Restoring degraded coffee landscapes, Ethiopia

Scaling-up deforestation free coffee production in the project region

Pre-feasibility report

December 2019

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UNIQUE forestry and land use

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ACRONYMS

BMU	German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BMZ	German Federal Ministry for Economic Cooperation and Development
BR	Biosphere Reserve
ECTA	Ethiopia Coffee and Tea Authority
DFATD	Department of Foreign Affairs, Trade and Development (Canada)
DFID	Department for International Development (United Kingdom)
ECX	Ethiopia Commodity Exchange
EIAR	Ethiopian Institute of Agricultural Research
FCPF	Forest Carbon Partnership Fund
GAP	Good Agricultural Practice
GBE	Green Bean Equivalents
GIZ	German International Cooperation
GIZ BFP	GIZ Biodiversity and Forest Program
HRNS	Hanns R. Neumann Stiftung
IDA	International Development Assistance
MFI	Microfinance institution
MIS	Management Information System
NKG	Neumann Kaffee Gruppe (coffee group)
OFLP	Oromia Forest Landscape Program
OFWE	Oromia Forest and Wildlife Enterprise
REDD	Reducing Emissions from Deforestation and Degradation
SLMP	Sustainable Land Management Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
WB	World Bank

SUMMARY

The project “Restoring degraded coffee landscapes” is funded by the Federal German Ministry for the Environment, Nature Conservation and Nuclear Safety together with the Lavazza Foundation. It is implemented by Hanns R. Neumann Stiftung in collaboration with UNIQUE forestry and land use. The target of the project is to develop and pilot a scalable smallholder coffee business model which contributes to reducing deforestation in western Oromia.

The pre-feasibility study was conducted for Illubabor zone, one of the key coffee producing regions in Ethiopia. The zone is one of the few areas in Ethiopia where still large areas of Ethiopia’s unique Afromontane forests remain, covering over 50% of the area. A part of the forest is protected in the UNESCO recognized Yayu Coffee Forest Biosphere Reserve.

The pilot project is working with 2,000 coffee farming households and nine cooperatives in districts bordering the biosphere reserve. Coffee farmers are trained on good agricultural practices for coffee and the organizational capacity of cooperatives is build. The project has developed a management information system and digital tool for efficient monitoring and access to data.

Coffee area and yield

Coffee is estimated to occupy about 10% of the area in Illubabor. Coffee is commonly cultivated under old growth forest trees and not mixed with any other agricultural crops. As a result, coffee farms are formally part of forest land.

The average size of coffee farms, often consisting of more than one plot, is one hectare and constitutes the majority of the farm land. Coffee provides the most important source of cash income for the estimated 240,000 households engaged in coffee production in Illubabor. Despite the importance of coffee for households, coffee farms are low input systems with low yields.

The average yield is 350kg of green beans per hectare. About 30% of the production is used by the household, the rest is sold. About two thirds of farmers sell coffee only to local traders. Farmers with access to cooperatives tend to sell the majority, but rarely all coffee to the cooperative. In the pilot project area, about 10% of the sales are in the form of fresh cherries. According to statistics for Illubabor, about 30% of coffee traded is washed coffee.

According to the Metu agricultural research station, the potential yield in the area is one ton per hectare and above. To achieve higher yields, farmers have to rejuvenate old coffee trees and implement good agricultural practices.

Biodiversity and carbon storage

Shade trees on coffee farms are relatively species rich and diverse in structure, providing buffers between the agricultural landscape and primary forests. Large amounts of carbon (on average > 600tCO_2/ha) are stored in the shade trees and the soils.

The amount of carbon stored in coffee farms in the project area is much higher than in conventional agroforestry coffee systems in Ethiopia (about 150tCO_2/ha) and considered to be at its maximum. Therefore, the focus of the project shifted from carbon sequestration by planting additional trees to the sustainable management of the shade tree layer and the carbon stocks.

Marketing of coffee

Ethiopia's coffee sector is highly regulated, limiting direct interactions between international buyers and producers. The majority of coffee exports are transacted at the Ethiopia Commodity Exchange. Coffee exported directly, i.e. bypassing the exchange, achieves higher prices.

Only about 15% of Ethiopia's coffee exports originate from cooperatives. Primary cooperatives provide very limited services, buying coffee for export through cooperative unions, and in some cases, provide access to farm inputs and household items.

The biggest union located in Illubabor, Sorgaba, is in the process of building the capacity for direct coffee export. At the moment, the majority of coffee is traded through the Ethiopia Commodity Exchange or channeled through the much bigger and more experienced Oromia Coffee Farmers Union.

Despite these limitations, cooperatives are important aggregators of farmers, providing entry points for extension services and financial services.

Scaling up sustainable coffee production

Several development pathways are open for sustainably improving coffee production and income in the project region. The strategy will focus on three intervention areas: productivity, quality, and market access. These options hold the greatest potential for improvement. Minor risks identified will be mitigated by appropriate project design and safeguards.

Risks are related to:

- *Gradual reduction of shade trees or altering species composition*, either intentionally to reduce shade and increase productivity, or unintentionally by failing to regenerate shade trees. The risk can be mitigated by training farmers on good practice shade tree management and informing them on the positive aspects of maintaining shade trees (resilience of the coffee farm to climate change and coffee quality). The feasibility of market based approaches (premium prices for coffee co-benefits) will be explored.
- *Investment risks* are related to changes in the natural environment (e.g. drought, pests and diseases), price volatility, and changing policies. For all risks, mitigating strategies are available, e.g. promoting resistant varieties and retaining shade for a suitable micro-climate, vertical integration with international buyers, and alignment with national and regional development strategies.
- *Food insecurity* could result from large income gaps of 2-3 years when rejuvenating coffee farms. However, coffee farms can be rejuvenated gradually, starting with the least productive coffee trees thereby limiting the temporal loss of income.

The feasibility study will assess the economy of the project at farm, cooperative and investor level. Partners for upscaling will be identified; mitigation and adaptation benefits assessed; and the set-up of the digital management information system refined. Finally, a financial mechanism and an implementation structure will be proposed.

The results of the feasibility study will be summarized in a business case to be shared with relevant stakeholder.

1 BACKGROUND

The project "Restoring degraded coffee landscapes" is funded by the Federal German Ministry for the Environment, Nature Conservation and Nuclear Safety together with the Lavazza Foundation. It is implemented by Hanns R. Neumann Stiftung in collaboration with UNIQUE forestry and land use.

The goal of the project is to develop, pilot and disseminate a scalable "garden coffee" business model which contributes to reducing deforestation pressure. The project has three objectives:

1. Analyzing and conceptualizing the economical, legal, and institutional feasibility of the "garden coffee" business model in the project region.
2. Piloting the sustainable, climate-friendly coffee production system to assess scaling potential.
3. Developing a business model to scale experiences gained in the pilot and to communicate this to relevant stakeholders.

The pilot project is implemented in the Illubabor zone in the Oromia region. The pilot area is representative for coffee growing areas in western Oromia, allowing conclusions regarding the scaling potential.[1] Parts of Illubabor are protected in the Yayu Coffee Forest Biosphere Reserve.

The pilot project is working with 2,000 coffee farming households and nine cooperatives in districts bordering the biosphere reserve (see Figure 1). Coffee farmers are trained on good agricultural practices for coffee. Cooperatives receive organizational capacity building. The project has developed a management information system and monitoring application for efficient collection and access to data.

Illubabor zone was selected as reference area for the assessment of the scaling up of project activities because it is representative for about one million hectare of coffee. Throughout the document the zone is referred to as the project region.

This pre-feasibility report:

- Summarizes the information collected in the framework of the scoping mission, the baseline survey, and registration of project participants,
- Describes the key actors in Ethiopia's coffee value chain,
- Summarizes the relevant policies and legislation,
- Proposes a set of activities for sustainable improvement of coffee production and the required investment framework for scaling up, and
- Describes the way towards the development of the business model.

[1] Illubabor zone was divided recently into two zones: Illubabor and Buno Bedale (eastern part). Statistics presented in this report refer to the original area.

2 CURRENT LAND USE, MANAGEMENT, AND FARM INCOME

2.1 Project location and environmental conditions

The pilot project is implemented in three woredas forming part of the Yayu Coffee Forest Biosphere Reserve (BR) in Illubabor zone, Oromia (Figure 1). The reserve, containing remnants of the afro-montane forest, is considered one of Ethiopia's biodiversity hotspots. The reserve is divided into three zones, the core, buffer and transition zones. Cultivation of coffee is common in the buffer and transition zone.

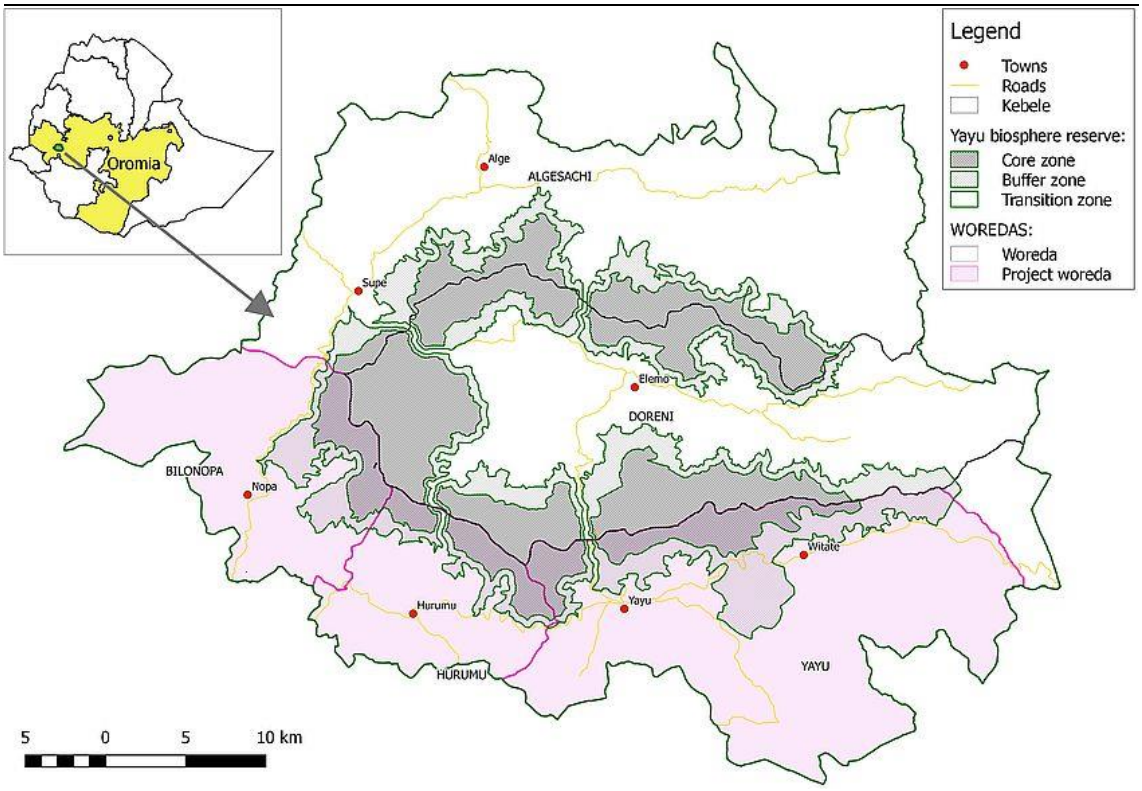


Figure 1: Project area in the Yayu Coffee Forest Biosphere Reserve
Biosphere boundaries provided by the GIZ Biodiversity and Forestry project.

Illubabor zone comprises mostly gently undulating terrain with elevations between 1,500m to 2,000m. The average temperature ranges between 16°C and 24°C (20°C in Metu), and the average rainfall between 1,500 to 2100mm (1,700mm in Metu). Rainall is unimodal, with most rainfall occurring from May to September.

Arabica coffee is native to the region, occurring naturally in the remnant moist afromontane forests. With climate change, coffee production in the lower areas of Illubabor (around 1,500m) may become less viable over the coming decades (Moat, Williams, Wilkinson, & others, 2017).

2.2 Land cover and use in the project region

Illubabor zone retains much of its original vegetation, with 65% of the zone covered by forests and woodlands (Figure 2 & Table 1). The largest forest areas are found in the southern and western woredas. Only 100,000ha (10%) of the region's forests are included in the Yayu BR, located in the center of the zone. The reserve also covers 54,000ha cropland, the majority of it in the transition zone (Figure 3). Across Illubabor about 470,000ha (28%) are classified as cropland.

Table 1: Land use in Illubabor

Land cover/use class	Area	
	ha	%
Forest*	916,500	55
Woodland	144,600	9
Shrub	22,500	1
Cropland	469,300	28
Grassland	95,700	6
Water bodies and wetland	900	0
Settlement	1,800	0
Total	**1,651,700**	

*Includes approximately 170,000 ha of forest and semi-forest coffee.[2]
(WLRC, 2016)

Observations made during field visit and baseline survey indicate a strict separation of coffee from other agricultural crops, and strong link between coffee production and forests. The total area under coffee in Illubabor is estimated to be 170,000ha (CTDMA, 2019), of which 14,000ha are classified as forest coffee areas (where coffee is harvested from wild coffee trees in the original forest). Assuming that the large remainder of the coffee area is managed as semi-forest coffee, about 17% of the area classified as Afromontane forest (916,500ha) is actually cultivated with coffee.[2]

[2] For a description of coffee management systems refer to section **Error! Reference source not found.**.

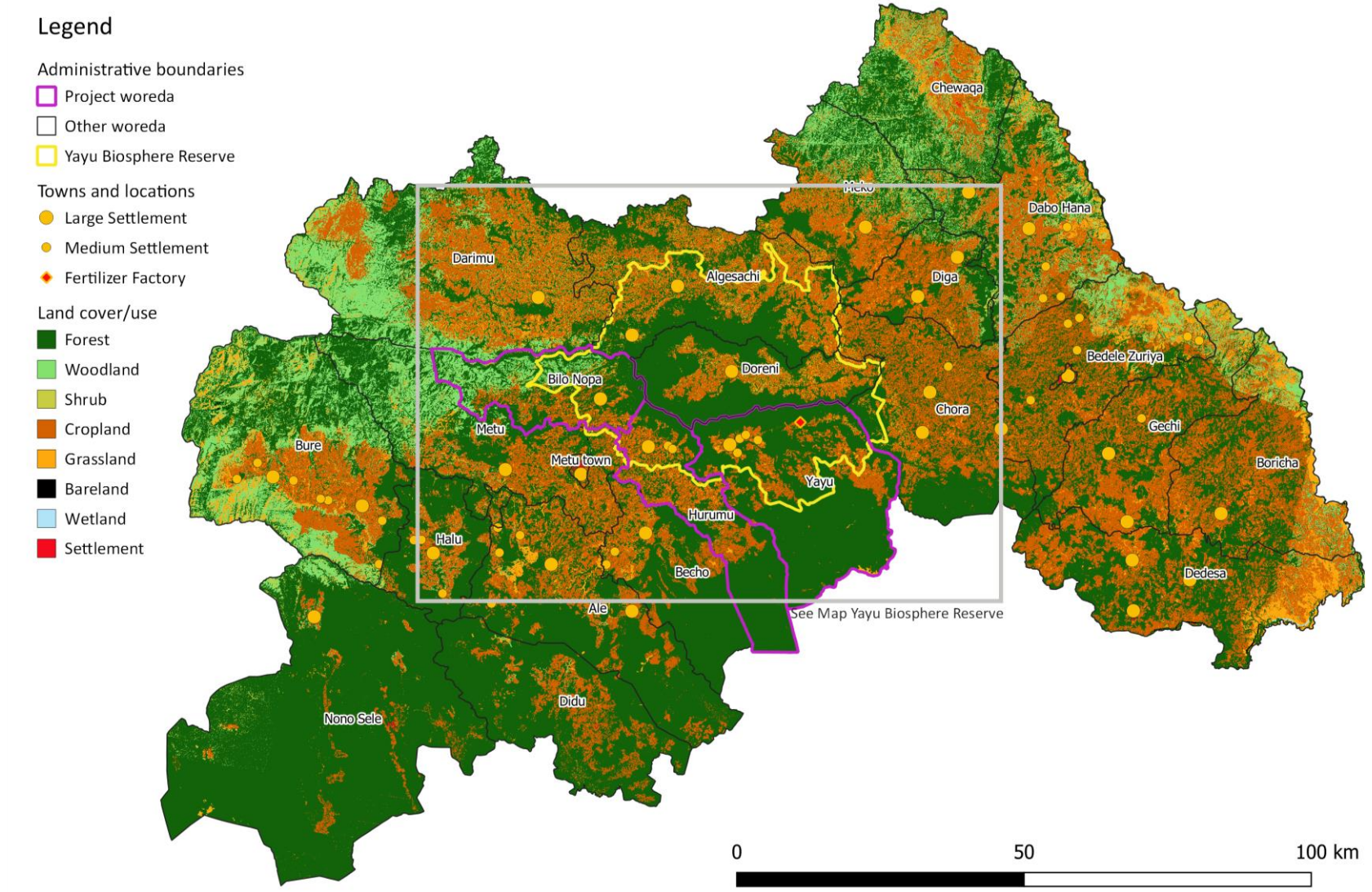


Figure 2: Land cover and use in Illubabor zone
(WLRC, 2016)

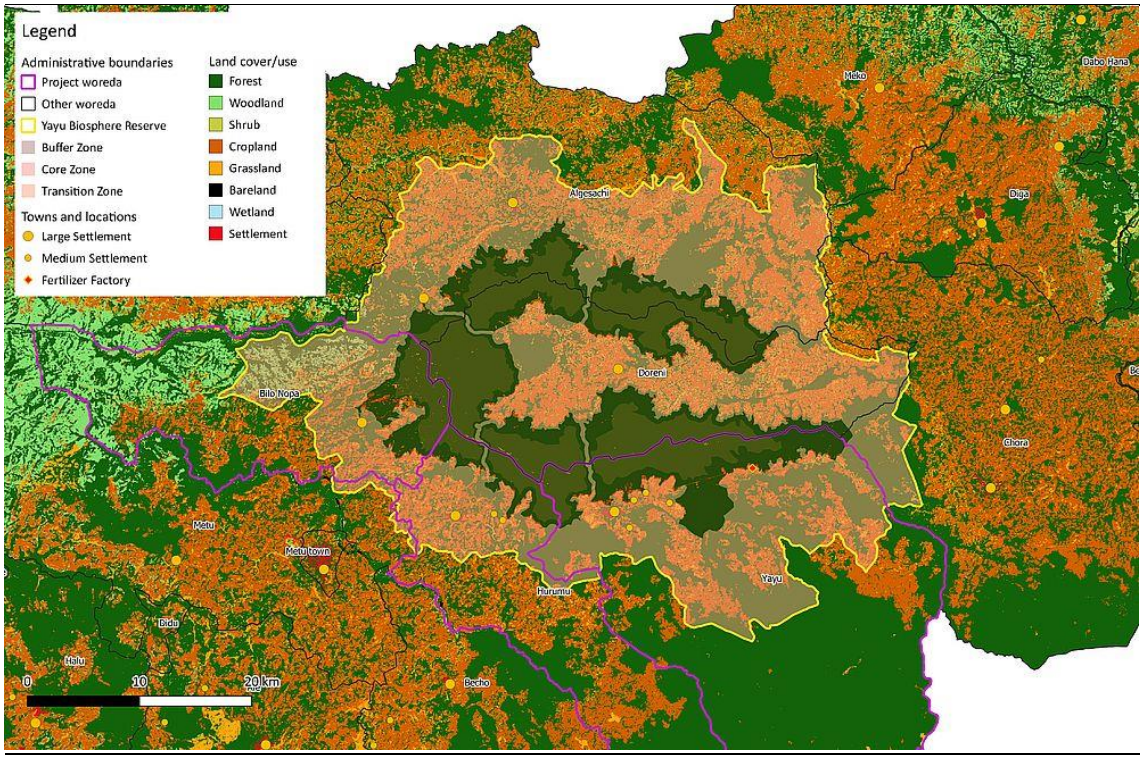


Figure 3: Yayu Biosphere Reserve
(WLRC, 2016)

The average land holding of the 480,000 farm households in Illubabor is 0.8ha. 38% of households use 1-2ha of land, and another 40% up to 5ha (CSA, 2016). In the pilot area the average land holding is 2ha, ranging between < 0.5 and 40ha (UNIQUE, 2019).

