the program financially and technically.

Phased approach for emission reduction activities

The program is implemented in three phases, progressively including and accounting for different activities that generate GHG emissions from the forested landscape in Oromia.[45]

Phase I, expected to begin in 2020, targets the accounting of emission reductions activities targeting net-avoided deforestation related activities only. Phase II, which may begin around 2022/2023 and upon development of a suitable methodology, will include accounting for emission reductions from avoided forest degradation. Phase III, which concerns accounting for the livestock sector, will be included into the program around 2025.

Development of and emission reduction accounting by individual (nested) projects

As a jurisdictional REDD+ program, the OFLP accounts emission reductions for the whole of Oromia. Emission reductions achieved by the project are planned to be sold to the World Bank, but the Emission Reduction Purchase Agreement was not signed at the time of writing this report. The OFLP implementation arrangement does not explicitly provide for nesting of small-scale GHG emission reduction projects.

However, involvement or investments by none-state-actors such as NGOs and the private sector that contribute to reforestation and avoided deforestation/degradation are welcome. These actors can develop and implement programs and projects within Oromia, but they cannot separately account for the emission reduction achieved or benefit from their action separate or independent from that of OFLP. Any emission reduction contributions made will be accounted as part of the OFLP, i.e. there will be only one monitoring, reporting and verification system applicable to all projects.

[44] Agroforest includes coffee agroforestry and semi-forest coffee systems.

[45] REDD+ activities refer to the various components of REDD+ such as deforestation, degradation, forest conservation, afforestation/reforestation, and sustainable forest management plus others. As a landscape program, the OFLP may also encompasses activities related to rural energy, farming, and livestock.

Emission reductions for individual projects can only be claimed if emission reductions are achieved at the regional level, applying the methodology by and reference level for the OFLP. Projects are not allowed to establish their own reference levels for emission reductions.

Benefit sharing

If net-emission reductions are achieved at OFLP level, benefits will be shared with the corresponding private sector entities and communities (to be invested at community/kebele level). However, NGOs or individuals (e.g. smallholder farmers) are not entitled to receive benefits from carbon credit sales.

The benefit to be shared will be proportionate to the contribution of a project to the overall emission reductions generated by the OFLP. This means, GHG emissions from the land use sector elsewhere in Oromia would reduce the benefit attributable to a nested project.

Due to the very large scale of the OFLP, it is unlikely that projects implemented at small scale or with limited emission reduction potential per hectare (as e.g. for avoided forest degradation in semi-forest coffee) will receive meaningful income from the emission reductions achieved by the project.

Sources: personal communication, Tesfaye Gonfa (Oromia REDD+ coordinator), April 2020; MEFCC, 2017a

Annex 6: Monitoring shade trees by farmers and extension staff

The reporting of trees planted and maintained is an important aspect of carbon projects. Carbon project developers of agroforestry projects have developed reliable and cost-efficient methods to monitor tree biomass at farm and farmer group level. These methods can be transferred and adapted to the project area.

One example is the monitoring method applied successfully in the Kenya Agricultural Carbon Project (KACP) of the Livelihood Fund. The KACP works currently with about 25,000 farm households in two districts. Project implementation started in 2012. The project has been validated and verified with the VCS (the fourth verification is scheduled for 2020). The monitoring method has been transferred successfully to other projects in Kenya and Zambia, and is currently adapted to projects in India and Burkina Faso.

The project monitors all project trees on participating farms, i.e. all trees planted after project start in 2012.The monitoring set-up requires the existence of farmer groups (e.g. Farmer Field Schools (FFS)). Tree monitoring has six components:

- Mapping of the farm boundary by the farmer group leader,
- Annual self-reporting of all project trees by the responsible farm household member after training in the FFS, reported tree parameters include tree species, and number of trees ticked in different diameter classes (10 cm classes)
- Control and aggregation of self-reported values by farmer group leaders (supported by extension staff),
- Data entry (group level) into the project data base by the project's extension staff,
- Periodic verification of trees reported by the project's extension/M&E staff for randomly selected sample farms (10-20% of farms), and
- Third party verification of the process and trees on farm for carbon projects.

