THE TRUE PRICE OF CLIMATE-SMART COFFEE

Quantifying the potential impact of Climate-Smart Agriculture for Colombian coffee

Solidaridad

True Price™

THE TRUE PRICE OF CLIMATE-SMART COFFEE

Quantifying the potential impact of Climate-Smart Agriculture for Colombian coffee

Authors: J. Brounen, A. de Groot Ruiz, C. Isaza, R. van Keeken, and E. Varoucha
Field work: Jackeline Londoño, Hector Aricapa
Designer: Mauricio Galvis
Data collection by Solidaridad
Data validation and analysis by True Price

March 2019

This report has been elaborated with generous contributions from the SAFE Platform, Global Coffee Platform and The Netherlands Ministry of Foreign Affairs.

March 2019

All values in this report are adapted according to the inflation for Colombia over the year 2017. Additionally, measures of individual external costs, as well as the aggregated external costs and total market values have been rounded to USD 0.05. All values are converted based on the average exchange rates of the European Central Bank and the Central Bank of Colombia over 2017[1].

Solidaridad is an international network organization with partners all over the world. Solidaridad has pioneered sustainability concepts in the coffee industry for more than 30 years. It is a transition manager, focusing on producer support, sustainable supply chain and market development. Solidaridad is aware of the effects of climate change on coffee production. By supporting its partners in Latin America with the implementation of Climate-Smart Agriculture practices it strives to enable the sector to cope with the challenge to adapt global production to this new harsh reality.

For more see information, see:
www.solidaridadnetwork.org

True Price is a social enterprise with the mission to realize sustainable products that are affordable to all by enabling consumers to see and voluntarily pay the true price of products they buy. In 2012, True Price was founded and in the subsequent years it developed into the world leading expert in methods and tools to measure and monetize societal impact. It calculated the true price of dozens of products around the world and we feel that the time is right to focus on realizing true pricing: a system where consumers and businesses can see, improve and voluntarily pay the true price of their products.

For more see information, see:
www.trueprice.org

The PCS is a public-private partnership promoted and funded by the Embassy of the Kingdom of the Netherlands. It was created in 2012 in order to facilitate work between the Government, the society at large and private companies to ensure that the supply of agricultural products in Colombia meets the growing demand for sustainable products in the global market.

For more information, see:
comerciosostenible.org

This report has been elaborated with generous contributions from the SAFE Platform. The SAFE Platform, comprised of frontrunner private sector participants, donors and non-governmental organizations, creates and supports projects that seek to transform these landscapes and demonstrate that producing 100 percent sustainable coffee and cocoa is possible. This initiative implements projects that seek to scale up innovative approaches in four main strategic areas: value chain improvements and responsible sourcing, climate-smart agriculture and resilient landscapes, access to financial services, and women and youth inclusion. The platform is powered by the Inter-American Development Bank and managed by Hivos. This study is part of SAFE learning initiatives trajectory.

For more information, see:
www.safeplatform.org

This report has been elaborated with generous contributions from the Global Coffee Platform. The Global Coffee Platform (GCP) is the leading facilitator of change in the coffee sector's journey towards sustainability. The GCP works to improve the livelihoods, ecosystems and resilience of coffee farming communities and the sector as a whole by enabling producers, international roasters, governments, traders, and NGOs to align and multiply their efforts and investments, collectively act on local priorities and critical issues, and grow and scale successful sustainability initiatives across the coffee world.

For more see information, see:
www.globalcoffeeplatform.org

[1] The exact exchange rates used are 1.13 for the conversion of EUR to USD and 2,951 for USD to COP.

EXECUTIVE SUMMARY

TOWARDS MORE CLIMATE SMART AGRICULTURE

In recent years Colombia is experiencing more gradually the effects of climate change. Productivity levels are lower at farms with no adaptation measures in place, putting their profitability under severe pressure and threatening the livelihoods of communities. Solidaridad and its partners have been working with coffee farmers in the past years to implement Climate Smart Agriculture as a response to this challenge.

CSA is implemented as a series of practices, that include (i) increased density of coffee trees, (ii) renovation with climate resilient varieties, (iii) better soil management, (iv) optimized shading, and (v) improved wastewater management.

The aim of the Climate-Smart Agriculture approach is to restore the profitability of smallholder farmers to healthy levels, and at the same time minimize *hidden* or *external costs*. These external costs can be classified as 'environmental' (impacting the environment), or 'social' (impacting workers or local communities directly). An example of an environmental external cost are the societal costs caused by water pollution as a result of waste water. An example of a social external cost are the societal costs related to the underpayment (payment below living wage) of external workers.

ASSESSING THE COSTS AND BENEFITS OF CSA

Over recent decades, companies in the coffee sector have invested significantly to ensure compliance with environmental and social standards. However, Solidaridad is convinced that the coffee sector needs to shift from a purely *compliance-driven approach* to a more *cost-benefit driven approach* to improve the targeting of investments in sustainability. The cost-benefit driven approach critically includes a full assessment of externalities.

Solidaridad believes that its investments into CSA are an effective way to generate benefits for all stakeholders: roasters, traders, producers, workers, providers, and communities. To substantiate this conviction, Solidaridad and its partners wants to understand the costs and benefits of CSA, and – crucially – investments into CSA.

THIS STUDY

Solidaridad, True Price and the SAFE Platform joined forces to create a comprehensive understanding of the relationship between the costs and benefits of CSA. The study is part of the Learning Initiatives of the SAFE Platform.

The implementation of Learning Initiatives has been designed to further expand the platform´s operative framework, providing its Partners, and other actors, with new possibilities of engagement with smallholder farmers.

Learning Initiatives aim to:

- Use and leverage information and learning products into concrete and tangible processes and activities, transitioning from learning to action.
- Consolidate the learning process, enhancing the visibility and analysis by Partners, and other actors, over field experiences, new approaches, methodologies and tools.
- Stimulate and steer the joint action of Partners, and other actors, towards specific collaborative efforts.

The focus of this analysis is on Colombian smallholder farmers. The study is based on primary data collected from a group of 60 smallholder farmers in the state of Cauca who apply a set of sixteen CSA techniques. An important differentiating factor of this study, in comparison to previous studies, is that data is collected in a thorough way on individual farm level. These data sets are complemented with information at regional or farm-level.

We can conclude that CSA scores well in a cost-benefit assessment if the following criteria are met:

a It is *sustainable*. The approach should be effective in reducing externalities both social and environmental nature.

b It contributes to a *decent livelihood* to the farmer. Smallholder farmers, whose livelihoods are under severe pressure, should see their household income increase, preferably towards making a living income.[2]

c It is *feasible* to the market. Coffee prices are very competitive. The CSA approach should not lead to higher prices unless this can be clearly related to a higher-quality product.

d It is *profitable* to the farmer. If investments are required to make the switch to CSA farming, the investments should be under control and generate enough profit per dollar invested.

e It is *cost-effective* to society. The investments should not only benefit the farmer, but also provide benefits to nature, amongst others by providing large natural capital benefits per dollar invested.