Farm households in the area commonly practice mixed farming. About 50% of farm households in Illubabor grow coffee (CSA, 2016). The most important crops by area besides coffee are Maize, Teff and Sorghum (CSA, 2017). According to CSA (2018), about 80% of households in Illubabor own some cattle for multi-purpose use, and about 30% own sheep and/or goats. Only about 10% of households own pack animals (horses or donkeys). The majority of livestock owners rely on green fodder (grazing and cut-and-carry).

2.3 Coffee management

Similar to other areas in Ethiopia, coffee in the project region is mostly produced by smallholders. In Ethiopia, three smallholder coffee management systems are recognized. They are commonly described as:

- Garden coffee: Planted coffee as a single crop or mixed with other annual crops, banana, and multipurpose tree species (fruit, timber, fodder)
- Semi-forest coffee: Planted coffee under old growth forest tree species; the focus is on coffee production. i.e. the number trees /crown cover and species composition is reduced in comparison to primary forest
- Forest coffee: Use of wild coffee, with no or very limited management of the surrounding forest and coffee trees. Old coffee trees can be rejuvenated or replaced with coffee seedlings from the existing coffee trees.

In the pilot area, semi-forest and garden coffee could not be distinguished as described above. Coffee farms are most commonly classified as semi-forest coffee. According to the baseline, garden versus semi-forest coffee is distinguished depending on the proximity of coffee plots to crop land and settlements, and ownership.[3] Coffee is usually not intercropped with annual or other perennial crops.

In the project area, the participating households grow coffee on 65% of their land on average. Most households own about 1ha of coffee, often distributed across several plots. According to CSA (2016), 80% of households in Illubabor cultivate coffee on 1 to 5ha.[4]

Coffee farms in the project area are typically too densely stocked, coffee trees are beyond their most productive age and too tall for easy harvesting. Shade tree density is high as well. Table 2 compares the situation of coffee farms in the project area with optimal coffee farms.

Table 2: Key descriptive parameters for coffee farms in the project area

Parameter	Project	Considered optimal
Spacing of coffee trees	on 90% of plots < 1.5m apart	2m
Age of coffee trees	on 70% of plots > 25 years or mix of all ages	4-25 years
Height of coffee trees	on 70% of plots > 2.5m	1.5-2m
Density of shade trees	on average 150 trees	50-250 depending on species

(HRNS, 2019; UNIQUE, 2019; Anteneh & Taye, 2015)

In many cases farmers do not apply good agricultural practices (GAP) for coffee management and harvesting (Table 3). Most farmers apply adequate post-harvesting practices, but do not have access to appropriate storage materials. Overall, the use of inputs is very low, confirming zonal statistics.[5]

Incidences of coffee diseases are fairly common. According to the baseline survey, 74% of farmers had Coffee Berry Disease and 90% Coffee Wilt Disease on at least part of their plots.

[3] Over 90% of the area classified as garden coffee by households is included in land certificates. For semi-forest coffee only about 50% of the area is included in certificates, the rest is customary.
[4] In the project area, households have on average three plots with coffee.
[5] 95% of the coffee area is stocked with coffee raised from indigenous seed and fertilizer is used on only 1% of the coffee area (CSA, 2017).

Table 3: Coffee management practices and implementation rate in the project area

Parameter	**Implementation rate** (% of households) **Common practice … … … good agricultural practice**		
Planting coffee using	local varieties: 55%	local and improved: 4%	Improved varieties: 41%
Pruning & removing suckers	Aadoption rate: about 40%, but techniques can be improved.		
Stumping	Adoption rate: about 40%, but the majority of plots still has old trees		
Fertilizer use and composting	3% use inorganic fertilizer		10% make compost 4% use organic fertilizer
Mulching	3% mulch some of their trees		
Selective picking	<5%	sometimes: 22%	always: 73%
Shade trees	removed shade trees 69% planted shade trees: 42%		
Drying	on the ground: 5%		off the ground: 95%
Storage material	other/no bag: 88%		jute bag: 12%

(HRNS, 2019; UNIQUE, 2019)

Yields in the project area are low, reflecting the sub-optimal coffee management practices and minimal input use. Comparing the current yield range in the project area with yields considered possible under farm conditions by the Metu Research Station (Table 4), farmers could more than double yield by:

- Rejuvenating their farms (stumping),
- Replacing low yielding and disease prone varieties with improved ones,
- Adjusting stocking and management of coffee trees,
- Improve nutrient management (mulching and use of (organic) fertilizer), and
- Pruning trees and removing suckers.

Opening up the shade trees crown cover may increase yield, but would reduce coffee quality and resilience to adverse climatic conditions, and pest and diseases. Many of the shade tree species also provide excellent bee forage, which is an important household income source in the region (VUNA , 2019).[6]

Refer to section 2.5 for other aspects of shade trees and shade tree management.

[6] Honey production in Illubabor was estimated at 3,000 tons in 2016 (CSA, 2018).

Table 4: Coffee yield in the project area and Illubabor zone

		Yield (kg GBE/ha)
Project farmers, recall data	Average	350
	50% of farmers	170-470
Detailed sample survey		310
Zonal statistic:*	garden, semi-forest coffee	700
	forest coffee	350
Metu research station:	high input system	2,400
	on farm with GAP	900-1,700

* Combining statistics on total coffee production for and number of coffee farmers in Illubabor, the average production is 350kg GBE/ha.

(HRNS, 2019; UNIQUE, 2019; CTDMA, 2019; personal communication Metu Agricultural Research station, October 2018; CSA, 2016)

2.4 Farm income from coffee

20 to 30% of the coffee produced is consumed by the household. The majority of farmers produce sun-dried coffee for sale. Only about 40% of households sell fresh cherries. Many farmers sell to both local traders and cooperatives. About 85% of farmers participating in the project sell coffee to traders (usually sun-dried), and less than 60% (especially those selling cherries) to cooperatives.

Few cooperatives around Yayu BR are certified with Rainforest Alliance. According to Getchi cooperative in Yayu woreda, the price premium is negligible (estimated to be 1 USD cent/kg GBE), not offsetting the cost of compliance (personal communication, October 2018). Two Participative Forest Management (PFM) cooperatives sourcing coffee from the BR buffer zone are certified by Fair Trade and Organic standards.[7]

Factory gate coffee prices for farmers vary according to supply, quality and product. The average price for cherries in 2018/19 was 40 Birr/kg GBE and 43 Birr/kg GBE for sun-dried coffee.

Table 5: Coffee prices

Product	**Price** (Birr/kg GBE)		
	Minimum	**Average**	**Maximum**
Cherries	27	40	60
Sun-dried	32	43	62

Assuming average current production of 350kg GBE/ha, sold half in the form of cherries and half sun-dried, the annual income from coffee would be about 14,500Birr/ha (about 500USD). If farmers were to renovate farms and apply good agricultural practices, yields could increase to 1,200kgGBE/ha[8], resulting in an income of about 50,000 Birr/ha (about 1,700USD).

[7] Supported by the GIZ Biodiversity and Forestry Program.

[8] Yield deemed feasible under farm conditions (Metu agricultural research station, personal communication, October 2018).

According to a study by Belay (2017), coffee generates about half of the annual cash income of households engaged in the sector in Illubabor (coffee sales and selling labor).

2.5 Biodiversity and carbon storage in coffee management systems

Biodiversity

Shade trees on coffee farms in the project area mostly native forest tree species. The number of shade trees is quite high with 150 trees/ha on average. The shade tree layer is diverse, with over 30 different species, and trees of different age/size, incl. old growth. Older shade trees are remnants from the original forests, which were transformed to the current semi-forest coffee farms over decades.[9]

Semi-forest coffee farms are estimated to cover about 10% of the total land in the Illubabor zone (see section 2.2 for details), i.e. are significant for conservation of biodiversity and as carbon sinks. Given their distribution across the landscape, coffee farms provide buffers to and stepping stones between the few remaining primary forests in the region.

Farmers influence the number, species and size composition of shade trees by selectively removing/killing shade trees for a variety of reasons (to adjust shade, because trees are too old, and for use as timber and fuel). Such changes are in principle not changing the forest characteristics, provided that farmers replace removed/dying trees by either planting new ones or by managing the natural regeneration.[10]

Carbon storage

Carbon is stored in two major carbon pools: the living biomass of shade trees and in the soil organic matter. The above and below ground forest carbon stock is estimated to be 270tCO_2/ha, which is significantly lower than in undisturbed Afromontane forest but higher than coffee agroforestry systems.[11]

Studies show that soil organic carbon stocks can be as high as 400 tCO_2/ha in the pilot region. 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 trees, dead wood and litter) are very small, constituting altogether less than 5%, of the total carbon stocks in coffee forests.

Few very large old growth shade trees store about 80% of the above and below ground biomass carbon. As a result, the removal of individual trees has a large impact on the carbon stocks until other, younger (medium-sized) trees are maintained over decades, to eventually compensate

[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. 30 different shade tree species were found in the project area. The most common ones are *Albizia gummifera* and *Croton macrostachyus. A. gummifera* has a very moderate light interception.

[10] Sufficient number of small shade tree species were found on all coffee farms. Unless removed by the farmer they will eventually replace dead or dying trees.

[11] Carbon stored in the above and below ground biomass of trees. Afromontane forest: > 470 tCO_2/ha (refer to the baseline report in the Annex); Coffee agroforestry: < 150 tCO_2/ha (UNIQUE, 2012)

for the carbon stored in the old-growth trees. The existing structure of the shade tree layer is conducive to a gradual replacement of old trees.

Deviation from the assumption in the IKI project proposal

The project proposal assumed high potential to increase carbon stocks with an initial low number of shade trees and degraded soils with low soil carbon stocks. By increasing the number of shade trees and implementing good agricultural practices carbon stocks were expected to increase.

Given the circumstances in the pilot area, the project decided to focus on coffee grown in high carbon stock forests with high biodiversity value. For these forests, sustainable coffee management is considered to be essential for the conservation of biodiversity and carbon stock. This approach is in particularly valuable for private coffee roasters eager to contribute to biodiversity following zero-deforestation coffee value chain approach.

The monitoring of these forests and the baseline setting requires a different approach than initially envisioned – the Reducing Emissions from Deforestation and Degradation (REDD+) approach. The area is part of the Oromia REDD+ Programme, which is one of the four pilot projects of the World Bank BioCarbon Fund Initiative for Sustainable Forest Landscapes. REDD+ Reference Emission Level approaches are used to account for avoided deforestation.[12]

The feasibility study will explore the options for forest monitoring and carbon accounting for the scaling of the pilot project. However, due to the small size of the pilot project and the scattered distribution of participating farmers across three woredas, the FCPF carbon accounting approach is deemed not feasible for the pilot project.

[12] For example the Forest Carbon Partnership Fund (FCPF) Methodological Framework: https://www.forestcarbonpartnership.org/system/files/documents/FCPF%20Carbon%20Fund%20Methodological%20Framework%20Final%20Dec%2020%202013.pdf

3 ACTORS IN THE COFFEE VALUE CHAIN AND COFFEE MARKETS

3.1 Coffee market

3.1.1 Demand and supply

The global demand for coffee is rising, with an average growth rate of 2.1% per year. 9.7 million tons of coffee were consumed globally in 2017/18. Ethiopia produced about 460,000 tons of Arabica coffee in 2017/18, equal to 5% of the total global production (including Robusta). (ICO, 2019) About 30% of coffee exported is washed, the rest is sun-dried (NKG Ethiopia, personal communication, October 2018).

Ethiopia is by far the biggest producer country in Africa, and ranking third globally for Arabica production (USDA, 2019b). Ethiopia is also one of the few producer countries with significant domestic consumption, with 50% of coffee production consumed internally (ICO, 2019). Nearly all coffee is exported in the form of green beans, although the share of roasted coffee for export is slowing increasing (FAO, 2019).

Ethiopia's Coffee Development and Quality Improvement Strategy (Berhanu, 2017) targets to increase coffee production from 460,000 tons (2017/18) to above 2 million tons per year by 2022. To that end, productivity per hectare is to increase to 1.2tGBE/ha and area cultivated with coffee to 1.8 million ha. The share of specialty coffee in coffee exported is to increase to 40% and 30% for washed and natural coffees respectively.

To achieve these targets the strategy highlights the need for better extension services, rejuvenation of coffee farms, application of improved farm management practices, and improving coffee quality and marketing systems.

Since 2012 the production of coffee in Ethiopia is steadily growing. The production increase is likely linked to the expansion of area under coffee, rather than increasing productivity.

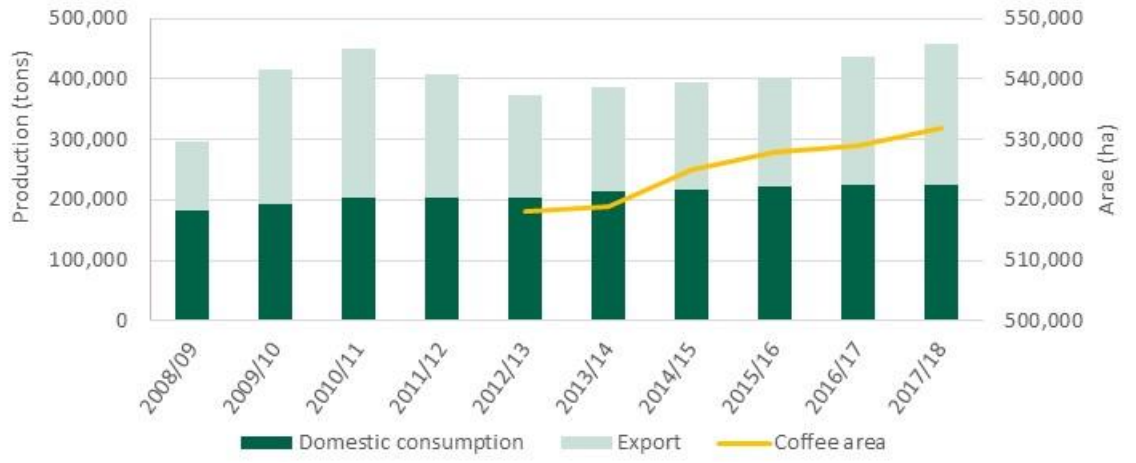


Figure 4: Development of coffee production in Ethiopia
(ICO, 2019; USDA, 2017 & 2019a)

Coffee produced in Illubabor zone is traded as Limu/Djimmah variety. About half of the total production is traded through the Ethiopia Commodity Exchange (ECX). The remainder is consumed locally or traded through channels outside the ECX. Similar to the national level, about one third of the coffee from the region and destined for export is washed coffee. In Illubabor, coffee is produced in 20 woredas, but only about half of them produce significant volumes.[13]

Table 6: Coffee production in Illubabor

Woreda	**Production** tons/year	**Area** ha
Bila Nopa	4,300	10,700
Hurumu	7,300	12,500
Yayu	12,700	24,300
Other woredas	60,700	125,000
Total for Illubabor zone	**85,000**	**172,500**

Data for 2016/17 (CTDMA, 2019)

3.1.2 Market trends and drivers

The global growth in demand for coffee is expected to continue in the future, driven by increasing number of consumers in emerging economies. At the same time preferences in established consumer markets are shifting towards high quality, sustainably grown, and specialty coffees.

Ethiopian coffee is, generally speaking, sought after by many roasters. However, the quality is not very high nor constant.[14] Only a small share of coffee is traded as specialty coffee at higher prices. The small share of high quality coffee available for export is due to the near absence of farm-level production standards and poor management along the value chain.

Coffee Arabica supply and prices are heavily influenced by the biggest producers, Brazil and Columbia. Both countries have increased production significantly over the last years. The price development for the past 10 years is illustrated in Figure 5a based on Brazilian Naturals, showing a steady decline over the past decade.

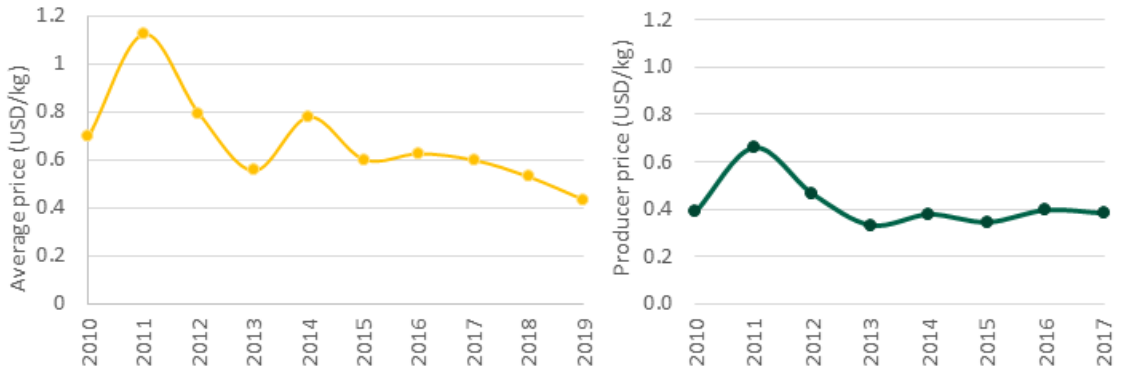
According to ICO statistics, producer prices in Ethiopia (Figure 5b) have been relatively stable in the last five years, but on a low level in comparison to the indicator price for Brazilian Naturals. Ethiopian farmers received about 60% of the Brazil indicator price in the past.

However, farmers interviewed in the baseline survey stated much higher farm gate prices of USD 1 and above. Similar prices were observed in a survey by GIZ in the region (VUNA , 2019).

High producer prices in combination with heterogeneous quality reduces the competitiveness of Ethiopian coffee in the world market, and may cause international roasters to look elsewhere.

[13] Didesa, Chora, Yayu, Hurumu, Doreni, Mettu, Bilo Nopa, Alge Sachi, Becho Alle, and Nanno (Belay, 2017). Includes woredas in Buno Bedale zone, previously part of Illubabor.