In the KACP, the targeted standard error is 15% with a 95% confidence interval. To achieve the required accuracy, the initial sampling size (for in-project verification) is determined with a test survey. Thereafter, sample size can be adjusted according to the variance achieved in regular verifications.

The method uses a mix of paper based and digital monitoring and reporting. Farmers and group leaders use simple reporting sheets on paper. At farm and farmer group level trees are aggregated for species and diameter classes (and seedlings). The boundary and group level tree data is recorded using mobile phones or tablets.

For new project participants, self-reporting and verification is conducted at close intervals, i.e. annually. Assuming stable adoption by long-term participants, intervals between reporting can increase over time.

The recording of all trees at each reporting event allows the calculation of change for:

- Number of trees/ha,
- changes in species diversity (based on recorded trees per species),
- changes in size (age) structure (based on distribution across diameter classes), and

- changes in tree biomass (using available allometric models) and carbon.

Fluctuations in shade tree number and size related to the necessary replacement of old shade trees will be evened out by the reporting at group level. At the same time, the joint reporting will introduce a measure of control amongst group members motivating individuals to continuously adopt good shade tree management.

Annex 7: Input values for the assessment of coffee farm economics

Conversion factors for coffee

1kg fresh cherries	0.17 kg green beans (GBE)
1kg fresh cherries	0.33 kg dry cherries
1 kg dry cherries	0.48 kg green beans (GBE)

Source: Abrar Sualeh, Jafer Dawid (2014): Relationship of Fruit and Bean Sizes and Processing Methods on the Conversion Ratios of Arabica Coffee (Coffea arabica) Cultivars Table 4

Exchange rate

1 USD	34.1 Ethiopian Birr (ETB)

Source: OANDA 03 June 2020

Financing conditions/assumptions

Discount rate for NPV calculation	10%
Interest on loans	17%/year
Basic loan – covering the cost of rejuvenation or replacement	
Rejuvenation ($^1/_3$ ha)	2,330 ETB
Replacement ($^1/_3$ ha)	4,240 ETB
Payback period	3 years
Advanced loan – covering rejuvenation or replacement and GAP	
Rejuvenation ($^1/_3$ ha) & GAP (1ha), disbursement over 2 years	15,000 ETB
Payback period	6 years
Replacement ($^1/_3$ ha) & GAP (1ha), disbursement over 4 years	17,500 ETB
Payback period	8 years

Credit and payment schedule advanced loan rejuvenation

	Credit		Repayment		
Year	**Disbursed**	**Balance**	**Interest**	**Principal**	**Total**
1	13,000	13,000	0	0	0
2	2,000	15,000	2,210	0	2,210
3	0	15,000	2,550	0	2,550
4	0	13,000	2,550	2,000	4,550
5	0	11,000	2,210	2,000	4,210
6	0	6,000	1,870	5,000	6,870
7	0	0	1,020	6,000	7,020
Total	**15,000**		**12,410**	**12,410**	**27,410**

Credit and payment schedule advanced loan replacement

	Credit		Repayment		
Year	**Disbursed**	**Balance**	**Interest**	**Principal**	**Total**
1	7,000	7,000	0	0	0
2	5,000	12,000	1,190	0	1,190
3	4,500	16,500	2,040	0	2,040
4	1,000	16,500	2,805	1,000	3,805
5	0	15,500	2,805	1,000	3,805
6	0	15,000	2,635	500	3,135
7	0	11,700	2,550	3,300	5,850
8	0	6,200	1,989	5,500	7,489
9	0	400	1,054	5,800	6,854
Total	**17,500**		**17,068**	**17,100**	**34,168**