This study aims to assess the five criteria based on an integrated approach to externalities as developed by True Price. Two central assessments are that of the *true price* (of a product) and the *true ROI* (of an investment). The true price and true ROI allow to compare different production systems and to identify sustainability issues from a cost-benefit perspective.

True pricing is a way of quantifying and monetizing sustainability. The true price is the market price of a product plus the social and environmental external costs. This represents the total amount that society as a whole "pays" for a product. All external costs are expressed in one comparable unit, money, making it thus possible to directly compare different production models and their associated external costs. This enables people to compare the effects of various products and production models on society and to make decisions based on this information. For example, the monetization of externalities in the coffee sector could facilitate investments that focus on tackling the most important externalities by identifying those with the highest cost. Consumers or producers of coffee can use this information in their decision-making process. The purpose of true pricing is not to make coffee more expensive by raising the retail price, but instead to make the coffee cheaper to society by decreasing the true price to the same level as the retail price as much as possible. Calculating the true price can help manage risks, steer innovations, and reduce social and environmental costs by improving transparency throughout the supply chain of a product. The final goal is to realize affordable and sustainable products: products with a low true price.

By using information on external costs various stakeholders can benefit. Consumers can shop for products with low external costs. Policymakers can optimize policies and incentives to reduce environmental and social costs, by comparing them across different scenarios. Furthermore, for businesses, externalities are increasingly driving financial revenues and costs.

There are various bottom-line benefits that businesses and investors can gain by using true pricing information:

1. **Improve sourcing decisions:** Compare different production models and herewith source products with lower external costs.
2. **Facilitate investment:** Mobilize investments in sustainable production systems with the largest improvement in the true price.
3. **Better risk management:** Control and reduce risks in the supply chain due to future cost increases (such as climate change costs) and regulation.
4. **Realize cost reductions:** Identify projects that are sustainable and increase resource efficiency to reduce costs.
5. **Facilitate innovation:** Identify alternative modes of production with lower external costs and higher (long-term) profitability.
6. **Improve marketing:** Credibly communicate superior social and environmental performance of a product.

The true price calculation, in this study, has eight environmental externalities in scope (climate change, air pollution, water pollution, soil pollution, land use/transformation, energy, water and scarce materials use) and four social externalities (underearning of smallholder farmers, underpayment of hired workers, lack of coverage of social security, and occupational health & safety). Additionally, the impact of soil degradation is explored.

The true price analysis has three important sub-elements: the total external costs, smallholder underearning, and the market price. If the total external costs of CSA coffee are lower than that of realistic alternatives, we can conclude that criterion

[2] A living income is the net income a household would need to earn to enable all members of the household to afford a decent standard of living. Elements include items such as housing, food, healthcare, etc.

a) is met, i.e. that CSA coffee is sustainable. If underearning is zero (or at least significantly lower than for the alternatives), then criterion *b*) is met and CSA contributes to a decent livelihood. If the market price of CSA coffee can be in line with alternatives, criterion c) is met and CSA coffee is feasible in the marketplace.

For criteria *d*) and e) we need to conduct an investment analysis. We start from the traditional financial metric of 'Return-on-Investment' (ROI), which relates the benefits of an investment to the required costs and shows how well the investment pays off. If the ROI of an investment is strongly positive, the investment is profitable and criterion *d*) is met.

The True ROI extends the conventional ROI to include external costs and benefits. A high true ROI for investments in CSA coffee indicates that criterion e) is met: not only does the farmer profit from the investment, but so does society in a cost-effective way.

MAIN RESULT 1

THE EXTERNAL COSTS OF CSA COFFEE ARE LOWER THAN THAT OF CONVENTIONAL COFFEE

We identified that the external costs of CSA coffee are USD 2.50. This is lower than the average conventional coffee in Cauca, which has external costs of USD 3.15. See also Figure 1[3].

The environmental external costs of conventional coffee are predominantly related to climate change and air pollution, which add USD 0.80 and USD 0.60 respectively to the true price, as shown in Figure 2.

The social external costs consist of underearning of smallholder farmers and underpayment of workers and their lack of social security, which have a similar contribution to the true price. Both farmer income and wages are well below the so-called living income for rural Colombia.

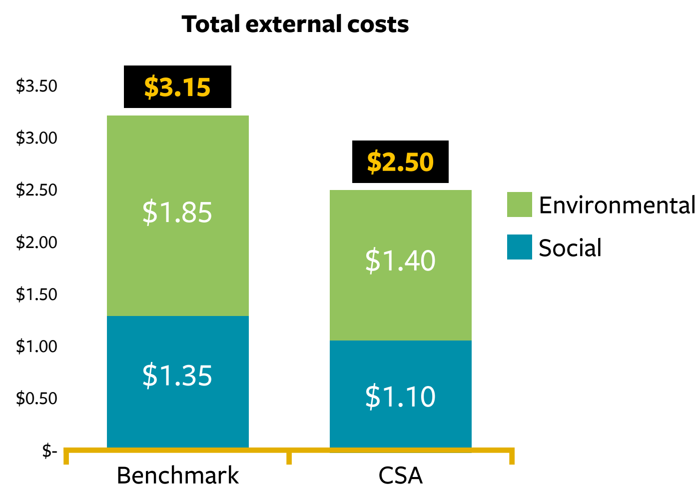

Figure 1: The true price of Benchmark and CSA coffee from Cauca (USD/kg parchment coffee).

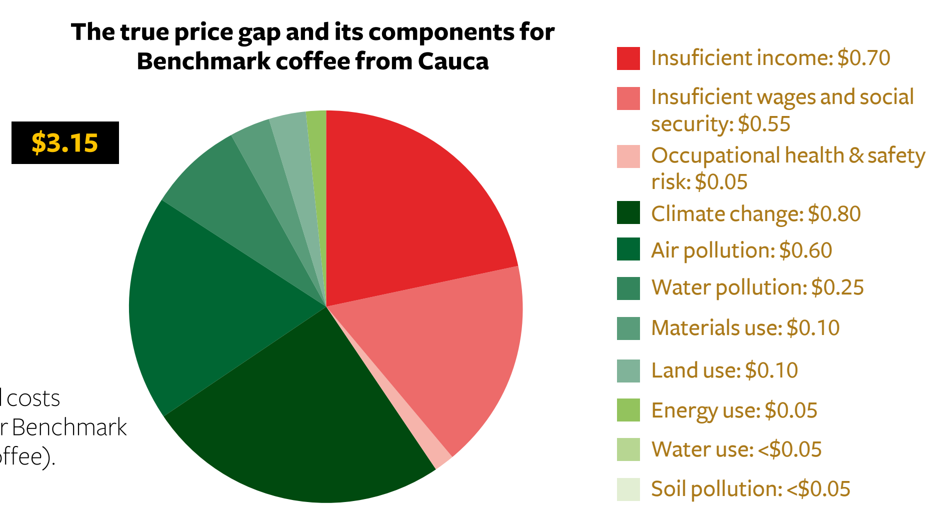

Figure 2: The external costs and its components for Benchmark (USD/kg parchment coffee).