[14] Causes stated by experts are the poor management practices at farm level and along the value chain, and the mixing of origins at the ECX and corresponding loss of traceability. (NKG, personal communication, October 2018)



a) Indicator price for Brazilian naturals (data until September 2019)

b) Producer prices Ethiopia

Figure 5: Development of coffee prices
(ICO, 2019)

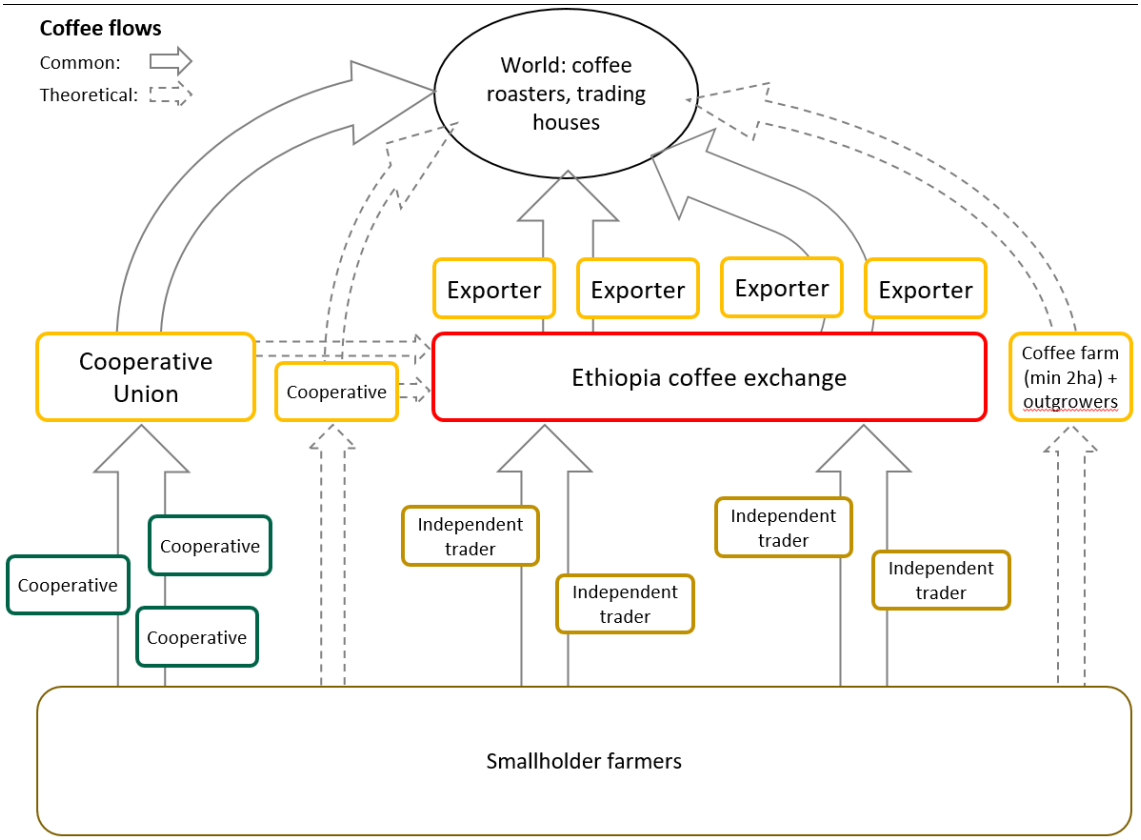
3.1.3 Market access of smallholder coffee farmers

Farmers in the project area sell coffee to local traders or cooperatives where available. About 40% of farmers sell all or a part of their production to cooperatives. Of those selling to cooperatives, only about 20% sell the larger share to traders.

The majority of coffee is sold in the form of sun-dried cherries. Cooperatives with washing stations also buy fresh cherries (about 10% of the production traded in the corresponding kebeles). The cooperatives (and cooperative union) and local traders process dried cherries to green beans before trading it through the ECX.

Coffee producers in the project area get paid on the spot when delivering coffee to a cooperative or trader. Cooperative members may receive a price premium after the coffee has been sold to the international buyer, depending on the actual price achieved. Farmers do not have any direct contact with other actors along the value chain, and are not involved in the marketing of coffee.

Individual producers with at least two hectare coffee farm can sell coffee directly to international buyers. According to the Illubabor Zonal Office of Agriculture (personal communication, June 2019), ten producers from the zone have been licensed to trade coffee. Two of these farmers have sold coffee to international buyers, but limit trade to their own production.



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 (in the project area Sorgaba). Larger smallholders (at least 2ha coffee farm) cany export coffee directly, but rarely do so. Direct interaction between producers and international buyers is most likely within the cooperative value chain.

Figure 6: Coffee value chain
Adapted from NKG

3.2 Value chain actors

Smallholder coffee producers, cooperatives and unions

The number of smallholder coffee farmers in Illubabor is estimated at 240,000 (CSA, 2016), producing 85,000 tons of coffee in 2016/17 (CTDMA, 2019).

Primary cooperatives and cooperative unions play an important role in the marketing of coffee from smallholders, and account for 10-15% of all coffee exports (EC 2017). Two unions trading coffee are registered in Illubabor.

Sorgaba union, located in Metu, has over 168 member cooperatives and owns a hulling station for processing of dried cherries. However, Sorgaba has still very limited access to direct export markets. Yayu coffee union, established with the support of the Ethiopia Forest Coffee Forum has 12 cooperative members. However, the union was not yet fully established in 2018. Sorgaba, as well as individual primary cooperatives are members of the Oromia Coffee Farmers' Cooperative Union.

The primary cooperatives involved in coffee marketing are usually PFM or multipurpose cooperatives. Both types cater to other value chains linked to forests (PFM) or other crops (e.g. providing inputs for grains).

Primary cooperatives, usually one per kebele, have about 200 to 500 members. Cooperatives buy coffee from members and non-members. All coffee delivered to the cooperative is paid on the spot. A dividend (based on the selling price achieved) is paid about three months later to members.

Four of the cooperatives operating in the project area had an average annual coffee turnover of 60,000kg. 34 of the cooperatives in Illubabor are equipped with washing stations.[15]

For all cooperatives interviewed, purchasing coffee in sufficient quantity to fulfill their plan (full use of trade credit) was a primary concern.[16] Only one cooperative actively controlled intake quality by buying only fresh cherries for washing and sun-drying by the cooperative.[17] Sun-dried coffee is processed at the hulling station owned by Sorgaba union, or by third party processors (see private sector). About 20% of the coffee traded through Sorgaba union is washed coffee.

Primary cooperatives can export coffee directly, or as micro-lot or bulk through the cooperative union and the ECX (see below). Only five cooperatives in Yayu are known to export coffee directly (supported by the GIZ Biodiversity and Forest Program (BFP)). Cooperatives interviewed, preferred to sell washed coffee via Oromia Coffee Union which has better access to international buyers than Sorgaba Union. Less than one third of Sorgaba's exports are direct, the rest is traded at the ECX.

Cooperatives interviewed have access to trade credits from Oromia Cooperative Bank, either directly or channeled through the Sorgaba Coffee Union. Interest rates are in the range of 13% to 15% per annum.

Primary cooperatives without membership in a coffee union usually have a very small coffee turnover due to the difficulties to access finance and markets.

Primary cooperatives and unions are important entry points for projects or institutions interested to invest in the coffee value chain but with limited capacity to deal with individual farmers. However, all cooperatives and the local unions struggle with inconsistent supply (quality and quantity) and directly accessing the more profitable international buyers.

Government

The *Ethiopia Coffee and Tea Authority's* (ECTA) mandate covers the entire coffee value chain. The focus of the authority is to improve quality and productivity/production. At regional and local level, the authority works collaborated with the *Agriculture and Rural Development Bureau*. The capacity of the Authority and the Bureau at to deliver extension services is very low.[18] The

[15] Installed with the support of the East Africa Coffee Initiative, implemented by Technoserve 2008-2015. Across Illubabor about 100 washing stations exist.

[16] Cooperatives compete with suppliers buying coffee. Suppliers are known to pay a higher spot price. Although the total price (spot and dividend) for farmers is likely higher if selling to cooperatives.

[17] Burka Kitabir with members in Kitabir and Agata kebeles.

[18] Only 23% of farmers received any training on coffee management by the government or projects in the last three years (UNIQUE, 2019).

authority is also responsible for the dissemination of new varieties. However, supply of improved seed and seedlings is insufficient.

The *Ethiopia Commodity Exchange* (ECX) *Authority*, established in 2008, and its representative offices in the coffee growing regions (Alternative Transaction Centers, liquoring and inspection units) label coffee based on geographical origin, control the quality of and grade coffee, and provide a trade platform for bulk and micro-lots from a specific source.

The *Ethiopian Institute of Agricultural Research* (EIAR) and its branches (e.g. Jimma and Metu) carry out research on coffee, and develop new varieties. For the Illubabor coffee growing zone 14 specific varieties along an altitudinal range are available.[19]

The *Oromia Forest and Wildlife Enterprise* (OFWE) is a governmental enterprise mandated to protect forests and regulate use. PFM cooperatives require a concession from, and their management plans have to be approved by OFWE.

The *Cooperative Promotion Agency*, with offices at woreda, level supports cooperative establishment, issues licenses, and performs annual financial and performance audits of cooperatives.

The federal *Ministry of Trade* and the *Oromia Trade Bureau* are responsible for business registration and licensing, and control of illegal trade (e.g. coffee traded by actors other than those listed below).

Private sector

Large scale private growers (also state owned firms) produce and often process coffee. They can sell coffee directly to the international market. However, not all private growers have the corporate infrastructure to export their own coffee. The growers can purchase and market coffee from outgrowers. In Illubabor zone only eight investment licenses have been issued.[20]

Collectors (Sebsabies) buy coffee from smallholder farmers, and sell aggregated lots to suppliers. They cannot export coffee. In particular in remote areas they provide access to markets for smallholder farmers.

Suppliers (Akrabies) are traders licensed to collect coffee for delivery to the ECX or sale to exporters. They buy coffee from farmers or collectors. Some suppliers own washing and/or hulling stations or work with privately owned mills. *Millers* without trade license are limited to the processing of coffee for third parties. According to Belay (2017), 65 privately owned washing stations and almost 600 suppliers operated in Illubabor in 2014.

Licensed *exporters* can be private growers, but the majority of exporters buys from suppliers. According to NKG (personal communication, October 2018) 700 exporters are registered with the ECX. Exporters are responsible for transport and storage of coffee and often add value by further sorting or blending coffee. Exporters are frequently engaged in import businesses. Selling coffee generates much needed foreign currency for imports. High profit margins for imports

[19] Information on past and ongoing research, and existing coffee varieties/cultivars is available on the website of Jimma Agricultural Research Center: http://www.eiar.gov.et/jarc/index.php/jarc-research/coffee-and-tea-research.
[20] Areas allocated range between 15 and 500ha. Detailed information on area actually cultivated with coffee and contact information for the investors was not available. Two individual farmers are known to export directly, but do not work with outgrowers. (Illubabor Office of Agriculture, personal communication, June 2018)

can offset losses made in times of low global price versus high (stable) coffee price internally (ibid).

Domestic wholesalers buy local grade coffee (i.e. not deemed fit for export) from suppliers and sell to retailers.

International buyers are not permitted to export coffee. They must work with exporters (including private growers and cooperatives) to source coffee.

Financial service providers

Banks provide credits for trade finance and value chain investments to unions/cooperatives, suppliers, and exporters. Direct lending to smallholder coffee farmers is uncommon. Key reasons are the small credit size and difficulty to assess farmers. A study by Bizualem et al. (2018), revealed that the available credit products don't match farmers' requirements and procedures to access loans are perceived as too complicated. Additionally, banks rarely have branch offices in rural areas.

Interest rates for bank loans vary according to segment. For coffee export interest rates are around 9-11%/year, for non-exporting agricultural businesses 16-18%/year, and finance to domestic traders/cooperatives to purchase coffee 13-16%/year. Major constraints to upscaling lending for banks are the difficult access to foreign capital and capital locked in low return government bonds.

Some *cooperatives, micro-finance institutions* (e.g. WALQO[21]), and local *traders* provide short term loans to farmers. In the pilot area, credits from cooperatives to members seem to be the exception.

Annual loans from WALQO to members range between 2,000 and 15,000Birr (USD500). They are commonly used to purchase inputs, pay labor, or petty trade. The interest rate is high with 17.5%/year. Micro-finance institutions rely heavily on the Development Bank of Ethiopia (and donors) to finance agricultural loans.[22]

A local trader interviewed stated to give interests free pre-harvest loans to farmers regularly supplying coffee to his business.

Development partners and programs

The GIZ BFP is implementing two projects of relevance in Illubabor: i) forest based value chains in Yayu BR and ii) sustainable supply of coffee and other products from Nono Sale woreda. While the former just started with the second phase of two years, the latter is in the project design phase, with limited pilot activities. Full implementation is expected to start in the second half of 2020. Farm Africa (Sustainable Forest Coffee Value Chain Development project) works with PFM cooperatives in the neighboring Buno Bedele zone.[23]

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[21] Credit and Saving Association of Oromia.

[22] Vision Fund provides loans through group lending schemes. Individual loans have a duration of 1-3 years, with an annual interest rate of 15-18%. Loan size is on average USD 350 and up to USD 1,200 with extra co-guarantor/collateral. (personal communication, November 2018)

[23] Chora woreda, formerly part of Illubabor zone. https://www.farmafrica.org/latest/news/post/921-new-project-helps-130000-small-scale-coffee-farmers-in-oromia-ethiopia

The Sustainable Land Management Program (SLMP, funded by WB, KfW, DFATD) and the Oromia Forest Landscape Program (OFLP) funded by the World Bank is/will be implemented in four and five woredas in Illubabor respectively.[24] In particular the OFLP is of relevance given the nature of coffee farms in the region.

The Oromia Agriculture and Rural Development Bureau is planning a coffee investment program for 300,000ha. However, exact target areas and financing modalities have not been decided yet (Head of the Agriculture and Rural Development Bureau, personal communication, August 2019).

Other programs at national level are the DFID financed coffee component of the Partnership for Forests implemented by GIZ together with TechnoServe, and the EU-Coffee Action (2019-2024) targeting increased coffee production and productivity, product quality, and better market integration of smallholders. The USDA Ethiopia Coffee Project (2020-2025), implemented by TechnoServe, is aiming to improve smallholder income by increasing yield and market access, and building resilience through the adoption of improved agricultural practices.

[24] SLMP: Ale, Bedele Zuriya (Buno Bedele zone), Bilo Nopa, and Metu; RIP: Nono Sale, Dorani, Hurumu, Yayu, Bilo Nopa.

4 POLICIES AND LEGISLATION RELATED TO COFFEE PRODUCTION

4.1 Land and forest (tree) ownership

The existing legislation is conducive to investments in coffee farms. Many of the land holdings have land certificates providing a sense of security for investments, but cannot be used as collateral for formal loans. Within the boundaries set by the forest legislation and the Yayu BR management plan, farmers can manage the tree canopy to adjust shade and replace dying trees. At the same time, all coffee farms are considered forest and thus, must not be converted to other land use forms.

Land ownership and use is regulated in the Constitution (1995), and federal and regional Rural Land Administration and Use Proclamations (456/2005 and 130/2007). Land ownership is vested exclusively in the State, but individuals and communities have the right to use land free of charge. Land use rights are documented in the form of holding certificates, stating land size, land use and cover, borders, and the obligations and rights of the holder(s). Land use rights are transferable by lease and inheritance. Private investors can lease rural land for agricultural development.

Forest use is regulated by the federal Forest Development, Conservation and Utilization Proclamation (542/2007) and the Forest Proclamation of Oromia (72/2003). Forests can be held by the state, private, and communities. Forest land is any land with a tree crown cover of at least 20% and a minimum area of 0.5ha. Forest owners have the right to harvest trees (with the exception of endangered species) but must replace them. However, in reality commercial timber utilization in natural forests is forbidden by local authorities. The use of native timber species is commonly allowed for subsistence purposes of PFM members.

State forest, or concessions in state forest (including community forests under PFM), require a management plan for utilization. Protected forests may be utilized with the consent of the authority and according to the management plan by local communities for honey and spice production, and to collect forest coffee, animal feed, and dead wood for fuel.

The *Yayu Coffee Forest Biosphere Reserve* is considered a protected area (UNESCO). However, BRs have no explicit legal status in the Ethiopian legislation and no dedicated entity responsible for it. Under the umbrella of the GIZ BFP program, the BR management plan was developed. The plan comprises management and use prescriptions, and the institutional structure for governance (including stakeholders from federal to kebele level). The implementation of Yayu BR management will hinge on the ability of the regional stakeholders to secure funding, including finance from development partners, private sector and NGOs.

The reserve is divided into three zones (core, buffer, and transition) with different prescription for protection, utilization and development (Table 7).

Table 7: Yayu Coffee Forest Biosphere Reserve management and use

Zone	Area (ha)	Current vegetation and use	Prescribed use
Core	27,000	▪ Undisturbed forest with wild coffee	▪ No human activities other than research
Buffer	22,000	▪ Slightly disturbed forest	▪ Collection of non-timber forest products ▪ No manipulation of the vegetation to e.g. increase coffee production
Transition	118,000	▪ Settlement, forest and garden coffee, agriculture	▪ Continuation of traditional land use activities ▪ Enrichment of coffee farms with local land races
Total	**167,000**		

(OEFCCA & OFWE, 2019)

4.2 Marketing of coffee

The Ethiopian coffee sector is highly regulated and controlled, reflecting the importance of the sector in the country's economy. The stringent regulation and control has positive sides, such as credible quality assessment by the ECX and availability of statistics for quantities traded at woreda level. On the downside, traceability of coffee declined with the establishment of the ECX and vertical integration of producers and international buyers is limited by the system.[25]

The legislation for coffee production and trade was revised 2017. Key points of the relevant laws and regulations are listed in Table 8.

Table 8: Legislation coffee production and trade

Proclamation / regulation	Key points
Ethiopia Commodity Exchange Authority Proclamation 551/2007 and Amendment Proclamation 1050/2017	▪ The ECX' function is to ensure access to market information and fair competition, prevent price manipulation, and ensure the financial integrity of all transactions ▪ All commodities traded through the ECX must have an exchange product certificate for product quality / grade and an exchange warehouse receipt showing product origin, quantity, condition, and location ▪ Commodities can be traded as spot or future or forward contracts
Coffee Marketing and Quality Control Proclamation 1051/2017	▪ All coffee traded has to pass through the ECX or alternative transaction centers (verified and authorized by the Authority) for grading. High quality coffee (grade 1-7) is strictly for export only. ▪ Coffee destined to the domestic market must be sourced from the ECX. ▪ Coffee "suppliers" require a license to collect and process coffee for delivery to the ECX or selling directly to exporters (passing through alternative transaction centers).

[25] It remains to be seen if recent adjustments to the ECX will help to improve the situation.

Table 8: Legislation coffee production and trade

Proclamation / regulation	Key points
	▪ Producers with a certificate of competence and coffee export business license can export coffee from their own farm (minimum 2 ha of coffee) and outgrowers, or cooperative members. ▪ Outgrowers are coffee farmers in a contractual relationship with a certified investor producing coffee. The investor provides extension services and technological support to outgrowers. ▪ To ensure traceability, supplier and exporters must not mix coffee from different agro-ecologies during collection, processing, transport, and warehousing.
Coffee Quality and Transaction Council of Ministers Regulation 161/2009	▪ Sets minimum standards for the production and primary processing of coffee (alien substances, use of immature coffee, packaging materials, use of chemicals) ▪ Inspection of coffee transactions, processing and transport

4.3 Environment

The Ethiopian Government has expressed its commitment to a green development pathway in various policies and strategies.[26] In reality, the implementation is often hampered by the need for economic growth taking precedence over other concerns and limited funding available for the effective protection of natural resources.