Input values

Item	Scenario			Source+ and comments
	I. Baseline*	II. Rejuvenation*	III. Replacement*	
Average yield in year 0 (dry cherries)	720 kg/ha			Yield ranged between 50 and 1,800 kg dried cherries/ha in the baseline survey.
Annual change	-15%	N/A		Personal communication Department of Coffee Agronomy, Jimma Agricultural Research Center. Given advanced age we assumed that the yield decrease has been ongoing for some time and is slowing down until it almost stabilizes around 400 kg dried cherries/ha.
First yield after rejuvenation/replacement (dry cherries)	N/A	575 kg/ha	575 kg/ha	Jimma/Metu Agricultural Research Center, adjusted to farm conditions based on expert opinion. First yield in year 2/3 and close to maximum yield (>90%) is achieved in year 6/7 after rejuvenation/replacement. From year 10 yield is assumed to remain stable for about 7 years. Year on year fluctuations are not reflected.
Average maximum yield in year 10 (dry cherries)	N/A	1,720 kg/ha	1,880 kg/ha	
Average price (dry cherries)	25 ETB/kg			The majority of farmers sell dry coffee cherries. The price of fresh cherries converted to dried cherry equivalent is very similar.
Input cost				
Seedlings	N/A	N/A	2 ETB/plant	Improved varieties
Plastic bags	12 ETB/bag			Due to the high cost and low availability of jute bags, the majority of farmers use plastic bags. 60kg dry cherries/bag
Jute bags	100 ETB/bag			
Labor cost	50 ETB/day			5 hours/day; In Metu area labor cost can be higher, with up to 100 ETB/day. Labor provided by household members is not reflected in the cashflow.
Transport cost (dry cherries)	30 ETB/bag			To the next trading center/market.
Establishment and management cost				

Input values

Item	Scenario			Source[+] and comments
	I. Baseline*	II. Rejuvenation*	III. Replacement*	
Stumping	N/A	6,985 ETB/ha	N/A	Includes one application of compost. Gap filling is needed if the spacing is very irregular, i.e. with large gaps.
Gap filling	N/A	385 ETB/ha	N/A	
Uprooting	N/A	960 ETB/ha	2,920 ETB/ha	Scenario II: removal of plants to achieve optimal spacing.
New plantation	N/A	N/A	4,800 ETB/ha	Includes one application of compost.
Weeding	1,850 ETB/ha*yr	5,200 ETB/ha*yr		Scenario I: weeding once/year Scenarios II & III: 2 times/year and including pest and disease management
Pruning and de-suckering	N/A	1,600 ETB/ha*yr		
Harvesting	9 ETB/kg dry cherries			
Drying	400 ETB/drying bed			Cost for the construction of one drying bed. One bed is used to dry 120 kg dry cherries.
Shade tree management	N/A	1,250 ETB/ha*yr		
Soil and water conservation	N/A	6,550 ETB/ha		Every 8 years

*More than 3,500 coffee plants/ha are common in the project area. The recommended spacing assumed for scenarios II & III is 2x2m or 2,500 coffee plants/ha.

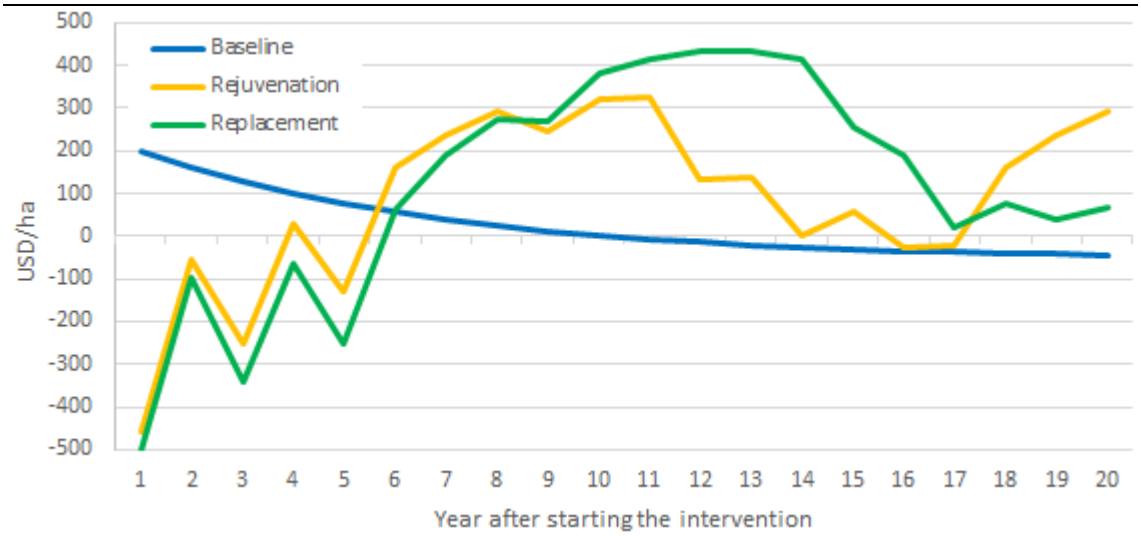
[+]Unless stated otherwise, values are from the project surveys (farmer registration, baseline, in-depth interviews of farmers) and experts of the HRNS team.