[3] Totals may not add up due to rounding.

CSA coffee has lower environmental external costs than conventional coffee, largely due to the fact that Climate-Smart coffee uses much less fertilizer. This reduces environmental costs by about 20%. From a societal perspective, CSA coffee farming provides more income to the farmers, reducing the cost of underearning.

CSA has a lower true price and helps smallholder farmers to get closer to earning a living income. **We conclude that CSA is more sustainable than the conventional production model, it helps smallholders to earn a more decent livelihood and it is feasible for producers to implement.**

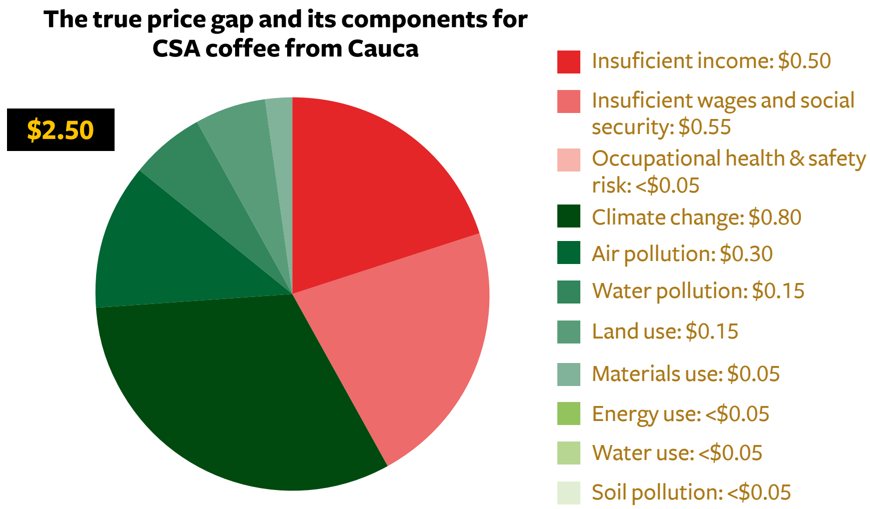

Figure 3: The external costs and its components for CSA coffee from Cauca (USD/kg parchment coffee).

MAIN RESULT 2
INVESTMENTS IN CSA HAVE A POSITIVE ROI AND TRUE ROI

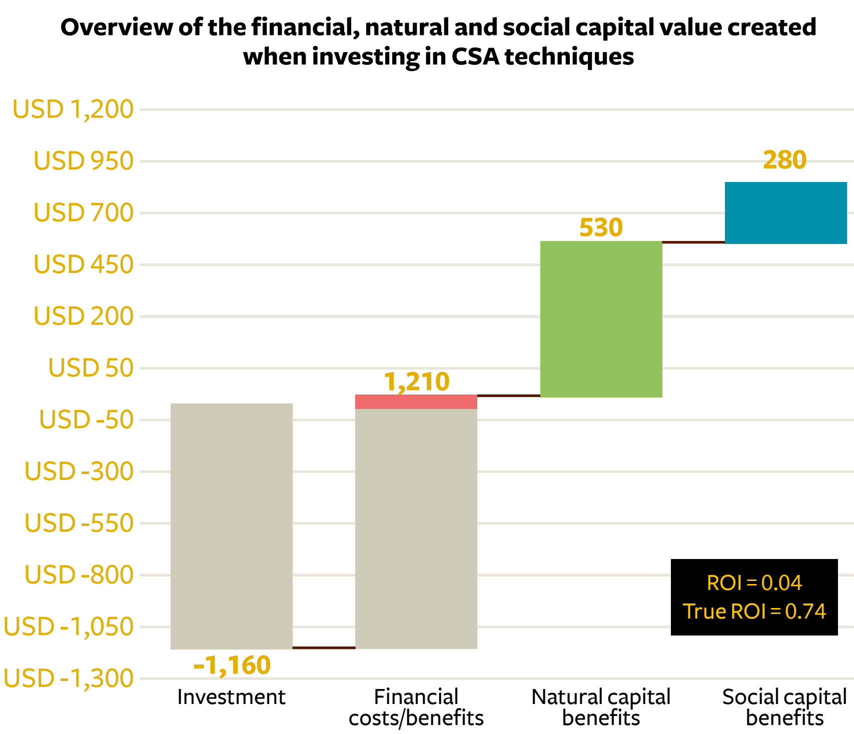

Figure 4: Overview of the financial, natural and social capital value created after year one when investing in CSA techniques (USD/farm). On average, farms have a coffee area of 1.41 hectares.

The farmers that PCS (Plataforma de Comercio Sostenible) members have supported in adopting CSA were originally very poor farmers, that grew their coffee in traditional ways on coffee plots that were often far past their peak yields. In order to switch to CSA farming, they need to renovate their plots. Additional investments are in specific trainings and farming machinery (e.g. biofilters). The ROI is a measure of how well these investments pay off over time. The true ROI gives the same information but takes benefits to society into account as well.

In Figure 4 we present the benefits on financial, natural and social capital. The figure also indicates the ROI and the true ROI.

We see that investments in CSA pay back well. However, the initial investment might be challenging for smallholder entrepreneurs.

We conclude that CSA is more profitable and more cost-effective, but that some support to the farmers is necessary.

CONTENTS

INTRODUCTION

KEY MESSAGES FROM THIS INTRODUCTION

- The **coffee sector** is **under pressure** and investment is required to turn the tide.
- **Climate-Smart Agriculture** (CSA) is an approach to farming developed by the FAO in 2013. **Solidaridad supports farmers** to apply this approach. It believes that this is an effective way to **contribute to** a **sustainable coffee** sector.
- **True pricing** is a way to objectively assess the **sustainability of production**. It provides comparable and clear insights into the environmental and social effects to society. Methods based on true pricing can also be used to assess **investment decisions**.

COFFEE CULTIVATION UNDER PRESSURE

Global coffee production is under pressure: Environmental factors such as climate change, climate variability and soil degradation affect the coffee production and farmers. These factors increase the costs for producers, communities, traders, roasters, and consumers. Smallholder farmers are likely to be hit the hardest: the effects of climate change increase their input and labor costs while at the same time they decrease their productivity levels. An example of such phenomena was the devastating effects of La Niña and the resulting rains which considerably impacted coffee harvests in Colombia for over three years. Such events are expected to increase in intensity and frequency, and so farmers face the challenge of climate change adaptation[4]. Climate change is however not the only factor threatening coffee farmer livelihoods. The volatile coffee prices that depend directly on the fluctuations of the international market affect the ability of farmers to make a decent livelihood, by decreasing revenue, increasing risks and thereby undermining their profitability[5].

The coffee supply chain has its own environmental footprint that has additional negative effects for the farmer and their communities. Coffee production contributes to air pollution, water contamination and global warming through the emission of greenhouse gases due to the use of nitrogen fertilizers, poor wastewater management and deforestation.