Of particular importance for the coffee sector are regulations regarding compliance with Ethiopian environmental standards (Environmental Impact Assessment Proclamations, federal 299/2002 and Oromia 176/2012, and regulations).

The Coffee Marketing and Quality Control Proclamation (1051/2017) states that processors require a certificate of clearance of environmental pollution for coffee pulping, cleaning and sorting, roasting, and grinding.

[26] For example the Green Growth and Transformation Plan II and the National Determined Contribution to climate change mitigation and adaptation.

5 INVESTMENTS FOR SUSTAINABLE IMPROVEMENT OF INCOME FROM COFFEE

5.1 Potential development pathways

Several potential pathways exist to increase farm income from coffee in the project region. The strategy for scaling up sustainable coffee production selected by the project will combine three intervention areas: productivity, quality, and market access (highlighted in Table 9). Investments will be required at farm and cooperative level, combining different funding sources (see section 5.3).

These intervention areas are expected to have the highest positive impact on household income, while constraints and risks can be managed by appropriate project design and application of safeguard measures.

Table 9: Pathways to increase farm income from coffee sustainably

Pathway	Investments*, pros and constraints
Increasing productivity	**Investment needed:** ▪ Rejuvenation of old coffee trees by stumping or replacement **Pros:** ▪ Doubling or more of productivity expected ▪ Higher yielding and disease resistant varieties are available **Constraints and risks:** ▪ Temporary loss of income ▪ High and long-term farm-level investment ▪ Limited availability of improved seed and seedlings ▪ Risk of displacing local land races (loss of biodiversity)
Improving quality	**Investment needed:** ▪ Good practice post-harvest management on-farm **Pros:** ▪ Possibility to access high priced specialty coffee markets **Constraints:** ▪ Requires consistent quality assurance processes along the value chain and access to market segments which pay for high quality
Improve market access and value addition	**Investment needed:** ▪ Building and maintaining a marketing network ▪ Certification with sustainability standards ▪ Development of single origins/specialty coffee ▪ Capacity for roasting and packaging **Pros:** ▪ Secure markets are an incentive for investments in productivity and quality at farm level ▪ With strong vertical integration buyers may carry part of the investments needed **Constraints:** ▪ The cost of producing certified coffee may be higher than the additional income (low price premium)

Table 9: Pathways to increase farm income from coffee sustainably

Pathway	Investments*, pros and constraints
	▪ Specialty coffee and sustainability standards cater to very specific markets, the implementation must be demand driven Specialty coffees frequently only take a fraction of the harvest (highest quality), i.e. the mainstream (good) quality coffee requires different marketing channels
Increasing area under production	**Investment needed:** ▪ Planting coffee and shade trees on non-forest land **Pros:** ▪ Increasing income from current low income agricultural land ▪ Multipurpose shade trees (fruit, timber) provide additional income **Constraints and risks:** ▪ Temporary loss of income ▪ High and long-term farm-level investment ▪ Increasing food insecurity (replacement of subsistence food crops) Conversion of forest land (displacement of food crops into forest)
Increasing the share of washed versus sun-dried coffee	**Investment needed:** ▪ Washing stations **Pros:** ▪ Washed coffee is sought after by many buyers ▪ Less work at farm level **Constraints and risks:** ▪ Limited road network and means of transport ▪ Selling at peak supply times resulting in lower prices[+] ▪ High quality sun-dried coffee can fetch higher prices than cherries ▪ High water need and potential pollution of streams

* The adoption of good agricultural practices in general is assumed for all on-farm investments. Published research results for yield under different management practices are available for shade tree type and density, spacing, rejuvenation practices, use of fertilizer and mulch amongst others. (Anteneh & Taye, 2015a; Anteneh et al., 2015b; Bote & Struik, 2010; Taye et al., undated)

[+] Sun-dried coffee can be stored and sold throughout the year to achieve better prices and/or using coffee as "in-house bank"

The project will **not** actively promote the expansion of area under coffee production, increasing the share of washed coffee, and the development of specialty coffee.

Area under coffee production: expanding coffee to current crop land will reduce household income diversity and may have negative effects on household income/food security in times of low coffee prices or low coffee production due to adverse conditions (weather, pest and diseases). An expansion of coffee area could also mean the conversion of primary forest into semi-forest coffee, causing environmental degradation.

Washed coffees: sun-dried coffees achieve similar market prices as washed coffee. Washing coffee requires large quantities of water and may cause pollution of streams and rivers. The infrastructure in many rural areas is not suited for the timely delivery of fresh cherries to washing stations.

Specialty coffees: while specialty coffees can fetch much higher prices than regular coffee, they are not easily applied to larger regions. Specialty coffees are usually developed for small, very

specific areas (e.g. one cooperative) or products (e.g. wild coffee). They often include only a small share of the production (the very best quality) leaving the bulk of coffee to regular marketing channels.

5.2 Risk mitigation approaches

5.2.1 Loss of biodiversity and carbon stocks

Changes to the forest component of coffee farms

In the traditional coffee management system practiced in the project region shade tree density and diversity is high. These managed coffee ecosystems store significant amounts of carbon in trees and soil, and contribute to biodiversity conservation.

Farmers regulate shade actively by removing individual trees, but also planting new ones to replace old and dying ones. Natural regeneration of shade trees is available and kept in check as part of weed control.

Reducing tree number and/or selecting only species with moderate light interception could contribute to increased yields but would have negative impacts on the carbon stored in the biomass and biodiversity of tree species.

Jimma Agricultural Research Center has identified several native species which are highly compatible with coffee, e.g. *Albizia spp*. common in the project area (Anteneh & Taye, 2015a). The recommended number per hectare varies considerably according to species, but assuming a mix of species, is similar to the current number of shade trees. Other species existing in the project area (e.g. *Croton macrostachyus*) provide bee fodder, i.e. diversify income from coffee plots. Last but not least, coffee grown under shade was found of to be of higher quality than coffee cultivated without shade (Bote & Struik, 2010).

The project should encourage coffee farmers to sustain the current tree cover and species diversity highlighting the positive aspects. The option of market incentives (i.e. premium prices for coffee farmers maintaining the tree layer will be explored in the feasibility study.

Reducing the genetic diversity of coffee

The replacement of old coffee trees with new, more productive and disease resistant varieties may lead to a reduction of genetic diversity, in particular where the old trees were raised from locally collected seed.

However, the genetic diversity of Ethiopian coffee is protected in several ways:

- Metu agricultural research station has a range of new varieties suited to the conditions in the region. These varieties were developed from old, existing materials.
- The genetic diversity of coffee is protected in situ in the core and buffer zone of the Yayu BR and in the coffee germplasm collections at research field gene-banks (EIAR, 2019).

5.2.2 Investment risks

Factors contributing to investment risks at different levels and mitigation options are listed in Table 10.

Table 10: Investment risks and mitigation strategies

Risk	Mitigation strategies
Changes in the natural environment ▪ Pests and disease outbreaks ▪ Weather extremes ▪ Changing climate ➔ Lower than expected yield or quality ➔ In severe cases loss of coffee plants	▪ Promote pest and disease resistant varieties adapted to the site conditions ▪ Maintain the shade coffee system to protect coffee from weather extremes ▪ Focus investments on areas where coffee is in its optimum (above 1,500m)
Price volatility driven by: ▪ Bumper harvests/expanding production in large producer countries ▪ Shifting customer preferences ➔ Lower than expected returns for farmers and trade	▪ Promote independence from the global commodity markets for coffee by: - Vertical integration with international buyers - Producing superior quality
Policy ▪ Changing coffee marketing structures and licenses for the domestic and export markets ▪ Access to foreign currency ▪ Restrictions on export of earnings ➔ Under/overestimated returns on investment	▪ Align investments well to existing policies and national/regional development strategies and programs ▪ Proactively involve government actors at all levels
Political instability ➔ Limited access due to political unrest ➔ Loss of control over project implementation (especially for foreign partners) ➔ Assets (infrastructure, coffee) damaged or destroyed	

5.2.3 Food security

Lower production of food crops at household and landscape level

Households increasing the investment on coffee plots may shift the available resources (finance, labor, land) away from staple food crops, thereby reducing self-sufficiency and income diversity. If coffee farms were to replace food crops at scale, the availability and cost of food items in the region may be affected negatively.

Coffee is already the key cash crop in the region, used to cover household needs throughout the year and including purchasing food. A higher level of disposable income from coffee is likely to improve food security. However, over-dependence on coffee exposes households to a high risk if production or prices are lower than expected.

The project will not actively promote the expansion of land under coffee. Investments targeting productivity, resilience of the coffee management system, and market linkages will help to reduce the exposure to the food security risk.

Temporary loss of income when replacing old coffee trees

The replacement or stumping of old coffee trees translates into an income gap of two to three years until the new coffee trees reach the former (and eventually higher) production level.

The project will promote gradual replacement/rejuvenation, starting with the most unproductive coffee plots to avoid large income gaps.

5.3 Framework for upscaling sustainable coffee production

A tentative structure for upscaling investment, shown in Figure 7, was discussed with key actors and financial institutions. The interests of the different investor categories are illustrated in Figure 8.

Proposed investment structure

Potential *investors* are impact investors, international development assistance providers, and Ethiopian development programs. Foreign investments can be in the form of guarantees and loans e.g. to banks or microfinance institutions and/or in the form of grants, especially in the initial phase of the scaling up (TA component). Domestic public investments can be linked to e.g. the planned coffee investment program for Oromia. Direct investments, e.g. by international buyers of coffee, in cooperatives or growers are also possible.

Two types of *financial intermediaries* for commercial lending to farmers, cooperatives, unions, and private sector exist – commercial banks incorporated in Ethiopia and microfinance institutions (MFI). Banks are well suited for lending to businesses, cooperatives/unions or any other aggregator representing smallholder coffee farmers, and financing assets and trade. MFIs can directly, or in partnership with cooperatives, lend to coffee farmers to purchase inputs and rejuvenate farms (group lending schemes). The ability of MFIs to lend directly to farmers has advantages, but does not replace the need for technical assistance which can be only provided to organized farmer groups.

Coffee cooperatives and cooperative unions use loans to invest in infrastructure and equipment to store and process coffee, buy coffee from farmers, and market coffee. Loans can also be passed on to farmers, e.g. in the form of inputs. Cooperatives also provide technical assistance to members. Channeling investment through cooperatives is challenging in two ways. (i) The organizational and financial capacity of many cooperatives is low, i.e. cooperatives would require substantial technical assistance initially. (ii) Only about 20% of coffee farmers are members of cooperatives with commercial focus on coffee, i.e. many coffee farmers cannot be reached through cooperatives.[27]

[27] Many cooperatives have other purposes (e.g. NTFP for PFM), are still too young, are not member of a coffee union, and do not have access to finance needed to trade with coffee.

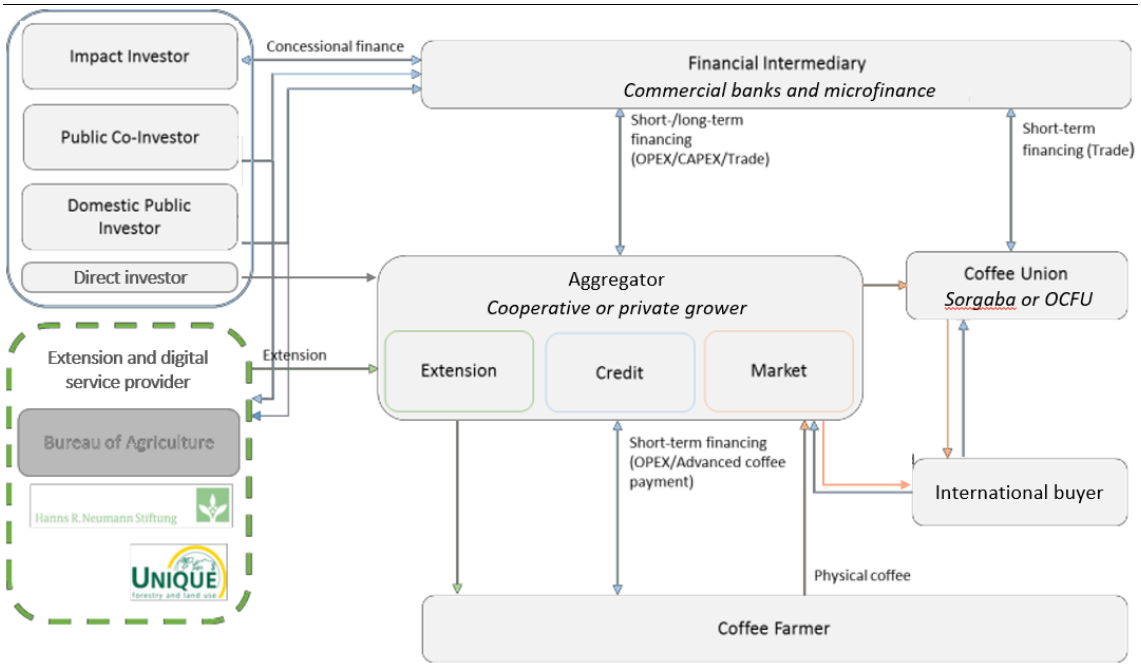

Figure 7: Proposed investment structure

International buyers are trading houses or roasters interested in securing their supply chain, in particular in regard to high quality coffee traceable to the producer. According to Ethiopian law, they can buy directly from cooperatives/union or private growers (with outgrowers). Therefore, international buyers can invest directly into their Ethiopian counterparts to improve production quantity and quality, value addition, and if required, certification. Alternatively, if their ability to engage at grassroots level is low, they can limit engagement to long-term offtake contracts, relying on cooperatives or private growers to produce coffee according to their requirements.

The *Extension and digital service provider,* comprising HRNS, UNIQUE, agencies of the Agriculture and Rural Development Bureau and others, will provide technical services to enhance capacity at farm, cooperative, and union level. The facility will be initially grant financed as a catalytic investment. Over time, after successful on-farm and cooperative investments, the provider will finance itself with a fee on the coffee traded through cooperatives. In the long-term, government, union and cooperatives will take on the responsibility for all extension and digital services.

Investors

High returns in the range of 13%-20% are expected by private equity investors, impact funds, MFIs, and commercial banks. Return expectations are a few percentage points lower for USD compared to Birr investments. Private growers require returns upwards of 10%.

Development partners such as the financial reform partnership between Ethiopia and Germany, and philantropic investors may provide finance at lower interest rates as they are less return and more misson driven (environmental and social development).

MFIs, private growers (with outgrowers), and philantropic investors give small loans to farmers (500-5,000USD), but may also fund investments into production infrastructure (about 100,000USD). Commercial banks and international buyers are most likely to fund cooperatives

or private growers with loans between 100,000 to above one million USD. The loan or grant funding provided by traditional aid and financial reform partners is usually above one million and up to 20 million, depending on the entity and range of activities funded. Impact funds and private equity investors are interested in direct, large investments above eight million USD.

Given the regulatory environment and the foreign currency restrictions, all foreign investors currently face severe investment barriers. However, the new president has proposed a revised investment law to parliament for approval, leading to the expectation that the investment environment will improve significantly over the next year.

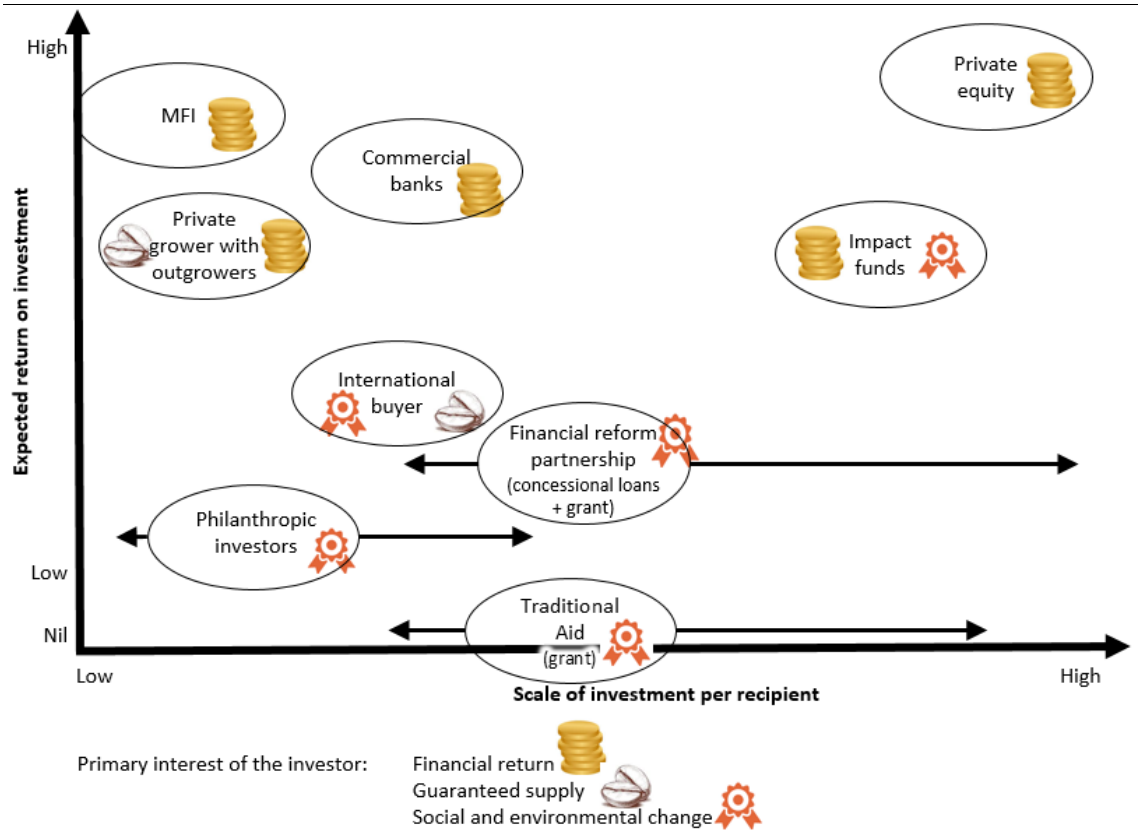

Figure 8: Investors – expected returns and credit size

6 KEY FINDINGS AND WAY FORWARD

6.1 Conclusions

Project interventions maintain the extremely rich biodiversity and high forest coffee carbon stocks through the sustainable use of the coffee. This will ensure a resilient and better living income in Illubabor region.

The traditional way of growing coffee under shade of forest trees is very common in the project region. Coffee farms have a diverse shade tree layer, store large amounts of carbon, and are an important element of the forest landscape mosaic.

Coffee constitutes an important income source and occupies the majority of land utilized by households. At the same time, coffee farms are low inputs systems with yields well below the potential for this area. The resulting low income from coffee contributes to the relative poverty of households in the region.

The project has to find ways to increase income from coffee without compromising the environmental integrity of the forest landscape. The interventions with the likely highest socio-economic impact and least environmental risk are rejuvenation of coffee trees, and improving input use, quality management, and market access.

The management of the shade tree layer is an integral part of the good agricultural practices promoted by the project. The optimal management will be identified and disseminated together with local experts.