Annex 8: Farm level economics including household labor cost

Contribution of household labor in coffee management

Activity	Share of household labor
Planting	70%
Weeding	5%
Composting (production and transport to field)	50%
Harvesting	50%
Uprooting old trees	70%
Construction drying beds (raised) and drying	50%

Cashflow accounting for household labor (not discounted)



Financial cost and benefit of a smallholder coffee farm (1ha) including household labor

Parameter	Scenario		
	I. Baseline	II. Rejuvenation	III. Replacement
Average recurrent annual cost (USD/year)	145	735	720
Investment cost (USD/year)*	N/A	520	710
Break even in year	N/A	6	6
Average annual profit (USD/year)	25	N/A	N/A
During rejuvenation / replacement (year 1-7)	N/A	-65	-145
From year 8 onwards[+]	N/A	165	250
NPV at 10% discount rate (USD)	530	175	180
IRR (%)	-7	13	12

*Labor and inputs for rejuvenation/replacement

[+]Includes recurrent stumping 13/15 years after the initial rejuvenation/replacement.

Annex 9: Ongoing coffee projects in Illubabor

The Forest coffee value chain project funded by David and Lucile Packard Foundation and High Water Global, and implemented by Farm Africa in Illubabor and the neighboring Buno Bedele zone.

The Program Sustainability and Value Added in Agricultural Supply Chains in Ethiopia is implemented by GIZ. The 1st phase of the project in Nono sale woreda (in south Illubabor) focussed on coffee, honey and spices value chains. It works with selected cooperatives. Since 2021, the program is implemented in three more woredas in Illubabor (Ale, Becho, Didu).

GIZ and Technoserve, with funding from the Partnership for Forests, implement a supply chain project for Ethiopian Wild Forest Coffee, including from Illubabor.

Ethio wetlands works on sustainable natural forest management and conservation through Participatory Forest Management. Coffee (forest and semi-forest) is one aspect of forest management. One project area covers all kebeles of Nono Sale.

The planned Oromia Coffee Investment program aiming at the restoration of coffee farms as well as the establishment of new ones. Details are not available yet.

Other programs and projects implemented at regional and national level may be of relevance, e.g. the 15 million Euro EU-Coffee Action implemented in Oromia and Southern Nations Nationalities and People regional states.

Annex 10: Service providers for monitoring and data management

SourceTrace

SourceTrace provides software solutions and data management on its digital platform DATA-GREEN for agricultural value chains. The company is incorporated in the US and has offices in India and Bangladesh.

Services include:

- Certification for established sustainability standards such as Organic, UTZ/Rainforest, Fairtrade, and Global GAP but also emerging ones. The company supports the producer/producer organizations in the establishment and maintenance of digital Internal Control System (ICS) required for the certification process and monitoring compliance.
- Traceability from the producer/producer organizations to the consumer. SourceTrace commonly applies GS1 standards[46] and promotes the use of blockchain technology to secure a transparent chain of custody.
- Market linkages by providing a common portal to producers and buyers.
- Financial services including credit, crop insurance, collections and payments; and establishment of a farmers' credit worthiness based on historic transactions.

Refer to https://www.sourcetrace.com for further information.

Apposit

Apposit is a software company focusing on developing technology solutions for organizations in Africa. The company is incorporated in the US and Ethiopia, and owned by the Nigerian mobile payments company Paga.

Apposit has its origin in the financial services sector, developing financial management and e-payment systems for Ethiopian government agencies, businesses, and development projects. Other services are the provision of marketing platforms, setting up mobile data collection systems and platforms, and the delivery of information to farmers (e.g. weather, prices).