Labor in the coffee sector is characterized by informality; 87% of total labor is informal, while almost half of the workers are employed on a day or piece rate, principally for harvest and specialized services[6]. This means that workers rarely do have access to social security structures such as pension and coverage for occupational risks. At the same time, the fact that coffee production is labor-intensive and that labor costs represent a significant part of total production costs pose a challenge to farmers and their income, and further hinder the formalization of labor in the sector.

[4] FNC (2012)
[5] Ibid
[6] Ibid

MORE AND SMARTER INVESTMENTS ARE REQUIRED TO TURN THE TIDE

In 2016, the Coffee Sustainability Catalogue calculated that a transformation of the coffee sector into a fully sustainable sector would require a total investment of approximately USD 4.1 billion.[7] Currently, the annual volume of sustainability investments in the coffee sector is much lower, approximately USD 350 million.[8] Projected climate change conditions indicate that if no adaptation measures are taken by 2050, 80% of the crops will be impacted in more than 60% of the current cultivation areas[9]. An increased volume of smarter investments into the coffee sector is vital to specifically target and adapt to increasing environmental and social challenges.

SPECIFIC INVESTMENTS IN CLIMATE-SMART AGRICULTURE ARE A KEY ELEMENT

Climate-Smart agriculture (CSA) should be a key element of the investment agenda for sustainable coffee. CSA is an approach to farming developed by the United Nations Food and Agriculture Organization (FAO) in 2013. The FAO defines CSA as "*agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes GHGs (mitigation), and enhances achievement of national food security and development goals*.".[10]

Solidaridad and partners have implemented CSA among thousands of farmers, workers, and their communities. In the coffee sector, CSA is implemented as a series of measures that include (i) increased density of coffee trees, (ii) renovation with climate resilient varieties, (iii) better soil management, (iv) optimized shading and (v) improved wastewater management.

Solidaridad and the SAFE Platform holds the belief that CSA is an effective way to contribute to a sustainable coffee sector. This belief can be tested by calculating the true price (quantifying sustainability) and the true ROI (measuring profitability of investments). It appears that CSA leads to more robust and higher yields at lower costs and to better and more consistent quality at better prices. CSA therefore supports the economy (higher profits), environment (reduced natural impacts), and farmers (positive social impacts).

Most existing literature on the effects of CSA is written from a compliance perspective. This report aims to go a step further and assess the intervention from a societal cost-benefit perspective. Switching to CSA farming requires investment and the amount the sector is willing and able to invest in sustainability is not open-ended. A CSA investment agenda needs to be justified by evidence.

Better insights into all costs of production (both financial and external) enable investments to have a higher impact and a lower risk. In other words, society will receive more *bang for its buck*. The development of this cost-benefit driven approach requires an extensive and quantified analysis of sustainability.

True Price and Solidaridad have already done a research on the effects of CSA coffee in Mexico. The results confirmed that CSA coffee has a lower true price than conventional and a higher Return-on-Investment[11]. In this analysis, it would like to now test the same for Colombia.

FIVE CRITERIA IN COST-BENEFIT ASSESSMENT

We propose five criteria that should be met to validate Solidaridad's belief that investments in CSA are an important element towards a better coffee sector:

- **a** It is *sustainable*. The approach should be effective in reducing externalities both social and environmental nature.
- **b** It is *contributing* to *a decent livelihood* for the farmer. Smallholder farmers, whose livelihoods are under severe pressure, should see their household income increase, preferably towards making a living income.
- **c** It is *feasible* in the marketplace. Coffee prices are very competitive. The CSA approach should not lead to higher prices unless this can be clearly related to a higher-quality product.
- **d** It is *profitable* to the farmer. If investments are required to make the switch to CSA farming, the investments should be under control and generate sufficient profit per dollar invested.
- **e** It is *cost-effective* to society. The investments should not only benefit the farmer, but also provide benefits to nature, by providing large natural capital benefits per dollar invested.

THE TRUE PRICE AS A TOOL TO QUANTIFY SUSTAINABILITY, ABILITY TO PROVIDE TO PROVIDE DECENT LIVELIHOODS AND FEASIBILITY

In order to score CSA on the five criteria mentioned above, we perform various quantitative analyses. Part of this can be done using traditional financial techniques. For instance, a financial model of a farm can assess the farmer income. If this is higher than the living income for CSA farmers and lower for realistic alternatives, CSA clearly meets the 'livelihood' criterion.

[7] Coffee Sustainability Catalogue (2016)
[8] Ibid
[9] Ramírez-Villegas et al. (2012)
[10] FAO (2010)
[11] Adelhart Toorop de, R. et al. (2017)

Other elements require quantifying the externalities of coffee production. In the first place, this necessary for the first criterion (sustainability) but also for the last criterion (cost-effective to society). In this report, we calculate the true price of CSA coffee and of an alternative production model. True pricing is a way to quantify the external costs of production. It serves to give comparable and clear insights into the environmental and social effects to society.

The true price of a product is defined as the sum of the market price and the external environmental and social costs. The last two elements constitute the so-called external costs. See also Figure 5.

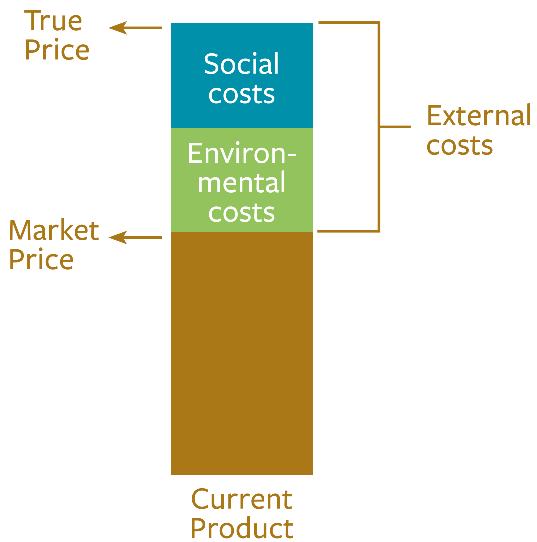

Figure 5: The true price quantifies the external costs of production.

Calculating the true price provides:

- An overview of all external costs of coffee production. As such, it serves to test sustainability.
- An assessment of farmer income, as 'underearning' is part of one of the social external costs; a production system has underearning only if entrepreneurs earn below the living income. As such, the calculation includes a test of whether decent livelihoods are provided for.
- The value for the market price. This helps to test the feasibility criterion.

This is all assessed in Chapter 4 of this report.

THE (TRUE) RETURN-ON-INVESTMENT (ROI) AS A TOOL TO QUANTIFY SUSTAINABILITY AND COST-EFFECTIVENESS

In order to test the fourth criterion, profitability, we calculated the ROI of investments in CSA and in an alternative production system. The ROI of an investment shows how well an investment pays off financially. In order to test the last criterion, cost-effectiveness, we calculate the true ROI of investments in CSA and in an alternative production system. The true ROI is an extension of the classical investment concept of ROI and provides an indication of how well an investment pays off from a societal perspective. Figure 6 gives the example of a 1 million dollars investment, that generates a 3 million dollars financial return, and a 2 million dollars natural capital return. The true ROI is 4 in this example. Chapter 3 and Appendix B give a more complete introduction of the concept of true ROI.