The conservation of the biodiversity value of coffee farms and carbon storage are important co-benefits. If the shade tree layer of coffee farms is not adequately managed, both biodiversity and carbon storage can be expected to diminish over time. Therefore, one of the projects' targets will be to train and encourage coffee farmers to maintain the shade tree layer.

The pilot project will identify best practice for shade tree management together with the Metu agricultural research station and other local experts.

Cost-efficient monitoring of the shade tree layer requires digital solutions. The options will be assessed in the feasibility study.

While different investors are placing focus on different key performance indicators, maintaining high biodiversity and high carbon stocks of shade trees, is likely to appeal to most investors. However, tracking forest degradation at landscape level in order to react and prevent it, is complex and costly.

In the framework of the feasibility study, the technical options to monitor degradation and deforestation will be explored. Aligned to the investors' requirements for zero deforestation tolerance in the value chain and the commitment to demonstrate and expand positive impacts, the most appropriate solution will be identified and become part of the business case.

The upscaling of sustainable coffee production requires village level aggregators for the provision of technical assistance and finance. Primary cooperatives are the most likely aggregators, but require substantial organizational development.

Scaling up the pilot project activities through extension and digital services and access to finance requires an efficient farmer aggregation mechanism. The pilot project works with primary cooperatives and their members (arranged into Farmer Field School groups). This arrangement – together with a digital platform – is the most likely avenue for efficient extension and access to finance in the scaling up scenario.

However, only about 40% of farmers sell coffee to cooperatives and the capacity of cooperatives to provide services other than buying coffee is low. Cooperatives would require substantial organizational development assistance and some investment before they can take on additional functions. The detailed capacity building needs and best approach to develop the capacity of cooperatives for service provision will be evaluated in the feasibility study.

Other options, e.g. working with suppliers or private growers, may be viable too and will also be assessed in the feasibility study.

Improving market access is an important condition for investments at farm level. It requires investments into quality management, product traceability, and marketing.

A more secure access to market (e.g. supplying specific roasters or trading houses) ensures producers of their ability to sell the coffee produced. In many cases, coffee sold directly to international buyers also results in higher producer prices, providing incentives to invest in coffee quality.

Improving access to markets requires interventions at different levels and aspects: quality management in primary production, processing, and storage; traceability of products; and marketing. Other aspects can be important, but should be demand driven: e.g. the certification with sustainability standards or the development of specialty coffees.

In the feasibility study, potential private sector partners, their requirements and interest to invest directly will be identified together with HRNS. The ability and capacity building needs of primary cooperatives and union in regard to quality management, chain of custody, and marketing will be assessed in detail.

Financial investments is required at farm and primary cooperative level. The most suitable financial intermediaries and financing structure will be identified in the feasibility study.

Financial investment will be needed at farm level (rejuvenation, inputs) and for primary cooperatives (trade finance, equipment). Depending on their availability and interest to participate, private growers and suppliers will require similar investments.

Likely, different financial intermediaries will be needed to channel finance to farmers and cooperatives. Of particular relevance are commercial banks and micro-finance institutions. The best match between loan suppliers and takers will be identified based on the available loan products and conditions, and infrastructure of the different financial institutions.

The option to adapt existing financing structures employed by private sector (e.g. NKG Bloom approach[28]) will be explored.

6.2 Feasibility study for the upscaling of sustainable coffee production

The feasibility study will be conducted for the coffee growing regions within Illubabor zone. The research and, subsequently, the business case will focus on investments in the coffee value chain and related forest landscape income sources.

In the feasibility study, in-depth analysis is required on:

- Cost and benefit for the selected combined development pathway, requiring information for
  - Proposed investments (extension for GAP and value chain development)
  - Investment costs
  - Yield and quality responses to investments (by the farmers and aggregators)
  - Price premiums for higher quality
- Institutions to be involved in upscaling
  - Capacity
  - Requirements including the assessment of safeguards
  - Investment type and size
- Forest monitoring (carbon)
- Digital tools and platform for
  - Extension
  - Documenting yield and quality responses
  - Monitoring forests (deforestation free value chains)
  - Chain of custody monitoring
  - Access to finance
  - Compliance with production standards
- Financing structure.

[28] https://uganda.nkgbloom.coffee/

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Annex:

Baseline report for the project “Restoring degraded coffee landscapes, Ethiopia”

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ACRONYMS

FFS	Farmer Field School
HRNS	Hanns R. Neumann Stiftung
MIS	Management Information System
GAP	Good agricultural practice
GBE	Green Bean Equivalents
CWD	Coffee Wilt Disease
CBD	Coffee Berry Disease
DBH	Diameter at breast height
CO_2	Carbon dioxide

8 METHODOLOGY

The baseline survey incorporates data collected for the entire project population and samples thereof, and at different levels of detail (Figure 9):

- Farmer registration, including all households participating in the project.
- Survey of farm households, including a sample of the project participants.
- Coffee farm inventory, including a sub-sample of the farms covered by the baseline questionnaire.

Details on the indicators and parameters covered are provided on the next pages. The registration form, questionnaire, and inventory design are available as separate documents and as software application (see below). The registration form and questionnaire were translated into local language (Oromiffa).

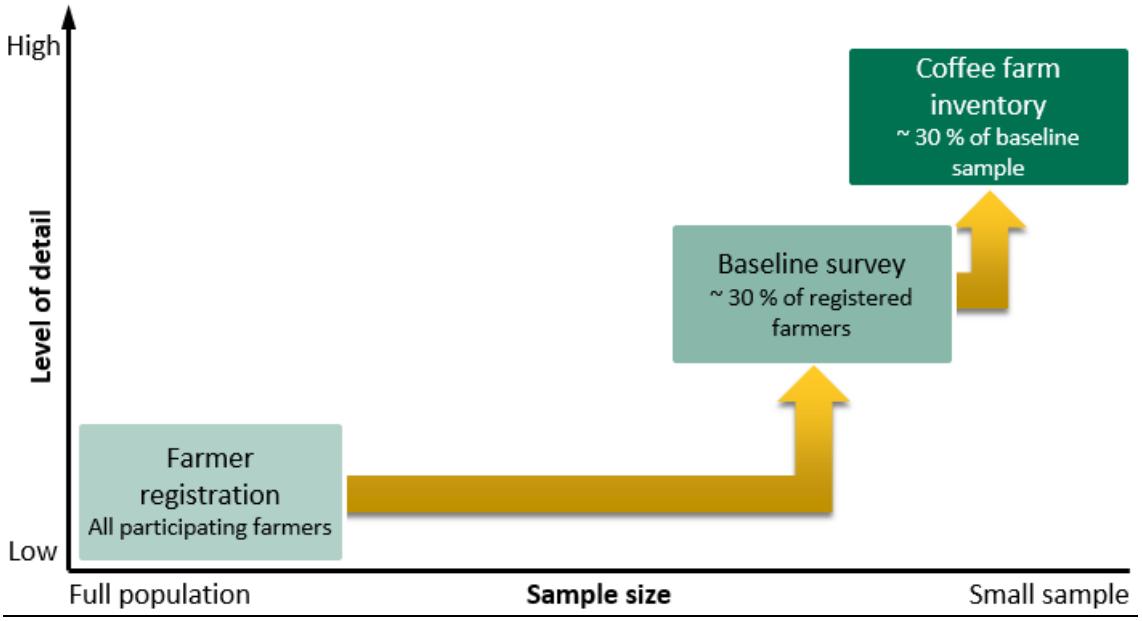


Figure 9: Levels of baseline data collection

Parallel to the baseline survey, other actors involved in the coffee value chain at local level were interviewed (cooperatives, traders/processors, authorities, and selected farmers). The primary aim of these interviews was to compile information required for the development of the business model (refer to the pre-feasibility study). Hence, the interviews provide contextual information for, but are not part of the baseline survey.

Management Information System

The data collected in registration and in the baseline survey was captured in the Management Information System (MIS) developed for the project. The data can be entered in the field using mobile devices or office based using a web-platform. The MIS allows entry of different data formats: text and numerical information, pictures and coordinates. The system has integrated control functions to reduce errors during data collection or entry.

Staff from HRNS was trained to use the field data collection software application and web-based platform prior to registration. The enumerators conducting the baseline survey only used the application on mobile devices. Training took place immediately prior to and in the pilot survey.

Data collection during farmer registration

The purpose of collecting basic data about farms and farming practices during registration was to increase the sample size. Furthermore, the validity of data collection in self-reporting versus individual interviews in the baseline survey can be assessed.

HRNS staff trained the Farmer Field School facilitator in the registration process, and provided registration forms to each household participating in the project. Each household provided basic information for the parameters listed in Table 11. The facilitator supported the members in filling the form, then passing them on to HRNS field staff who entered the data into the MIS.

The recruitment of farmers started in early 2019. By end of May 2019 – just before the beginning of the baseline survey – 255 farmers forming nine FFS (Annex 1) had be recruited and their data entered into the MIS.

Table 11: Information collected during registration

Indicators	Parameters
Household	▪ Gender and age of the registered farmer (household head) ▪ Marital status ▪ Household size
Land use, area and ownership	▪ Farm size ▪ Ownership (land certificate, leased, or customary) ▪ Area used for coffee, other crops, grazing and other
Coffee production [A]	▪ Density of coffee trees ▪ Age of coffee trees ▪ Coffee sold (to the cooperative or other) ▪ Coffee consumed by the household
Agronomic practices for coffee	▪ Harvesting ▪ Storage ▪ Nutrient management ▪ Pruning ▪ De-suckering ▪ Weed control ▪ Pest management ▪ Soil and water conservation measures ▪ Shade trees removed and planted ▪ Coffee trees removed and planted

[A] Different coffee products (fresh cherries, sun-dried) were converted to Green Bean Equivalents.

Farm household survey

The survey assessed the status of coffee farms and current farming practices. The questionnaire was developed based on similar surveys of coffee farmers by HRNS in Ethiopia and Uganda.

Of the registered farmers, 30 % were selected for the farm household survey, distributed across the nine FFS. The indicators included in the questionnaire (Table 12) are similar to the ones used in registration, but require more detailed answers. For example, area and information for some agronomic practices had to be provided for different coffee management systems (garden coffee, semi-forest coffee, and forest coffee) separately.

Table 12: Information collected in the baseline survey - questionnaire

Indicators	Parameters
Household	As in Table 11. ▪ Food supply shortages
Land use, area and ownership Coffee management system	As in Table 11. ▪ Garden coffee ▪ Semi-forest coffee ▪ Forest coffee
Status of coffee plots per coffee management system	▪ Density of coffee trees [A] ▪ Age of coffee trees [A] ▪ Shade trees [A]
Coffee yield and sales [B]	▪ Quantity sold and consumed by the household ▪ Quantity sold to buyers by type ▪ Price for different products (fresh cherries, sun-dried, green beans)
Agronomic practices for coffee	▪ Harvesting ▪ Drying ▪ Storage ▪ Coffee planting [C], purpose, and planting material [A] ▪ Nutrient management (fertilizer, mulching, residues, compost) [A] ▪ Pruning [A] ▪ De-suckering [A] ▪ Stumping [A,C] ▪ Weed control method and frequency [A] ▪ Pest management (techniques known/applied, occurrence) [A,C] ▪ Soil and water conservation measures [A] ▪ Shade trees removed [C] and planted [C], reason [A] ▪ Irrigation ▪ Use of non-household labor and task

[A] For coffee management systems

[B] Different coffee products (fresh cherries, sun-dried) were converted to Green Bean Equivalents for comparison. See Annex 2 for conversion factors used.

[C] Within the last three years.

Coffee farm inventory

The purpose of the coffee farm inventory is to verify the information received in the questionnaires and to collect data on shade trees.

Inventories were conducted for about 30% of the farmers included in the questionnaire. These farms were selected randomly but excluded forest coffee plots (which are not targeted by the project). If a farmer had more than one coffee plot, the one closest to his homestead was selected.

The indicators and parameters covered in the inventory are listed in Table 13. Due to the sometimes short lived visibility of some practices or damages caused by incorrect practices, the information from the farm inventory has to be used together with the household survey.

Table 13: Information collected in the coffee farm inventory

Indicators	Parameters
Coffee plot area	▪ Boundary of the plot
Productivity	▪ Density of coffee trees ▪ Approximate age ▪ Average number of stems per coffee tree ▪ Average height
Shade trees	▪ Number ▪ Diameter and height ▪ Crown cover ▪ Vitality ▪ Regeneration
Agronomic practices for coffee	▪ Presence of weeds ▪ Trees pruned, stumped, suckers removed ▪ Nutrient management (fertilization, mulching, residue management) ▪ Harvesting (damage) ▪ Planting ▪ Soil and water conservation measures

Carbon storage

The most relevant carbon pools in agriculture/agroforestry are above ground biomass, below ground biomass and soil organic carbon. The carbon stored in the dead wood, litter and shrub (including coffee) biomass can be considered negligible based on the existing literature.[29]

Biomass in coffee trees is expected to remain the same (not withstanding short-term fluctuations due to rejuvenation/renovation of coffee trees).[30]

[29] The three carbon pools combined constituted between 1% and 5% of total carbon stock in three comparable sites with moist afro-montane forest in south-west Ethiopia (Admassu et al, 2011; Abyot et al., 2019; Nesru, 2015).

[30] The biomass (carbon) of coffee trees will be reduced temporarily when coffee trees are replaced or stumped. However, the new trees will store the same amount of carbon, i.e. the long term average carbon storage in coffee trees is assumed to be as high as before. A reduction of the number of coffee trees to optimal stocking will not affect carbon storage. Refer to the CDM AR tool 14: https://cdm.unfccc.int/Reference/tools/index.html.

The carbon content of shade trees (above and below ground biomass) is calculated as below. For soil organic carbon values from existing studies for comparable eco- and management systems and are presented. Soil organic carbon can be considered to be close to its maximum given the current low impact management and dense vegetation of coffee and shade trees.[31]

Calculation of above and below ground biomass, and carbon stock of shade trees:

$$AGB + BGB = ((0.091 * DBH^{2.472}) + (0.048 * DBH^{2.303}))/1000$$

$$C = (AGB + BGB) * CF * \frac{C}{CO_2}$$

AGB: above ground biomass (t dry matter)

BGB: below ground biomass (t dry matter)

DBH: diameter at breast height (cm)

C: Carbon stock in the below and above ground biomass of trees (tCO_2e)

CF: Carbon fraction of wood (0.47)

C/CO_2: Carbon to Carbon dioxide fraction (44/12)

Correlation of data sets

The data collected in the registration, baseline survey and inventory was compared matching the information received for each participant of the baseline survey with the answers given by the same person at the time of registration. Similarly, the results of baseline questionnaire and inventories of corresponding coffee farms were compared.

For indicators where the differences between the registration and survey are significant, the results include the information of both data sets. Results from the inventory are presented where they provide additional information.

The method for the comparison of data from the registration and the baseline questionnaire is provided in Annex 3.

[31] Potential future losses in soil organic carbon related to changes in management can be reflected based on management, i.e. reducing carbon stock with activity based factors.

9 RESULTS

9.1 Households

Seventy eight Farmer Field School members participated in the farm survey questionnaire, representing their respective households. Of these households four are single headed, i.e. are not married, or divorced, or widowed. Only two of the interviewed FFS members are women.

Very few FFS members are young farmers (9%). About half of the members are between 30 and 50 years old, and 40% over 50 years old. The majority of households have five to six household members.

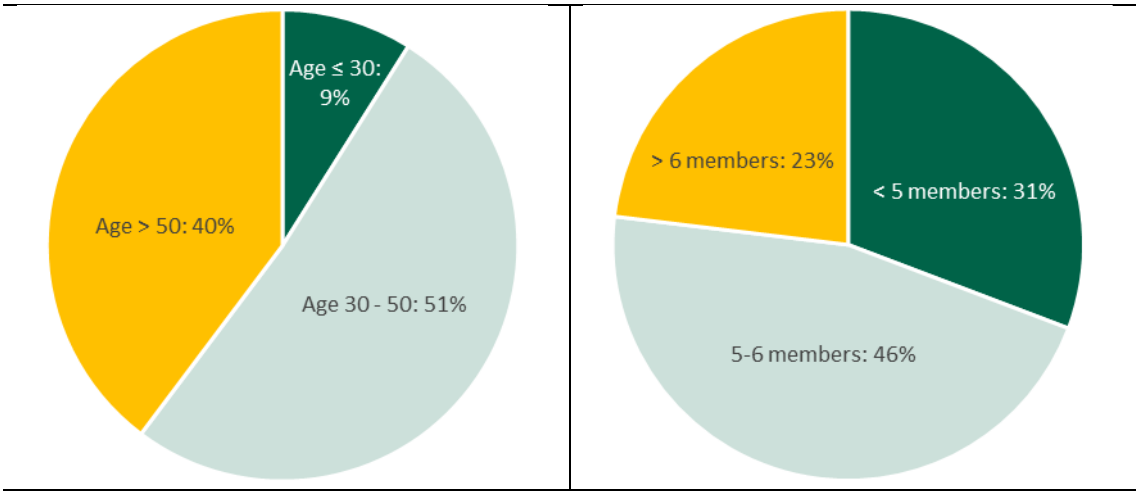


Figure 10: Age of FFS members and household size

Over 70% of households experience food shortages for part of the year, and over 30% for three months. Food insecurity is in particular high from June to August.[32]

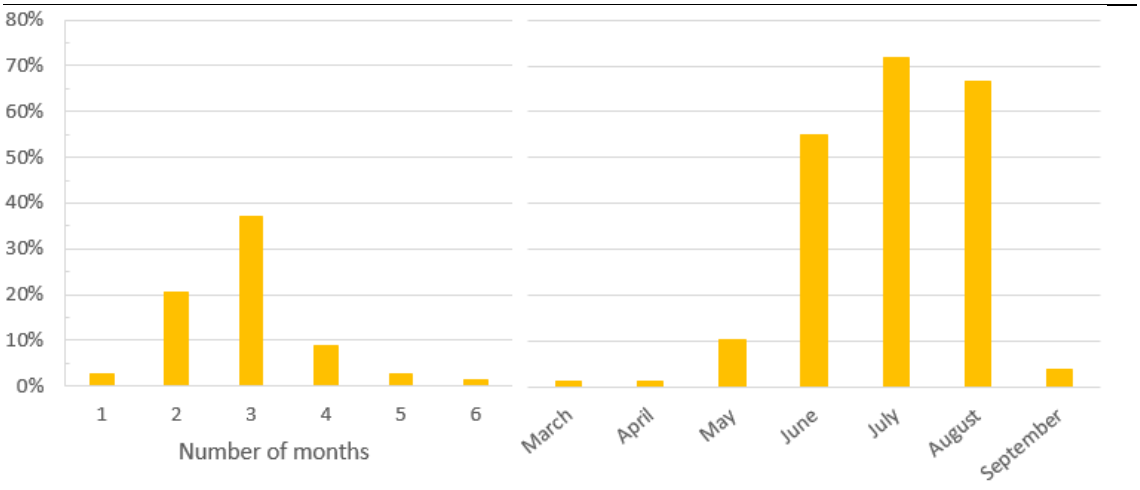


Figure 11: Households with food shortages and duration

[32] The area has only one wet season from May to August. Hence food crops become available just before/with the coffee harvest.