Refer to https://www.apposit.com/ for further information.

[46] Refer to https://www.gs1.org for information.

Annex 11: Commercial lending to businesses and farmers

Lender	Borrower	Purpose and volume	Conditions
National banks	Trader, exporter	Trade Investments	Collateral: housing property and other assets 8%-17% per year and up to 15 years depending on purpose and volume of the credit
Oromia Cooperative Bank	Union Cooperative	Trade – Union: 2.7 million USD – Cooperatives: ≥ 6,500 USD (esti-mated max 60,000 USD)	Membership in the bank & trade record 1 year duration Interest rate 10,5%/year to the union passed on to coops at 12.5%/year[C]
Micro-finance institution	Farmer groups Group members guarantee for each other	Any purpose 80 – 550 USD/individual	No collateral[D] ≤ 1 year 17%-21%/year
	Individuals	For business ≤ 1,400 USD (max 15,000)	Own house or government employed guarantor[D] 1-3 years 17%-18%/year
	Small enterprises[A]	For business ≥ 15,000 USD	≤ 3 years 13%/year
	Youth groups[B]	For business Amount not known	Letter from the kebele No collateral[D] ≤ 3 years 8%/year
Cooperative	Cooperative members	Any purpose ≤ 140 USD	Usually ≤ 1 year No collateral Coop capital: 7.5%/year Dedicated credit line from the union (bank): 12.5%/year
Trader	Farmers selling coffee	Any purpose ≤ 30 USD	Coffee sales record ≤ 0.5 year No collateral

[A] A licensed business with 6 to 30 employees and/or total asset of 50,000/100,000 to 500,000/1,500,000 Birr for the services and industry sector respectively. (MUDH, 2012)

[B] Persons aged 15 to 29 years. (MYSC, 2004)

[C] Cooperatives can take credit to similar conditions directly from the bank, but very few do.

[D] All borrowers must have a savings account with at least 10-20% of the loan volume. Part of the credit can be used to fulfill the requirement.

Sources: personal communication WALQO and, Wasasa micro-finance in Illubabor, Sorgaba Coffee Union and affiliated cooperatives March 2020; AACCSA (2016)

Annex 12: Financing investments on coffee farms and in processing capacity

Assumed rate of adoption, yield development, and installation of additional processing capacity

	Anticipated project duration																			
Year after project start	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Area producing coffee (,000 ha)																				
Baseline cumulative[A]	226.2	222.3	214.7	207.0	195.5	184.0	172.5	161.0	149.5	138.0	130.3	122.7	118.8	115.0	115.0	115.0	115.0	115.0	115.0	115.0
Target rejuvenation[C]	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8										
Target replacement[C]	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8										
Target incl. GAP	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8										
Area for which loans are taken (,000 ha)[B]																				
Rejuvenation[C]	1.3	1.3	2.6	2.6	3.8	3.8	3.8	3.8	3.8	3.8	2.6	2.6	1.3	1.3						
Replacement[C]	1.3	1.3	2.6	2.6	3.8	3.8	3.8	3.8	3.8	3.8	2.6	2.6	1.3	1.3						
Rejuvenation & cost of GAP	1.3	1.3	2.6	2.6	3.8	3.8	3.8	3.8	3.8	3.8	2.6	2.6	1.3	1.3						
Area rejuvenated / replaced cumulative[D]	3.8	7.7	15.3	23.0	34.5	46.0	57.5	69.0	80.5	92.0	99.6	107.3	111.1	115.0	115.0	115.0	115.0	115.0	115.0	115.0
Yield development for Illubabor (t GBE/ha)																				
Baseline	100,000	98,305	94,915	91,525	86,441	81,356	76,271	71,186	66,102	61,017	57,627	54,237	52,542	50,847	50,847	50,847	50,847	50,847	50,847	50,847
Rejuvenation	0	351	990	2.236	3.849	6.085	8.705	11.620	14.639	17.713	20.812	23.441	24.894	25.950	26.030	25.936	24.929	24.251	23.851	23.692
Replacement	0	0	383	1.022	2.204	3.801	6.053	9.296	12.187	15.461	18.791	22.106	25.112	27.886	29.904	30.535	30.656	29.380	27.231	26.270
Incl. GAP	0	176	687	1.629	3.027	4.943	7.379	10.194	13.221	16.395	19.670	22.749	25.051	26.984	28.063	28.343	27.912	27.054	26.406	25.496
Total	100,000	100.000	98.832	96.976	96.413	95.521	96.186	98.409	102.296	106.148	110.587	116.900	122.533	127.599	131.668	134.844	135.661	134.345	131.532	128.336
Annual change		-1%	-2%	-1%	-1%	1%	2%	4%	4%	4%	6%	5%	4%	3%	2%	1%	-1%	-2%	-2%	-2%
Processing capacity gap and additional installations (t GBE/year)[D]																				
quantity hulled	95000	93891	92127	91592	90745	91377	93488	97182	100841	105057	111055	116406	121219	125085	128102	128878	127628	124955	121919	119989
quantity washed	5000	4942	4849	4821	4776	4809	4920	5115	5307	5529	5845	6127	6380	6583	6742	6783	6717	6577	6417	6315
capacity per dry mill	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
capacity per wet mill	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Processing gap dry		-1109	-1764	-535	-847	632	2111	3693	3659	4217	5998	5351	4813	3866	3018	776	-1250	-2673	-3037	-1930
Processing gap wet		-58	-93	-28	-45	33	111	194	193	222	316	282	253	203	159	41	-66	-141	-160	-102