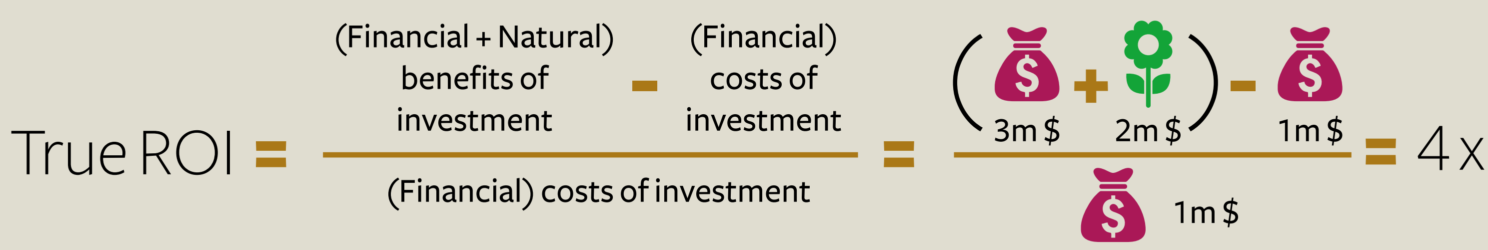

Figure 6: Example calculation of the true ROI of an investment.

The assessment of the true ROI is illustrated in Chapter 5 of this report. Figure 7 is a summary of the five criteria in cost-benefit analysis used in this study.

CRITERIA IN COST-BENEFIT ANALYSIS	REQUIREMENT	ASSESSED IN
Sustainability	CSA should have low social and environmental external costs	Chapter 4
Provision of decent livelihoods	CSA should provide at least a living income to smallholder farmers	Chapter 4
Feasibility	CSA coffee should not sell for higher prices than other coffee of the same quality	Chapter 4
Profitability	CSA should require investments that are under control	Chapter 5
Cost-effectiveness	CSA should require investments that benefit nature and society	Chapter 5

Figure 7: Assessment of the five criteria of cost-benefit analysis.

CONSIDERING THE CASE OF COFFEE FROM CAUCA, COLOMBIA

This report focuses on Colombia to test the relevance of CSA to a sustainable investment agenda for the coffee sector. The main reason to test this approach in Colombia is because coffee production in Colombia is in the frontline of climate change. Colombia is a well-known origin of high-quality Arabica coffee. As mentioned above, coffee production in Colombia faces several challenges related to climate change risks and coffee prices, which threaten the future of Colombian coffee. Many of the rural workers head to urban areas in the search for better wages in the industry or in the services sector. A significant portion of the new generation in rural areas does not believe agriculture to be a profitable business.

The department of Cauca was selected as the focus region (see Figure 8) for this study. Cauca is one of the four regions in Colombia with Protected Denomination of Origin (PDO). Cauca is responsible for approximately 10% of the area planted in 2017.

Figure 8: The department of Cauca in the south of Colombia.

The department is a long-term sourcing area for large, well-known traders like FNC, ECOM, Louis Dreyfus amongst others and leading roasters like Nespresso and Starbucks. From an operational point of view, CSA techniques have been implemented since 2013 in Cauca and substantial data has been collected on their performance. The abovementioned characteristics and challenges faced by Cauca coffee farmers make this region a strong test case.

THIS REPORT

This report contains a study on the true price analysis of coffee production in Colombia. It focuses specifically on the true price of two coffee production models. The two coffee production models represent farms adhering to non-CSA coffee production and farms following CSA techniques.

This report consists of five Chapters, which elaborate on five topics that have already been touched upon in this Introduction.

- Chapter 1: Concept. How can true pricing be used to assess the sustainability of coffee? This chapter explains true pricing.
- Chapter 2: Context analysis. This chapter defines the two different coffee production models in Cauca, the definition of CSA and its benefits.
- Chapter 3: Study methodology. This chapter outlines the set-up of the study of the true price and true Return-on-Investment of coffee from Cauca.
- Chapter 4: Results true price analysis. This chapter discusses the results of the true price analysis for the two types of coffee.
- Chapter 5: Results true ROI analysis. This chapter outlines the required investments and what the total impact of the investments is.

1.
TRUE PRICING AS A MEASURE OF SUSTAINABILITY

KEY MESSAGES FROM THIS CHAPTER

- **External costs** are a central element of the cost-benefit approach to **sustainability**.
- The **true price** is a **measure** of the size of external costs. Products with a **lower true price** are **more sustainable**.
- **Calculating the true price** helps to manage risks, steer innovations, and **reduce social** and **environmental costs** by improving transparency.

There are many definitions of sustainability. A key element is that sustainable production minimizes negative externalities: costs that affect stakeholders or assets that are not compensated. Examples include lack of coverage of social security (to employees) or soil and water pollution (to local communities). This chapter introduces the concept of external costs and the true price. As discussed in the Introduction, true pricing analysis can also help to assess whether a production system '*provides for a decent livelihood*' and is '*feasible*'.

1.1 EXTERNAL COSTS AND COFFEE

External costs are the basis of the concept of true pricing. External costs occur when consuming or producing a good or service imposes a cost upon a third party. More precisely, external costs are costs to people that arise from producing a good, now or in the future, and which are not reflected in the market price. These external costs can be classified into social and environmental external costs.

An example of an environmental external cost is the costs related to carbon dioxide (CO_2) emissions. For coffee to reach its consumer, the coffee beans must be transported, often over thousands of miles. Transport is associated with CO_2 emissions, as is the roasting of coffee. CO_2 emissions lead to climate change and the costs of climate change will be felt by future generations and are already being felt by communities located in areas that face rising sea levels. This means that not only the consumers pay for coffee, but many other stakeholders in the supply chain bear part of the cost too.

An example of a social cost is the costs related to underearning of smallholder farmers. Coffee farmers are often poor smallholders that make much less than a living income. A living income is an income sufficiently high so that farmers can provide themselves and their families with a decent living: access to food, healthcare, education, and other basic expenses. When the coffee price is so low that smallholders face underearning, they are effectively bearing part of the costs of the coffee that the consumer buys in a coffee store or supermarket.

1.2
WHAT IS A TRUE PRICE?

The true price of a product is defined as the sum of the market price plus the external environmental and social costs, as shown in Figure 9. The market price is paid by the buyer of the product. The external costs are not paid by either the buyer or the seller. Instead, they are passed on to other parties, such as farmers or the environment.