9.2 Farm size and use

The average farm size of project participants is about 2 ha (Table 14). Farm size varies greatly between households, with the smallest farm being only 0.3 ha and the biggest over 40 ha. Over 90% of households have land certificates for at least part of their land.

Coffee constitutes the major crop, occupying on average 65% of the total farm area (excluding forest coffee). Farmers allocate about one quarter of their land to other crops, in particular maize. Five households had no crop land at all.

According to statistics for Illubabor zone (CSA, 2018), about 80% of households own cattle, around 30% sheep and/or goats, and about 10% pack animals. 45% of households with cattle owe 1-4 heads and 25% up to 9 heads. The majority of livestock owners rely on green fodder (grazing and cut-and-carry). Beekeeping is another important economic activity in the area.

Table 14: Farm size, ownership and use

		Area (ha)			
	n	**Average**	**Median**	**Min**	**Max**
Farm size					
Total	78	2.9	2.1	0.3	42.0
Excluding forest coffee	78	2.5	1.9	0.3	12.0
With land certificate	72	2.5	1.9	0.1	30.3
Area used for					
Coffee	78	2.2	1.2	0.2	39.0
Excluding forest coffee	78	1.7	1.0	0.2	9.0
Crops	73	0.7	0.5	0.0	4.0

9.3 Coffee farming system and productivity

Most farmers have coffee plots in areas they qualify as garden coffee. About 40% manage coffee in a semi-forest setting. Only five out of the 78 farmers harvest coffee from forests (Figure 12).

Farmers define the management systems based on distance of coffee plots from crop land and settlements, not on the number or species of shade trees. Coffee plots embedded into the agricultural landscape are called garden coffee, plots along the fringes of larger forested areas are semi-forest coffee. The location of garden and semi-forest coffee plots included in the inventory validates this distinction (Figure 13). The two systems show no difference in the density or type of shade trees (see section 3.6)

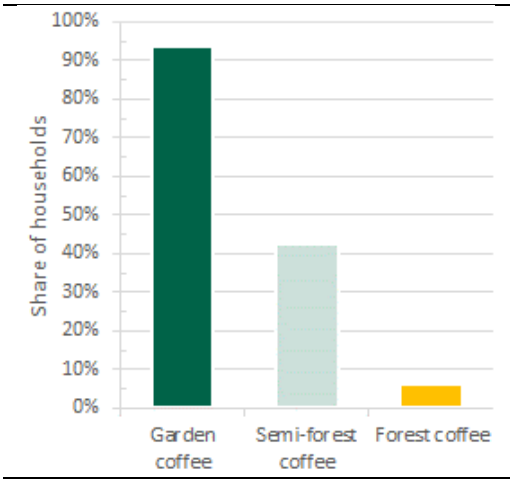


Figure 12: Coffee management systems

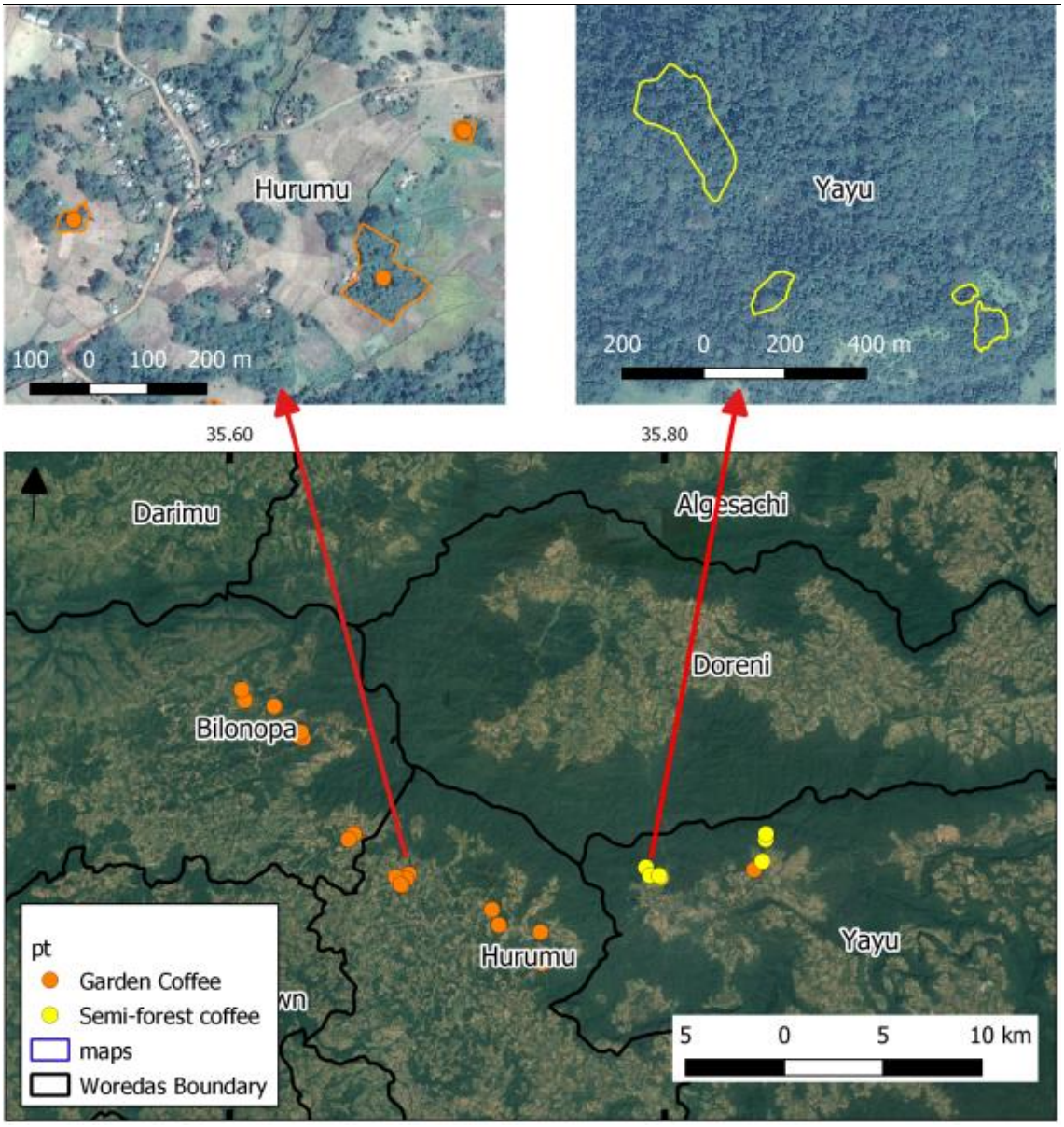


Figure 13: Location of garden coffee and semi-forest coffee plots in relation to land use

According to the farmers interviewed, the majority of coffee farms have a very high stocking, with coffee trees estimated to be 1.5m or less apart. Of the 27 coffee gardens covered in the inventory about half had high stocking, the other half medium stocking (circa 2m apart). In most cases coffee trees had two stems.

Coffee trees tend to be quite high. On over 70% of the farms included in the inventory, the average height was 2.5m and above.

Figure 14 shows the age for the majority of coffee trees and the share of productive trees in a specific garden or semi-forest coffee plot as estimated by farmers. In about one-third of the coffee plots the majority of coffee trees is older than 25 years. Approximately the same number of coffee farms have a mix of all ages. On just under 30% the majority of trees is in the most productive age period of 4 - 25 years. In line with the age of coffee trees, farmers estimated the

percentage of productive trees in their farms to be about 40% for the garden or semi-forest coffee management systems.

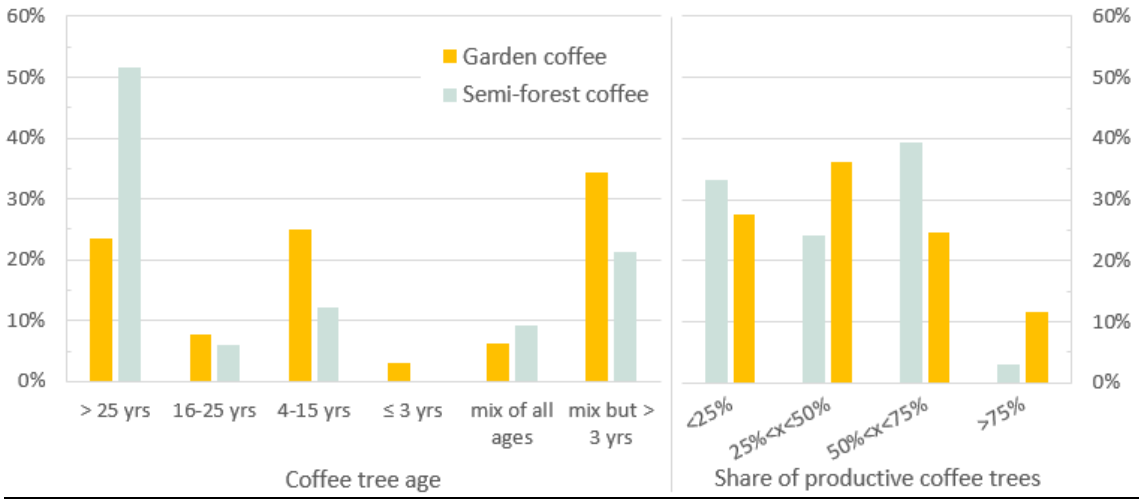


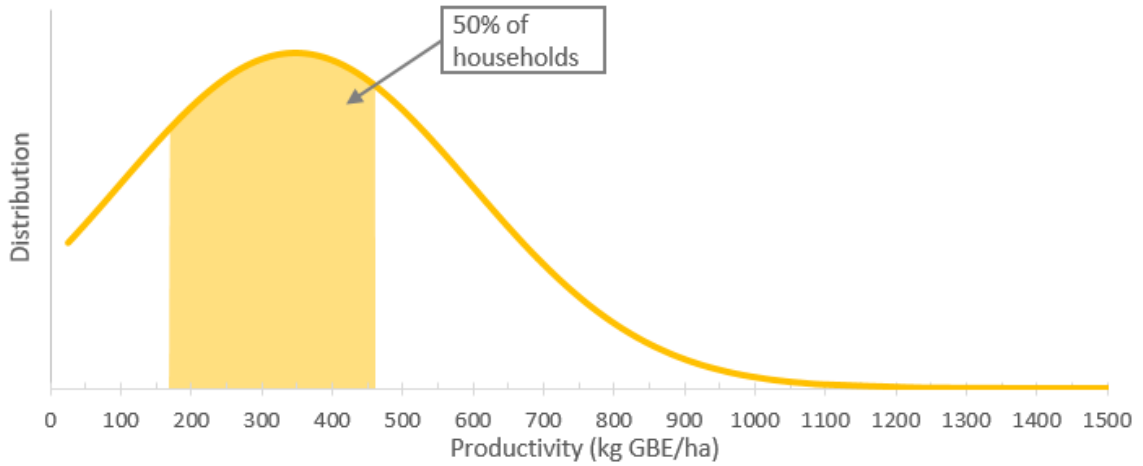
Figure 14: Age of the majority of coffee trees and share of productive trees in coffee farms

The majority of households produce between 170 and 460kg of Green Bean Equivalents (GBE) per hectare (Table 15 and Figure 15). The average productivity is about 350kg GBE/ha. The maximum productivity stated was above 1,500kg GBE/ha, indicating the potential production in the area.

Table 15: Productivity of coffee farms

	Production (kg GBE/ha)*
Average (kg GBE/ha)	347
Median (kg GBE/ha)	280
Minimum (kg GBE/ha)	25
Maximum (kg GBE/ha)	1,509

*Values for farmers registered by October 2019.
n = 707 (excluding incomplete entries and values above the maximum)



Values for farmers registered by October 2019. n = 707

Figure 15: Productivity of coffee farms

9.4 Agronomic practices

A summary of adoption rates per practice (against the HRNS Ethiopia good agricultural practice (GAP) adoption criteria) is provided in Annex 5.

Planting coffee

Sixty percent of the farmers interviewed planted coffee in the last three years. Of these, over 80% established new coffee gardens and/or entirely replaced old ones (Figure 16).

Farmers used both improved and local varieties, and mostly sourced seedlings from government or raised their own (Figure 17). Some farmers use wildlings and only about 10% of farmers buy seedlings from other farmers.

The coffee farms included in the inventory were all older ones. About 60% of the surveyed farms had some coffee trees likely planted within the last three years.

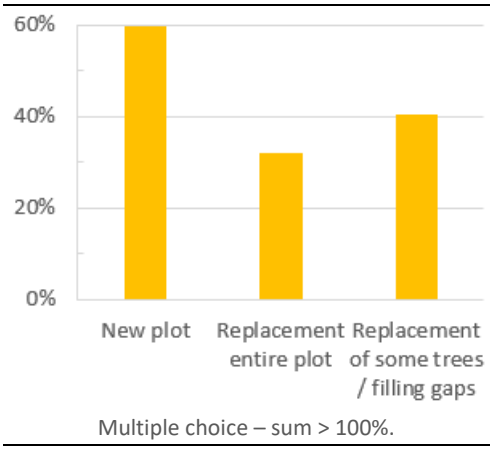


Figure 16: Reasons for planting

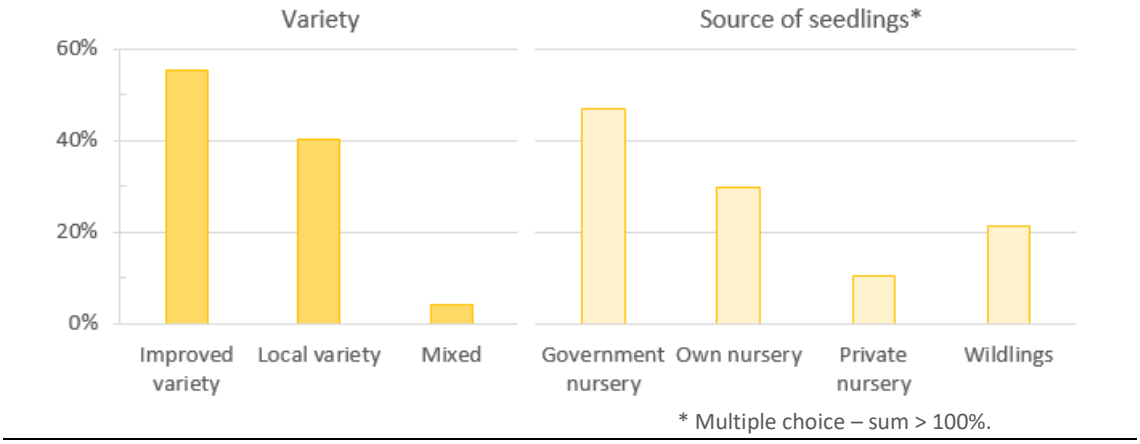


Figure 17: Planting coffee - variety and seedling source

Weeding

Two thirds of farmers apply a combination of slashing and hoeing to manage weeds, doing so twice per year. Generally speaking, the intensity and frequency of weeding is higher in the garden coffee system versus semi-forest system. Shade tree saplings are usually removed as well, although only few farmers remove all of them.

Weed coverage observed in the inventory is heterogonous across the different management systems.

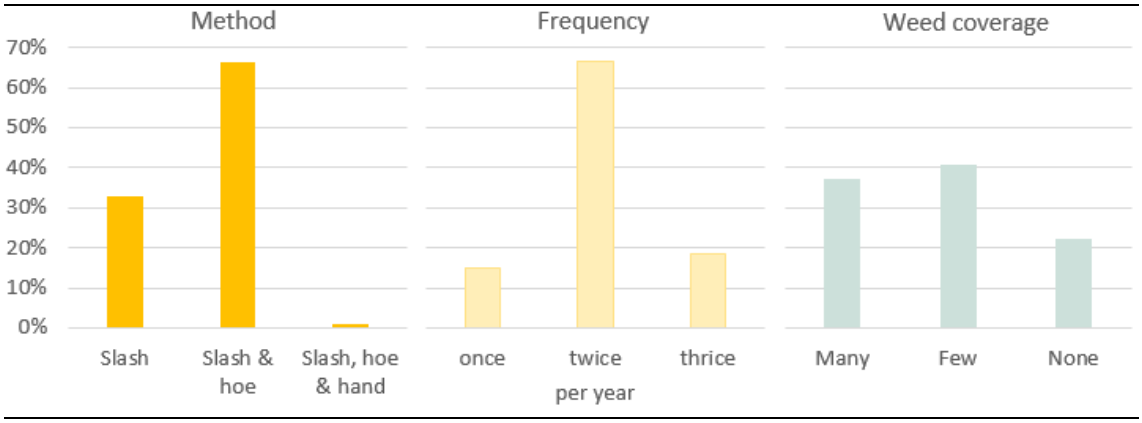


Figure 18: Weeding

Managing coffee trees

Around 40% of farmers said they pruned, removed suckers from, or stumped coffee trees in the last three years. Only 9% of households own pruning shears. The area stumped was usually small, i.e. below 20% on average. 80% of farmers indicated they are planning to stump some trees next year.

In the coffee farm inventories, signs of pruning were observed only once. Stumped trees not at all.

Table 16: Management of coffee trees

Activity	Farmers implementing the activity		Other details
	Interviews	Inventory	
Pruning	38%	1 coffee plot	9% own pruning shears
Removing suckers	45%	None	
Stumping (in the last 3 years)	37%	None	Area stumped on average: 17% minimum: 1% maximum: 100%

Nutrient and soil management

Few farmers apply mulch, compost or fertilizer to their coffee farms. Residues from pruning are often left where cut (68%), whereas 90% of farmers remove the residues from stumping.

Table 17: Nutrient management

Type	Farmers implementing related activities
Applying mulch	3%
Produce and/or use compost	12%
Using inorganic or organic fertilizer	6%
Residues from pruning*	
left where cut	68%
left in piles	5%
removed	29%
Residues from stumping*	
left where cut	7%
left in piles	3%
removed	90%

* Share of those who pruned or stumped.

Only 6% of farmers interviewed have soil and water conservation structures in their coffee garden (terraces or bunds). In the registration a slightly higher number (13%) indicated to have soil and water conservation structures.

Harvesting

In the interviews 73% of farmers said that they pick selectively, i.e. only ripe cherries. However, damages on coffee trees observed in the coffee farm inventories indicate that harvesting practices can be improved. The height of coffee trees (usually > 2m) is likely to contribute to damage, with branches being pulled down for harvesting. All respondents said that cherries fallen to the ground are included in the harvest.