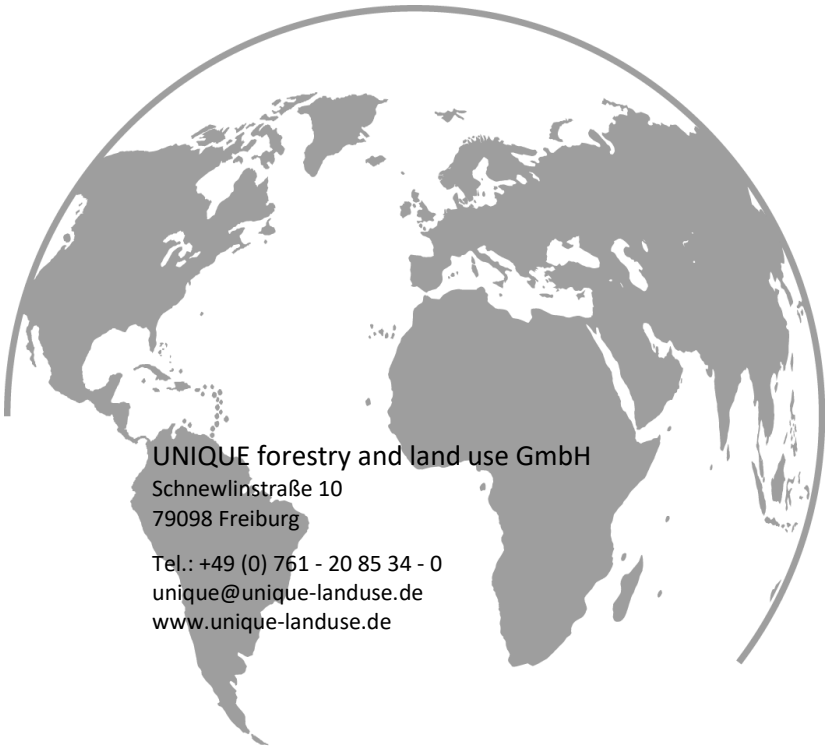
	Anticipated project duration																			
Year after project start	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Additional hulling stations					1	2	3	3	4	5	4	4	3	3	1					
Additional washing stations					1	2	3	3	4	5	5	4	3	3	1					
Additional/improved aggregation centers	22	22	22	22	22	22														

[A] Current coffee area less area where old coffee plants have been rejuvenated or replaced (="Area for which loans are taken")

[B] Per hectare adopting, credit payments for one third of a hectare in year 1, 3, and 5.

[C] GAP are implemented but financing is not required to cover the additional cost.

[D] Starting with the installed capacity in 2020. Values for capacity per mill are based on IPE Triple line (2017). The proportion between wet and dry processed coffee is assumed to remain the same.



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