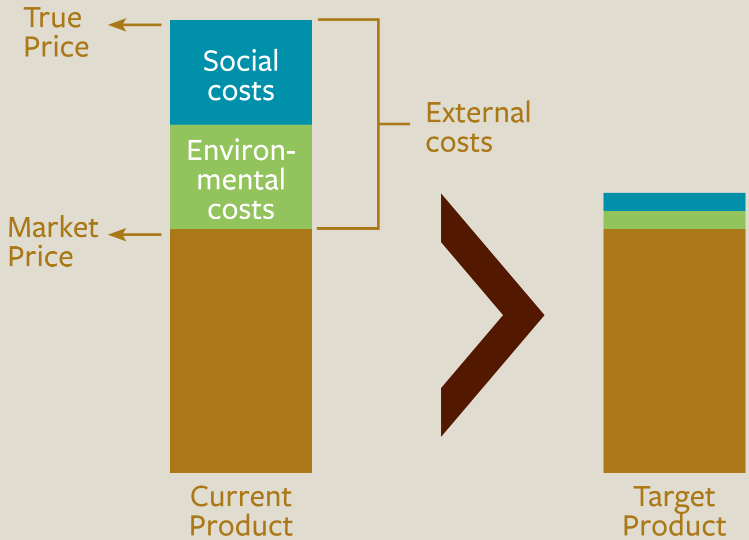

Figure 9: Reducing the true price of a product.

To express the environmental and social costs in monetary terms, these need to be monetized: translated from their natural units (e.g. tons of CO_2 equivalents) into dollars. The monetization includes several techniques. The main techniques can be separated into '*damage costs approaches*' (monetizing the welfare effects of an externality) and '*abatement costs approaches*' (monetizing the costs to prevent or restore a negative externality).

The total external costs are defined as the sum of social and environmental costs. A product for which the total external costs are absent or are very small, has little to no externalities. While there are many conceptions of sustainability, the absence of external costs is a fundamental element of the sustainability of a product.

1.3
WHY CALCULATE A TRUE PRICE?

The true price gives insights into and comparable data about environmental and social external costs of production αα– in this case of coffee production. We have already encountered two examples of external costs in this section: carbon dioxide emissions and underpayment. They capture the negative effects on society arising from production. Traditionally, environmental and social external costs have different measures and are expressed in different units (e.g. kilograms of CO_2 emissions or dollars of underpayment). This makes them difficult to compare. True pricing overcomes this complication.

True pricing expresses all externalities in one comparable unit that everybody uses daily, money. The process of converting an externality (e.g. CO_2 emissions) into an external cost (e.g. dollars) is called 'monetization'. Various acknowledged methods exist to monetize externalities. Monetization makes it possible to directly compare different production models and their associated external costs. This enables people to compare the effects of various products and production models on society and to make decisions based on this information. For example, the monetization of externalities in the coffee sector could facilitate investments that focus on tackling the most important externalities by identifying those with the highest cost. Consumers or producers of coffee can use this information in their decision-making process. The purpose of true pricing is not to make coffee more expensive by raising the retail price, but instead to make the coffee cheaper to society by decreasing the true price to the same level as the retail price as much as possible.

1.4
HOW TO USE TRUE PRICING?

The aim of calculating a true price is to manage risks, steer innovations, and reduce social and environmental costs by improving transparency throughout the supply chain of a product. The final goal is to realize affordable and sustainable products: products with a low true price.

By using information on external costs various stakeholders can benefit. Consumers can shop for products with low external costs. Policymakers can optimize policies and incentives to reduce environmental and social costs, by comparing them across different scenarios. Furthermore, for businesses, externalities are increasingly driving financial revenues and costs. The underlying trend is that external costs are being internalized at increasingly higher rates due to lower transaction costs,[12] consumer demand for sustainable products, and more effective regulation.[13]

[12] Transaction costs are the costs of providing for some good or service through the market rather than having it provided from within the firm.
[13] True Price, Deloitte, EY, & PwC (2014)

There are various bottom-line benefits that businesses and investors can gain by using true pricing information:

1. **Improve sourcing decisions:** Compare different production models and herewith source products with lower external costs.

2. **Facilitate investment:** Mobilize investments in sustainable production systems with the largest improvement in the true price.

3. **Better risk management:** Control and reduce risks in the supply chain due to future cost increases (such as climate change costs) and regulation.

4. **Realize cost reductions:** Identify projects that are sustainable and increase resource efficiency to reduce costs.

5. **Facilitate innovation:** Identify alternative modes of production with lower external costs and higher (long-term) profitability.

6. **Improve marketing:** Credibly communicate superior social and environmental performance of a product.

2. SUSTAINABILITY AND COFFEE PRODUCTION IN CAUCA, COLOMBIA

KEY MESSAGES FROM THIS CHAPTER

- **The main externalities of coffee production** in Colombia are air, soil and water pollution from fertilizer use, underearning of smallholder farmers and underpayment and lack of social security of hired workers.
- This report analyzes the true price **two coffee production systems in Cauca, Colombia:**
  - The **Benchmark coffee** in Cauca. The production is associated with externalities as outlined above.
  - Coffee production with **CSA** techniques in Cauca that aims to **mitigate climate change**.
- **Objective information** of the most sustainable coffee production model can help to **scale up investments** to support this model.

The previous chapter discussed how production and consumption are associated with external costs. True pricing is a way to capture external costs. Products with relatively low external costs can be assessed as more sustainable.

In this report, we apply the true pricing approach to coffee production in the Cauca department in Colombia. The aim is to identify the production models that lead to coffee with a relatively low true price. We can then assess how these production models can be scaled up. In that way, the total level of external costs can be reduced.

In this chapter, we set the scene for the analysis, where we compare two coffee production models:

1. Conventional coffee production in Cauca, Colombia (referred as 'Benchmark' in this document).
2. Coffee produced with Climate-Smart Agriculture techniques (referred as 'CSA coffee' in this document) in Cauca, Colombia.

These two types of coffee production are central in the other chapters of this report:

- Chapter 3 presents the study methodology to assess the true price and true ROI of coffee production.
- Chapter 4 provides the results for the true pricing study for both production models.
- Chapter 5 focuses on the investments required to start farming with CSA techniques.

2.1 PRODUCTION MODEL 1: AVERAGE COFFEE PRODUCTION IN CAUCA, COLOMBIA ('BENCHMARK')

Within the coffee sector the occurrence of external costs is well-documented.[14] A large share of the environmental external costs come from the use of chemical fertilizers. The application and use of fertilizers contribute to air, soil and water pollution. Further, additional environmental costs are created through the high chemical oxygen demand of wastewater from the washing of coffee, which leads to methane emissions.

Coffee harvesting is typically done by families and informal temporary hired workers. Typically, farmers do not earn a living income, nor do workers earn a living wage or have access to social security.

2.2 PRODUCTION MODEL 2: COFFEE PRODUCED WITH CLIMATE-SMART AGRICULTURE TECHNIQUES ('CSA') IN CAUCA, COLOMBIA ('CSA COFFEE')

Solidaridad and its partners from PCS (Plataforma de Comercio Sostenible) have introduced farmers in Cauca to Climate-Smart Agriculture (CSA). See the box below for a brief introduction of CSA and its implementation in the coffee sector. Since 2013, Solidaridad has been involved in applying Climate-Smart techniques to coffee production. Among their main strategies for supporting sustainability, Solidaridad and its partners help farmers adopt Climate-Smart Agriculture (CSA) practices. Previous examples of Solidaridad's actions include field experts working with farmers on pilot projects to decrease firewood consumption, increase forested areas and produce organic fertilizers for crops.