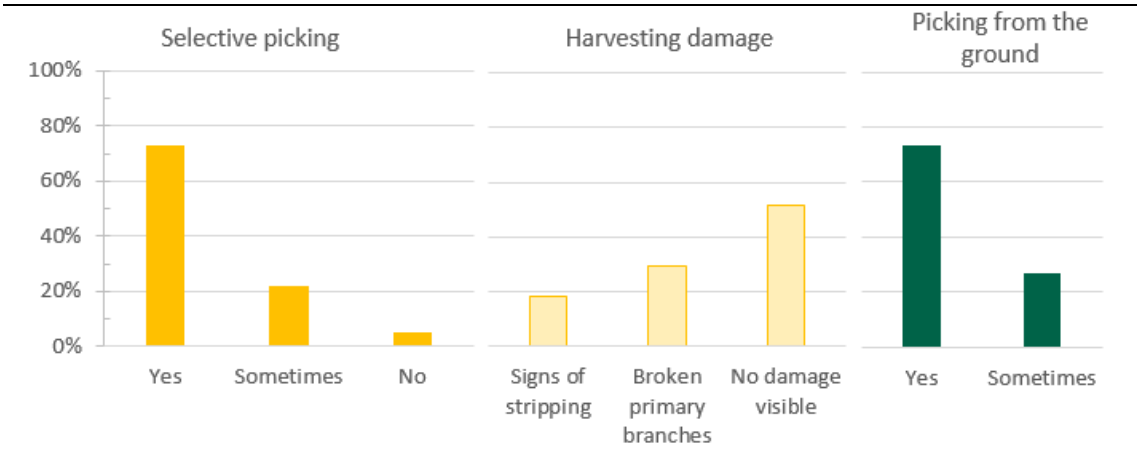
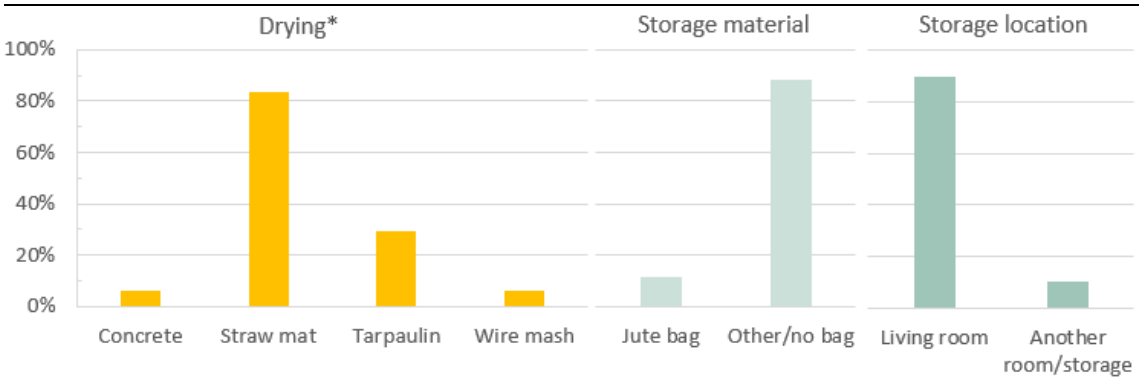


Figure 19: Harvesting practices

Post-harvesting

Only five percent of farmers dry coffee on the ground, but not directly on the soil. Farmers use different materials to spread cherries for drying. The most common material are straw mats.

Very few farmers use jute bags to store dried coffee. Of those using other means, 87% did so because of the higher cost of jute bags and 28% indicated (additionally) insufficient supply. 90% of households store coffee in the living room.



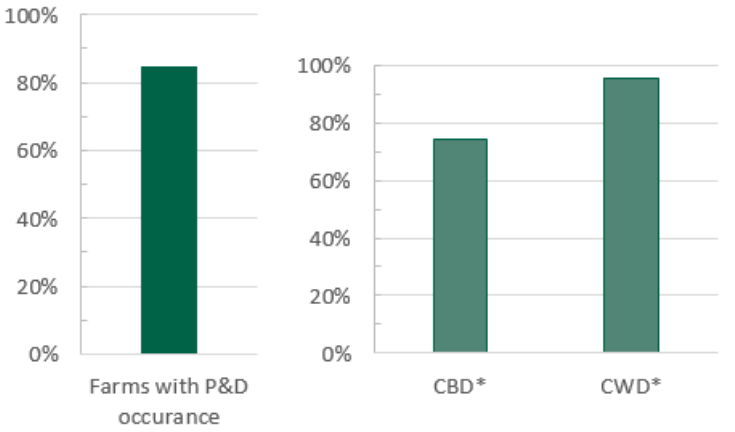
* Multiple choice – sum > 100%.

Figure 20: Post-harvesting practices

Pests and diseases

Over 80% of farmers interviewed had incidences of pest and diseases. Of these, 95% had Coffee Wilt Disease (CWD) and 74% Coffee Berry Disease (CBD) (Figure 21).

When asked which management options they know against CWD, 90% answered with "uproot and burn infected trees". Only one farmer mentioned the sterilization of tools, and nine said they know none. However, when asked subsequently if they sterilize tools and how, 57% claimed to do so, mostly by heating tools (Figure 22).



* Multiple choice – sum > 100%.

Figure 21: Pest and disease occurrence

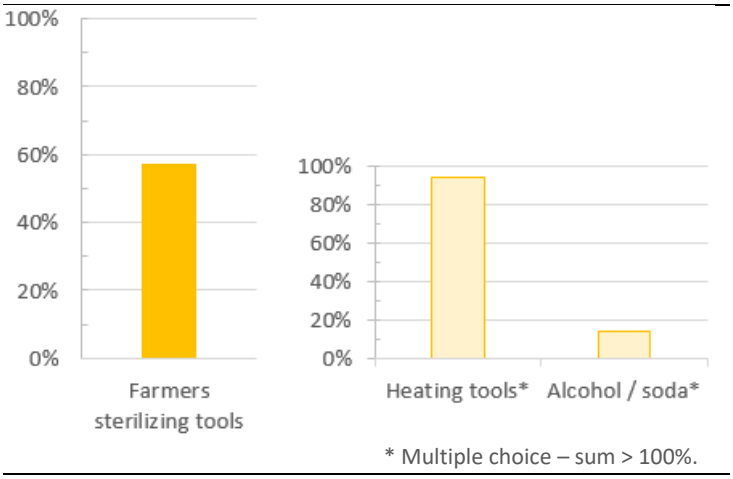


Figure 22: Sterilization of tools for disease prevention

Shade management

All households included in the baseline survey have shade trees on their coffee farms.

Within the last three years, 42% of the households planted new trees to replace old/dying trees or fill gaps.

In the same period, 69% of farmers removed trees since they felt "too much shade" reduces the coffee yield.

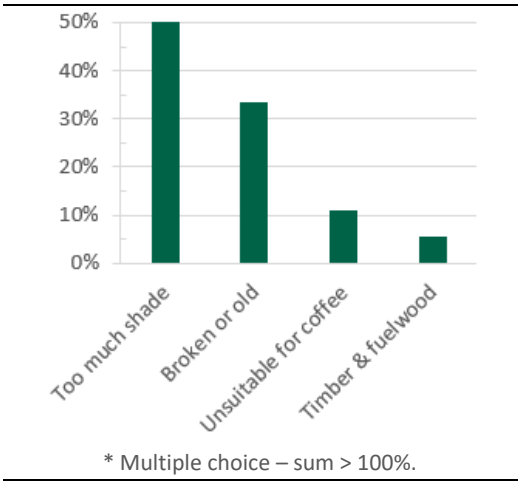


Figure 23: Reasons to remove shade trees

9.5 Coffee sales, price, and income

Sales

Over 90% of farmers produce sun dried coffee for sale. Around 40% of farmers also sell fresh cherries (Figure 24). One large farmer sold green beans.

A large share of coffee produced is consumed at home (Figure 25). The average value for home consumption calculated from the baseline survey is 57%. Data collected in the registration indicates a lower share with 34%.

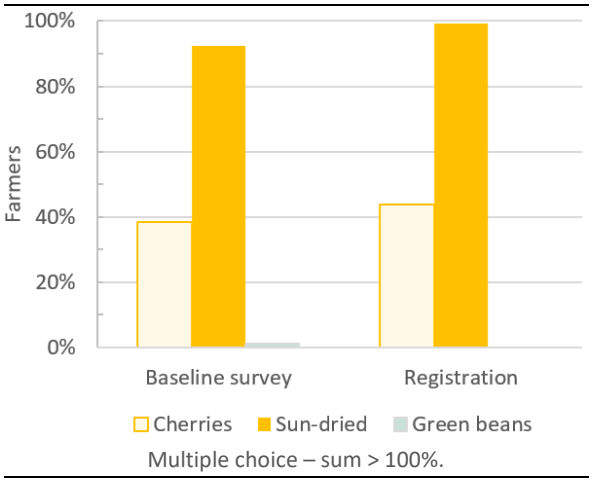


Figure 24: Coffee products

About 85% of farmers sell coffee to traders. In the baseline survey the share of farmers selling at least some of their coffee to cooperatives was just above 60%, in the registration only 40%. Of those selling coffee to cooperatives, over 80% sold more than half of their sales volume to the cooperative.

Coffee in both forms (cherries and sun-dried) is usually delivered to the trader or cooperative. Only in a few cases did traders collect sun-dried coffee from the farmer's home.

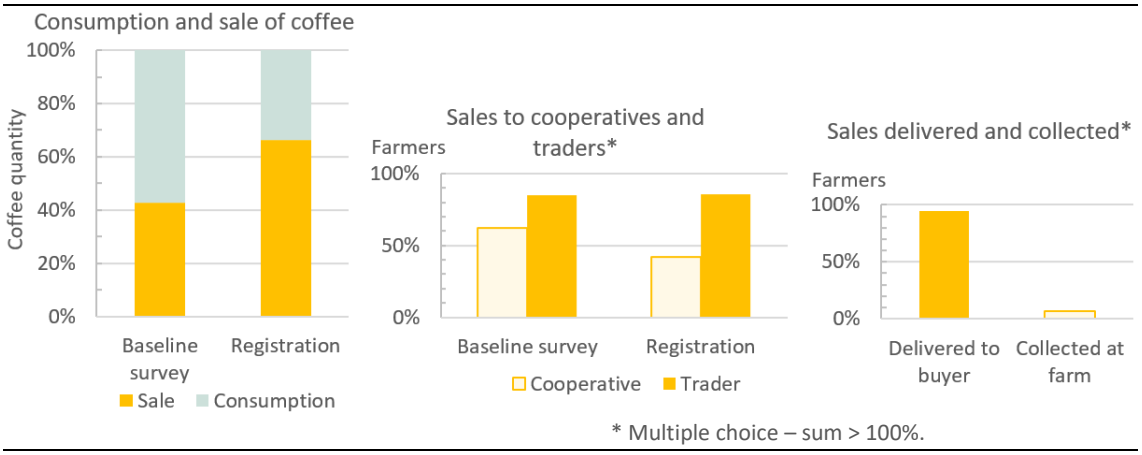


Figure 25: Coffee household consumption and sales

Prices

Coffee prices for farmers vary according to supply, quality and product. The average price for cherries in 2018/19 was 40 Birr/kg Green Bean Equivalents and 43 Birr/kg GBE for sun-dried coffee. Farmers selling sun-dried coffee earn about as much as those selling fresh cherries.

Table 18: Coffee prices

Product	Price (Birr/kg GBE)			# of responses
	Minimum	Average	Maximum	
Cherries	27	40	60	29
Sun-dried	32	43	62	72
Green beans	N/A	61	N/A	1

Income

Assuming production of 350 kg GBE/ha, sold half in the form of cherries and half sun-dried, the annual income from coffee would be about 14,500 Birr/ha (500 USD). If farmers were to renovate farms and apply good agricultural practices, yields could increase to 1,200 kg GBE/ha[33], resulting in an income of about 50,000 Birr/ha (about 1,700 USD).

[33] Yield deemed feasible under farm conditions. Personal communication, Metu research station.

9.6 Biodiversity and carbon stock

The number and diversity of shade trees was surveyed on 27 coffee plots. 20 of them were classified by their owners as garden coffee and seven as semi-forest coffee.

Shade tree density is quite high with 151 trees/ha on average across both systems. The number of regeneration trees (understory trees, diameter < 5 cm) is slightly higher with 174/ha.

The difference between the number of shade trees in the garden and semi-forest management systems is negligible (Figure 26). On all plots forest tree species native to the area are common. In a few cases typical agroforestry tree species were encountered (Mango, Grevillea, Eucalyptus, and Sesbania, Figure 27). These species were found only in four plots classified by farmers as garden management system. Hence, the distinction between the two management systems cannot be based on the number or species of shade trees.

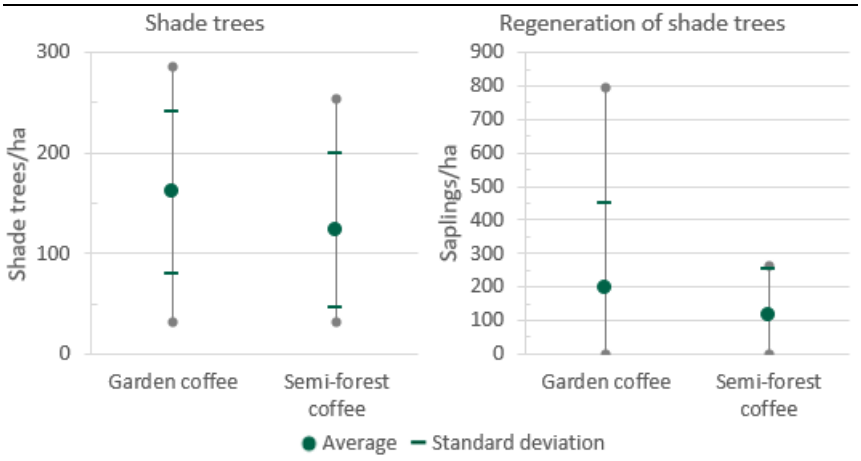


Figure 26: Shade trees in garden and semi-forest coffee systems

Across all plots surveyed 33 shade trees species were identified (Figure 27), including a number of high value and rare tree species such as *Prunus africana*. The most common species are *Albizia gummifera* and *Croton macrostachyus*. The two species were also the ones with the highest distribution across plots (11 each).

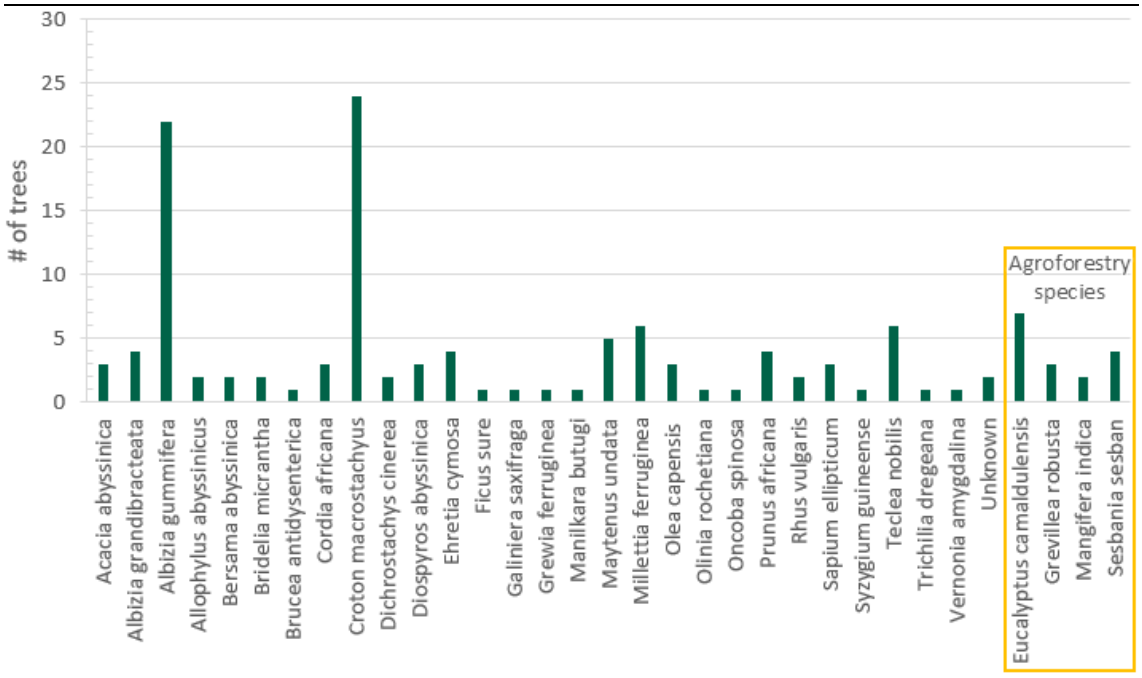


Figure 27: Tree species occurrence

Figure 28 shows the diversity of species at plot level and by size class. Most plots had two or three different species. One plot had six different species. The distribution of trees by size is equally diverse, although trees with diameter at breast height (DBH) of up to 30 cm are most common.

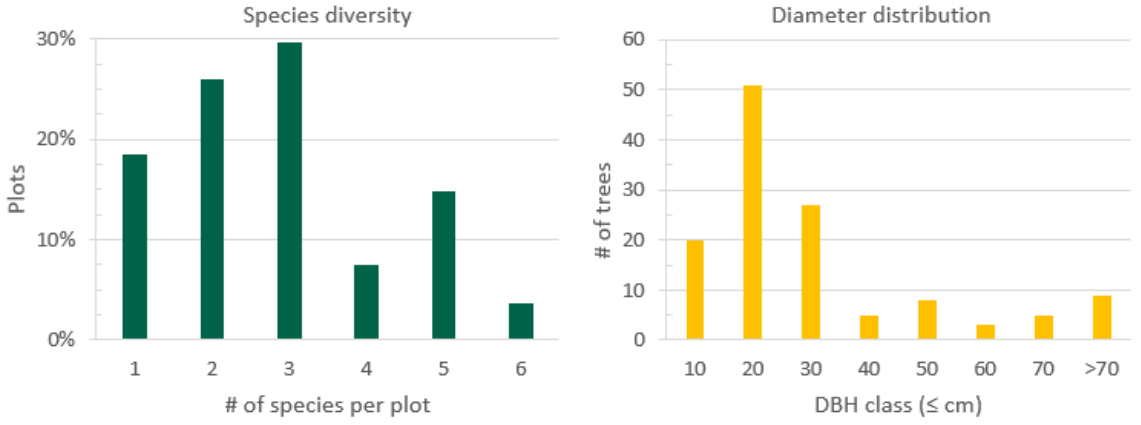


Figure 28: Diversity of trees per plot (314m²) and DBH class distribution

The average **carbon stored in the biomass of shade trees**, including the above and below ground biomass, is estimated at 290 tCO_2/ha, with a standard deviation of ± 170 tCO_2/ha. The variability in carbon stocks is driven by a few plots with very large trees. Trees with diameters above 50 cm constitute only 13% of all trees but store almost 80% of the carbon.

Documented values for carbon stocks in the above and below ground biomass of trees in moist afro-montane forests in Ethiopia are much higher, ranging between 470 tCO_2/ha and 1,400 tCO_2/ha (Nesru, 2015; Abyot et al., 2019; Admassu et al., 2019).[34]

Soil organic carbon in disturbed afro-montane forest in Illubabor (Abyot et al., 2019) and Kaffa (Admassu et al., 2019) is 390 and 360 tCO_2/ha.[35] Kassa et al. (2017) found virtually no difference between soil organic carbon on sites under forest and coffee cultivated in agroforestry with multi-purpose tree species and food crops, with 430 tCO_2/ha. Crop land had only about 75% of the carbon stock.[36] Hence, soil organic carbon in the coffee plots in the project area can assumed to be high with about 400 tCO_2/ha.

9.7 Correlation between registration and baseline data

Values for selected parameters collected in both registration and baseline survey were compared. Answers regarding agronomic practices compare reasonably well (Table 19). Across the ten compared practices, on average 77% of answers were the same or similar.[37] The best matches were achieved for coffee drying (95%), harvesting (95%), and composting (91%). Discrepancies were highest for removal of shade trees, pruning, and removal of suckers.