Since 2016, PCS members have been accompanying a group of 60 farms with the implementation of CSA techniques in Cauca. These farms do not follow all CSA techniques mentioned above, but a selection of practices (see section 2.3). Compared to the average coffee production in Cauca, these 60 farms have a slightly larger coffee area and lower coffee production per hectare. On average, farms have a coffee area of 1.41 hectares and a yield of 938 kg parchment coffee per hectare[15]. Given this low production volume, most farm owners are not able to earn sufficient income to support a decent living for themselves and their households. Nevertheless, these smallholder farms use less chemical and organic fertilizer than the average coffee production, which means that the environmental pollution is typically lower.

2.3 CENTRAL ISSUE IN THIS REPORT: THE SUSTAINABILITY OF CSA COFFEE

The central issue in this report are the benefits of CSA farming, including the benefits to smallholder farmers, to the employees and to the environment, and how they can be objectively assessed.

For this analysis, we identified sixteen CSA techniques that fall under the so-called Good Agricultural Practices (GAPs), of which we analyzed the financial, social and environmental return. For the description of these sixteen techniques, see Appendix F.

Objective information on the costs and benefits of CSA coffee helps sup ply chain partners to scale up their investments in the Climate-Smart techniques. Impact investors and coffee companies downstream in the value chain are also presented with clear benefits of supporting the transition. Such support by coffee companies can consist of changing their sourcing strategy and investing.

[14] See for instance IDH & True Price (2016) and references therein.
[15] Weighted average based on farm size (including only the coffee cultivated area).

CLIMATE-SMART AGRICULTURE IN COFFEE FARMING

The concept of Climate-Smart Agriculture (or CSA) was first launched by FAO in 2010 in a background paper prepared for The Hague Conference on Agriculture, Food Security and Climate Change. CSA has three main objectives:

- Sustainably increase food security by increasing agricultural productivity and incomes.
- Build resilience and adapt to climate change.
- Reduce and/or remove greenhouse gas emissions where possible.

Climate-Smart Agriculture is particularly relevant to coffee, as climate change threatens to reduce the regions where coffee can be grown significantly. If climate change continues at its current pace, most of the regions in which coffee is currently grown in Colombia become unsuitable.

Solidaridad has been involved in applying Climate-Smart techniques to coffee since 2013. The CSA program stimulates shade farming: planting other trees above the coffee plants to shield them from direct sunlight and create a more constant microclimate. In addition, coffee varieties are selected that are more resistant to coffee rust and climate change.

CSA farms do use some fertilizers, pesticides and bases that reduce soil acidity. These are always of organic nature and are used to give a boost to production compared to very extensive farming methods. In combination with the choice of coffee varieties, this should also give sufficient protection against coffee rust. This ensures that coffee yields on CSA plots are not only higher than the alternative, but – crucially – also more stable. Strong fluctuations due to pests and changes in microclimates are mitigated.

Climate-Smart techniques during the processing of coffee include the use of biofilters and bio digesters. This improves wastewater treatment and prevents most methane emissions, thus eliminating environmental costs.

The interventions described above aim at increasing productivity and reducing environmental external costs. In addition, Solidaridad aims to reduce social external costs by stimulating farmers to pay external employees better and provide them with food and shelter during the harvest period.

3.
STUDY METHODOLOGY

KEY MESSAGES FROM THIS CHAPTER

- The **true price analysis** in this report is based on **eight natural** externalities and **four social externalities**.
- External costs can also be added to **elements of investment analysis**. This gives for instance the true 'Return-on-Investment'.

This chapter presents the methodology of the study. It elaborates on the material presented in Chapter 1 (Introduction to true pricing) and Chapter 2 (Introduction to coffee production models in Colombia). More technical parts of the methodology are described in the Appendices.

Section 3.1 presents the methodological choices with respect to the coffee production models. Section 3.2 outlines the methodology for the true pricing study to lay the groundwork for the next chapter that presents the resulting true prices of the two production models. Section 3.3 presents the methodology for the investment analysis, including the concepts of 'Return-on-Investment' (ROI) and its extension of 'true ROI'.

3.1 COFFEE PRODUCTION MODELS ANALYZED

Chapter 2 introduced the coffee production systems in Colombia that are in scope for this report. Here, we discuss the technical aspects of analyzing these systems.

COFFEE PRODUCTION MODEL CHARACTERISTICS

Primary data from farms accompanied by Solidaridad was collected to estimate the true price for farms that apply CSA techniques in Cauca. We use a sample of 60 farms with an average farm size in the sample of 1.41 hectares and a yield of 938 kg parchment coffee per hectare[16]. This is somewhat larger compared to the average farm in Cauca, which is 1.03 hectares, and has a yield of 1,098 kg parchment coffee per hectare. Data was also collected on the CSA techniques applied in each farm during the year 2017. Appendix F elaborates on the CSA techniques or Good Agricultural Practices (GAPs) considered in this study.

COFFEE PRODUCTION MODEL BOUNDARIES

The coffee value chain, from cultivation to consumption, consists of many steps. The steps in scope for this study are *cultivation* and *on-farm processing* of coffee cherries up to 'parchment coffee'. Next steps, such as transportation, are only in scope as far as they directly impact farmer income.

[16] Weighted average based on farm size (including only the coffee cultivated area).

External costs at later process steps, such as transportation and roasting, are out of scope.

This study considers the year 2017.

FUNCTIONAL UNIT

The functional unit of this study is a kilogram of parchment coffee. This is how farmers sell the coffee to traders when they perform the washing step on-farm. This type of coffee bean is dried but not hulled. Processing 1 kg parchment coffee gives 0.67 kg roasted coffee that can be sold to consumers.

A kilogram of parchment coffee has an average sales price to farmers of USD 2.25 in Cauca. The weighted average[17] of the sales price for the sample of 60 farms is slightly higher, at USD 2.45.

DATA SOURCES

The analysis for the average coffee from Cauca is mainly based on secondary literature. The analysis of the farms supported by Solidaridad and its partners is mainly based on primary data collected for the year 2017. This is supplemented by secondary literature and expert opinion where necessary. See Appendix C for a more elaborate discussion on the data sources used. In addition, Appendix D provides an overview of key assumptions used in the different analysis steps.

LIMITATIONS OF THE STUDY

The various limitations of this study are mentioned below:

- Not all social external costs could be included in this study due to data availability. The selection of social costs to be included was made based on materiality and data availability. Social costs that were not analyzed include those related to child labor and gender.

- Primary data that was collected on the PCS-supported farms is based on a sample of 60 farms. All calculations are performed per individual farm, but to describe the production model we use weighted average values, if more applicable, also for cases where this applies only to a limited number of the farms.

- For the analysis of the benchmark different data sources were combined regarding the production costs and the yield per hectare. The source with the production costs refers to a higher yield per hectare, which indicates lower costs per kg parchment coffee. This might lead to an overestimate of social external costs. However, as we don't have a representative sample that includes both data points, further research is needed to verify the reliability and representativeness of the production costs of the benchmark.