Table 19: Comparison of qualitative registration and baseline survey data

Agronomic practice	Data points in agreement
Drying	95%
Selective picking	95%
Composting	91%
Mulching	76%
Planting coffee	75%
Storage material	72%
Stumping	72%
Removing suckers	67%
Pruning	67%
Removal of shade trees	66%
Average	**77%**

The comparison of numerical data sets (Table 20) shows that answers of interviewees are at the very least not entirely reliable, with only about 50% to 60% of the answers given in registration and baseline being comparable (age, household members, coffee area). The difference between values for farm area is within the same range if permitting a substantial deviation of one hectare between answers. However, statistically, the two data sets are significantly different.

[34] Carbon stock in the surveys changed along two gradients: altitude and human use/degradation of forests.
[35] Degraded forests are similar to the semi-forest coffee in the project area, i.e. have much lower tree density but still very high canopy cover.
[36] Former forest land, converted to crop land between 15 and 25 years before the study took place.
[37] Answers given in the baseline study had to be simplified in some circumstances to allow comparison. See Annex 3 for a more detailed explanation.

The match between the two data sets is worst for coffee production, with not a single respondent stating the same values in the two surveys. Additionally, the differences are unilateral, with all (but one) values derived from the baseline survey being smaller. Lastly, the differences between the two data sets are not just significant, but large. This indicates that respondents gave intentionally incorrect answers in at least one of the surveys, most likely the baseline survey.

Possible reasons for and implications of the differences are discussed in chapter 4. The detailed results are provided in Annex 3.

Table 20: Comparison of quantitative registration and baseline survey data

Parameter (registration / baseline)	Unit	Data points in agreement (within a difference ± x)	Registration mean	Baseline mean
Age of FFS member	Year	64% (1)	49	49
Household size	-	53% (0)	5	5
Farm area / Area as per certificate	ha	51% (1.0)	3.2	2.3
Coffee area / Area all management systems	ha	63% (0.5)	1.9	2.2
Coffee area / Garden & semi-forest coffee	ha	63% (0.5)	1.9	1.7
Coffee production	kg GBE	1% (20)	167	27

Highlighted cells indicate significant difference between the two data sets (paired t-test with confidence interval 95%, see Annex 3 for details).

10 DISCUSSION

10.1 Coffee farm management and income

Very **few young farmers** are members of the Farmer Field Schools.[38] FFS facilitators interviewed highlighted the challenge of younger community members to become farmers in their own right due to the shortage of unoccupied agricultural land. Non-FFS members (family members and others) can participate in trainings. Especially younger persons should be encouraged to do so, enabling them to improve practices on their parents farm or future own farm.

Key income source of households are coffee, other crops and livestock. Coffee occupies the largest share of land. In the project region, coffee is predominantly cultivated under old growth forest trees. Intercropping with other annual or perennial crops is uncommon. As a result, diversification on the coffee plot is not an option. However, the diverse nature of household income should be kept, i.e. investments into coffee should take place on existing coffee plots, not other farm land.

As the most important crop, **coffee must generate the income needed to cover household needs** throughout the year. However, at the moment it fails to do so, with most households experiencing food shortages for part of the year. Low yields, in combination with low prices for farmers are the cause for low income from coffee.

Farms in the project area are mostly stocked with old coffee trees, are low input systems, and coffee diseases pose a problem. All factors contribute to the low yields of about 15 % of what is deemed feasible.

Coffee quality is also an issue, with many farmers including cherries from the ground into their harvest and picking unripe cherries in at least some cases. The mixed quality of coffee was also stated by the cooperatives interviewed. Additional quality losses may be caused by the use of unsuitable materials for storage of dried cherries and delayed transport of fresh cherries to the cooperative.

Low yields and mixed quality emphasize the need for farm-level investments and technical assistance. The most urgent investment at farm level is the replacement of old and disease prone coffee trees with disease resistant and higher yielding varieties. With these on-farm investments, combined with good agricultural practices, income from coffee could be two to three times higher than it is at the moment.

Coffee farms in the project region are diverse ecosystems and store a lot of carbon. The low income from coffee may cause farmers to shift to other crops or reduce shade substantially to increase productivity at the expense of coffee quality and climate change resilience. In both cases, the biodiversity and carbon stocks associated with semi-forest management systems would decline.

[38] One criterion for membership is the ownership/management of a coffee garden.

Experiences with optimal shade management, balancing coffee production with climate change resilience and ecosystem services exist and may be transferable to the project region.[39] The Farmer Field Schools should inform farmers about the value of shade trees and how to manage shade trees (canopy cover and regeneration).

10.2 Combination of different survey methods

The combination of three different methods – self-reporting at the time of registration, detailed baseline questionnaire, and farm inventory – proved to be valuable. It increased sample size efficiently, allowed the collection of very different and complementary information, and cross-referencing of data to validate the results.

The overall fairly good match of qualitative data collected in the registration and the baseline indicates the credibility of the information. However, the causes (see below) for the apparent mismatch of numerical data must be identified and addressed in future surveys.

The results also show that self-reporting at group level (registration) is a promising approach for collection of information from farmers.

The adoption of certain agronomic practices cannot always be detected in farm inventories. However, for visible practices inventories provide more reliable information on the adoption in comparison to interviews. Furthermore, inventories provide detailed data on shade trees, which cannot be collected in interviews.

10.3 Differences between data recorded during registration and in the baseline questionnaire

Several likely explanations exist for the **poor match of numerical data**. The incorrect **answers on coffee production** given in the baseline survey may be a matter of distrust against the survey team or to emphasize the need for technical assistance. Production numbers collected by the FFS facilitator in the registration are more likely to be correct. Farmers trust the facilitator, and the facilitator would likely recognize an answer as being incorrect – introducing an element of control. In either case farmers may have reported lower than actual production to emphasize their need for technical assistance.

Additional, but in comparison minor deviations, can be caused by:

- Farmers recalling production and sales without written records,
- Harvesting and sales of coffee in several smaller batches throughout the season,
- Farmers often own more than one coffee plot,
- Farmers sell coffee in different forms (cherries, sun-dried) and to different entities, and
- The baseline questionnaire requested a higher level of detail, influencing the response.

[39] For example Kitessa (2016): Shade Tree Selection and Management Practices by Farmers in Traditional Coffee Production Systems in Jimma Zone, Southwest Ethiopia; Adugna & Struik (2011): Effects of shade on growth, production and quality of coffee (*Coffea arabica*) in Ethiopia.

Area cultivated with coffee also shows significant differences between the two surveys. However, the differences are not unidirectional like the ones on production. Possible reasons for differences are:

- Farm and coffee area is estimated, not surveyed,
- Distribution of land across several plots,
- Parts of the land not included in the land certificate, and
- Higher level of detail in the baseline questionnaire.

Qualitative answers on agronomic practices also differed to some extent. Possible causes could be:

- Misunderstanding the question,
- Multiple choice answers are more likely to get the "correct" response,
- Farmers may managed different coffee plots differently, and
- Difficulties in the evaluation, comparing single choice answers (registration) with multiple choice ones (baseline).

Proposed solutions to overcome the challenges listed above are:

- Continue to collect data in self-reporting at group level,
- Revise the baseline questionnaire to allow better comparison of answers,
- Collect trade volume from the cooperatives (overall and per farmer) to triangulate the information received by the farmers, and
- Conduct future surveys – especially farm inventories – in different seasons to better capture e.g. harvesting practices.

10.4 Use of mobile devices for data collection

Overall the digital data collection proved to be time efficient and enabled plausibility checks already during data entry. Transcription errors could also be prevented. Adjustments to the survey design (based on the pilot survey) could be implemented efficiently.

The daily transfer of data to the server was hindered by poor internet connection in Metu. However, the team extracted data from the tablets manually at the end of each day, backing up data externally.

A direct comparison of registration data while conducting questionnaires might help to reduce differences between data sets. The feasibility of such checks will be explored in the next survey.

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ANNEX

Annex 1: Farmers and FFS registered and included in the baseline survey

Woreda and kebele	FFS*	# of farmers per FFS*	Farmers included in the baseline survey	Farmers included in the inventory
Bilo Nopha				
Agata	Gamta	27	10	3
Suli	Basiri	29	8	3
Ulmaya	Abuko	30	8	2
Hurumu				
Gaba	Degaga	31	9	3
Goljo	Misoma Gudina	30	8	2
Haro	Abdi borii	27	8	3
Wangenye	Damaqisa	29	11	3
Yayu				
Bondawo	Abdi Bori Bondawo	27	7	4
Wabo	Nagenya	25	9	4
Total	**9**	**255**	**78**	**27**

* FFS and farmer registered at the time of the baseline survey (June 2019).

Annex 2: Conversion rates coffee products

Cherries	Sun-dried	Green Beans
1.0 kg	0.4 kg	0.2 kg
-	1.0 kg	0.5 kg

Source: ITC 2011

Annex 3: Correlation of registration and baseline survey data

Method

Agronomic practices

The answers for agronomic practices were simplified to allow comparison of the two data sets. For example, in the registration farmers answered the question on planting or removing shade trees across all plots regardless of the management system. In the baseline system, answers were given differentiating between garden, semi-forest, and forest systems. The comparison was limited to “yes” or “no” type of answer.

In some cases, farmers could answer questions with a “sometimes” or “mixed”, e.g. in the case of selective harvesting. In the comparison such answers were taken as a match to both the “yes” and “no” type of answer. In this example the answer “sometimes/mixed” given in the baseline was a match to both “selective” and “stripping” answers given in registration.

Parameters which had very few positive responses in both surveys (e.g. fertilization, and soil and water conservation) were not included in the comparison.

Numerical data

For five parameters numerical data was available from both surveys. This includes two very basic parameters, for which discrepancies were expected to be low: age of the FFS member/respondent and household size. The actually interesting parameters were farm area, coffee area, and coffee production.

The comparison included the number of actual matches between two corresponding values and the statistical analysis of the mean difference between data sets.

Exact matches between values are highly unlikely for a variety of reasons:

- Age: The date of birth was likely not formally recorded.
- Household members: Persons living only occasionally with the family (e.g. students) may be counted as dependents or not.
- Farm and coffee area: Farm size is estimated for land included in the land certificate but not surveyed. Parts of the land managed may not be included in the certificate.
- Production: Farmers have no written records of production or sales, often sell coffee in different forms, and in small quantities throughout the harvesting season, and consume part of their production.

Taking these factors into account a permissible range of difference was set based on the author’s judgement. The set range may over- or underestimate the actual uncertainty of respondents, and should be adjusted in future survey if better estimates are available.

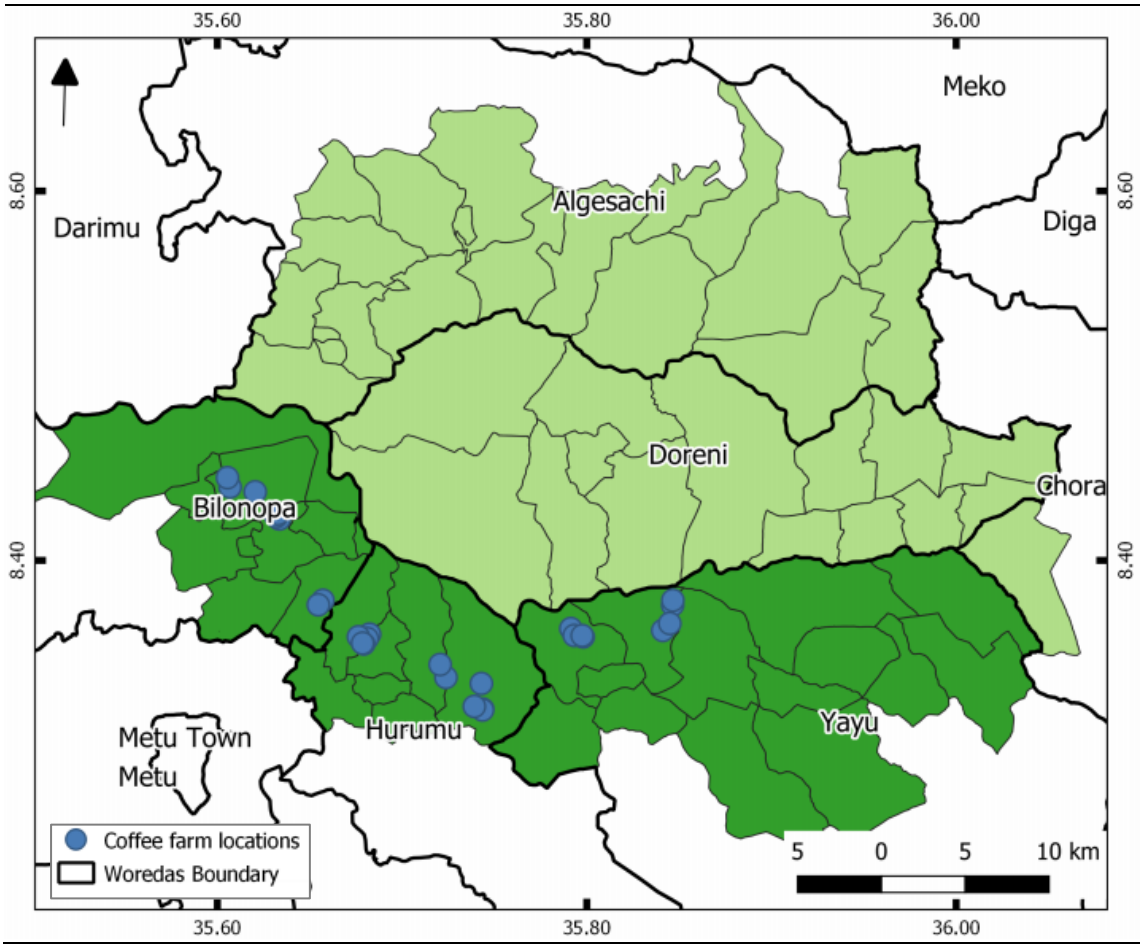
The statistical significance of the difference between the two data sets was analyzed using a two-tailed paired t-test, with a 95% confidence interval. Outliers were removed for the purpose of calculating standard deviation, standard error of the mean and P-value.

Statistical values

Parameter (registration / baseline)	Unit	Data points in agreement (within a difference ± x)	Registration mean	Baseline mean	Confidence interval 95%		Statistical difference			
					-	+	Mean of difference	Standard deviation	Standard error of mean	P (0.05)
Age of FFS member	Year	64% (1)	49	49	0	1	0,01	2,50	0,30	0,71
Household size	-	53% (0)	5	5	0	0	-0,05	0,79	0,10	0,52
Farm area / Area as per certificate	ha	51% (1,0)	3.2	2.3	-0,1	0,8	0,33	2,01	0,23	0,00
Coffee area / Area all management systems	ha	63% (0,5)	1.9	2.2	-1,5	1,5	0,24	0,54	0,07	0,86
Coffee area / Garden & semi-forest coffee	ha	63% (0,5)	1.9	1.7	-1,6	1,8	0,27	0,52	0,06	0,38
Coffee production	kg GBE	1% (20)	167	27	288	365	326,83	166,62	18,99	0,00

Highlighted cells indicate significant difference between the two data sets.

Annex 4: Coffee farms included in the inventory



Location and size of coffee plots included in the inventory

	Garden coffee plots	Semi-forest coffee plots
Location		
Land cover use class		
▪ Cropland	2	-
▪ Forests	17	7
Biosphere zone		
▪ Core	-	1
▪ Buffer	5	5
▪ Transition	14	1
Plot size (ha)		
Minimum	0.03	0.21
Average	0.48	0.98
Maximum	1.34	3.97

Source: Land cover use class and biosphere zones provided by GIZ Biodiversity and Forestry project.

Annex 5: Summary adoption rates GAP

Agronomic practice	Criteria to rate adoption	Specifications	Baseline adoption rate	
			Questionnaire	Inventory
Weeding	2 or more rounds of weeding in past 1 year		85% twice or more	not applicable
	AND main weeding method is NOT herbicide		no farmer uses herbicide	not applicable
	AND only few or no weeds observed under coffee tree canopy			37% Many weeds 41% Few weeds 22% No weeds
Pruning	Pruning has been applied in the past 12 months		38%	1 plot
	AND at least 3 out of 4 pruning methods applied	Centers opened		not observed
		Dead branches removed		not observed
		Branches touching the ground removed		1 plot
		Broken / unproductive stems and/or branches removed		not observed
	AND Unwanted suckers removed on more than half of the field (desuckering)		45%	not observed
Stumping	Around 25% of the tree stumped (or more)		37% stumped some trees	not observed
	AND two correct stumping methods applied	Cut approximately 35-40 cm over the ground		
		Cut 45° degrees facing North to South		
	AND Farmer can explain the plan for stumping in the next season		78% were planning to stump	not applicable
Mulching	About half (50%) of the WHOLE COFFEE FARM covered with mulch or more		3% are mulching < 25% of the area	not observed
	About half (50%) of the YOUNG TREES covered with mulch or more			

Agronomic practice	Criteria to rate adoption	Specifications	Baseline adoption rate	
			Questionnaire	Inventory
	AND Farmer can explain the plan for mulching in the next season		32% were planning to mulch	not applicable
Organic Fertilizer and Composting	Household is making compost		10% make compost	not observed
	AND a compost heap is observed on the field			
	AND organic fertilizer has been applied to more than 25% in the past season		4% use organic compost	
	AND per tree at least 2-4 kg OR 2 spade of organic fertilizer applied			
	AND fertilizer applied as ring around coffee trees		as above	
Integrated Pest & Disease Management	Sanitation: Panga sterilized with alcohol or soda ash after every tree		6% use alcohol or soda ash (partly at end of day only)	not applicable
	Farmer knows at least 4 correct methods of fighting CWD.		90% know 2 methods (uproot and burn, sterilize tools)	
Proper Shade tree management (permanent and temporary shade trees)	Light or medium shade is present on the farm	Light shade, 20% to 40%	not applicable	not applicable
		Medium shade, 40% to 60%	100% exceeding 60% shade	100% exceeding 60% shade
	AND IF there is a new plantation at least 201 temporary shade trees per ha		not encountered	not encountered
Soil and Water Conservation	At least one soil and water conservation practice observed in the field	Cut-off drain on highest point of plot	none	not observed
		Graded terraces with grass bands	6% terraces with bunds	observed on 2 plots
		Water traps	none	not observed
		Trenches	none	not observed

Agronomic practice	Criteria to rate adoption	Specifications	Baseline adoption rate	
			Questionnaire	Inventory
Selective Picking	NO signs of stripping observed the previous season		73 % harvest selectively, 22% only sometimes	19% with signs of stripping & 30% broken primary branches
	AND More than 75% picked selectively			
Coffee Drying	Coffee is dried using any of the recommended methods	On a tarpaulin or plastic on the ground (canvas)	95%	not applicable
		Cement Floor		
		On mats		
		On tables (e.g. bamboo, sorghum straw)		
Coffee Storage	Coffee stored in Jute Bags		12%	not applicable
	AND coffee stored in bag on raised bed in a shelter outside living room		10% different room/storage (raised bed not asked)	
Planting	Seedlings sourced from a private or government nursery		of those planting: 47% sourced from government or private nursery	not applicable
	AND seedlings are of improved variety		of those planting: 55%	
	AND Seedlings look healthy (no pests or diseases seen, not water stressed, green leaves)			not part of the inventory
	AND density of new plantation is suitable	Around 1.8m x 1.8m		
		Around 2m x 2m		