- The investment analysis for the CSA techniques assumes that both the costs and benefits take place during the year 2017 and does not cover costs and benefits over multiple years.

- All true prices, farmer incomes and investment KPIs quoted in this report, are given as a point estimate. We did not perform an uncertainty analysis to assess the uncertainty range.

See also Appendix D for an overview of the assumptions and model choices for the calculations.

3.2 EXTERNAL COSTS IN THE TRUE PRICE ANALYSIS

As mentioned before, the true price is based on the economic idea of external costs. External costs are costs imposed on others, caused by economic activities that are not reflected in the prices charged for the goods and services being provided. External costs can be classified as environmental costs when they have a direct effect on the environment and as social costs when they have a direct effect on the welfare of people.

An overview of the type of external costs included in this study is presented in Figure 9. The external cost of soil degradation is assessed by providing a range of estimates based on secondary data for Cauca but is not included in the total true price (see sub-chapter 4.2.1). Each type of external cost (such as water pollution and lack of coverage of social security) is typically a category consisting of several external costs. For example, water pollution consists of eutrophication and several forms of ecotoxicity. For social security, external costs are access to healthcare, pension, unemployment savings and sick leave.

A more technical overview of the calculation of the true price, including the concept of 'Impact Pathway' is given in Appendix A. The living income/wage is a crucial input to the social external costs of underpayment and underearning. It is also interesting on its own right. Appendix E presents the living income for rural Colombia.

[17] Weighted average based on coffee production volume.

TYPE OF EXTERNAL COSTS	SPECIFICATION OF EXTERNAL COSTS
Climate change	Greenhouse gas emissions, such as carbon dioxide and methane
Air pollution	Harmful air pollutants (excluding GHG emissions)
Water pollution	Eutrophication, acidification, marine ecotoxicity and freshwater ecotoxicity
Soil pollution	Terrestrial ecotoxicity and human toxicity
Land use and transformation	Land conversion and land occupation
Energy use	Use of scarce energy resources
Water use	Use of scarce water resources
Materials use	Use of other scarce materials
Soil degradation	Soil erosion and loss of soil quality
Underpayment of hired workers	Underpayment gap between living wage and hired workers' wage
Underearning of smallholder farmers	Underearning gap between living income and smallholder farmers' income
Lack of coverage of social security	Lack of social security provision, including healthcare, pension, unemployment benefits and sick leave
Occupational health & safety risk	Occurrence of (non-) fatal accidents in coffee production

Figure 10: Overview of social and environmental external costs.

3.3 MONETIZING EXTERNALITIES FOR INVESTMENT ANALYSIS

The technique of monetizing externalities can also be applied to other economic metrics than prices. The concept of 'Return-on-Investment' (ROI) is relevant here. The ROI is, in simple words, how often an investment pays itself back. An opportunity that turns a 1 million investment into 5 million (ROI = 4) has a higher ROI than an opportunity that turns 10 million into 20 million (ROI = 1).

In traditional investment analysis, externalities are not considered – just as in traditional prices, the external costs are not considered. However, the concept can easily be generalized to a 'true ROI'. This formula is derived and explained in Appendix B.

In conclusion, just like an ROI tells an investor how much financial *'bang for her buck'* he or she gets, the true ROI tells how much 'bang for our buck' an investment provides from a societal perspective. This measure enables stakeholders, who invest in sustainability, to maximize the impact of their investments. The amounts that the sector is willing and able to invest in sustainability is not open-ended, therefore maximizing the impact of investments is crucial.

$$\text{True ROI} = \frac{\text{Benefits of investment} - \text{Costs of investment}}{\text{Costs of investment}}$$

4. THE TRUE PRICE OF DIFFERENT COFFEE PRODUCTION MODELS IN CAUCA, COLOMBIA

KEY MESSAGES FROM THIS CHAPTER

- **Conventional coffee production (Benchmark)** has **significant external costs**, that are mainly linked to climate change and air pollution due to methane emissions from wastewater treatment and the use of fertilizers.
- **CSA coffee** reduces environmental and social external costs.
- The true pricing analysis assesses CSA coffee as **sustainable, helping to provide a decent livelihood** and **feasible** (from a market perspective).

This chapter presents the results of the true pricing analysis for the production models of coffee in Cauca, Colombia as introduced in Chapters 2 and 3. For the elements of the true price and the methods used, please refer to Chapter 3. The true price analysis can be used to assess the sustainability criterion in the cost-benefit analysis of CSA. In addition, sub-results of the true pricing analysis provide input on the ability to provide a decent livelihood and the feasibility criterion.

Results in this chapter are presented in U.S. Dollar, unless specified otherwise, and are rounded to the closest 5 cents. For the results of the 60 farms applying CSA techniques ('CSA coffee') we show the weighted average based on production volume.

This chapter is organized as follows:

- Section 4.1 presents the external costs of the two coffee production models and discusses the most important observations.
- Section 4.2 discusses the external costs for each coffee production model, where we zoom in on the different contributions to the true price and explain their origins.
- Section 4.3 presents the true price of the two coffee production models.
- Section 4.4 concludes the chapter.

4.1 COMPARISON OF EXTERNAL COSTS IN THE TWO COFFEE PRODUCTION MODELS

The results of the external costs calculation of the two coffee production models are given in Figure 11[18].

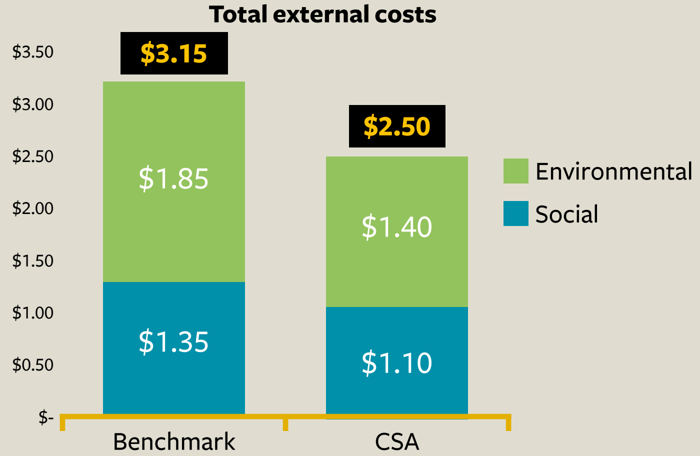

Figure 11: The true price of Benchmark and CSA coffee from Cauca (USD/kg parchment coffee).

COLOMBIAN COFFEE FROM CAUCA IS ASSOCIATED WITH EXTERNAL COSTS

The two coffee production models have similar external costs. The average coffee produced ('Benchmark') has external costs that amount to USD 3.15 per kilogram of parchment coffee, while CSA coffee has lower external costs, that correspond to USD 2.50 per kilogram of parchment coffee. Section 4.2 zooms in more-in-depth on the elements of the external costs.

CSA COFFEE LOWERS BOTH ENVIRONMENTAL AND SOCIAL EXTERNAL COSTS

The environmental external costs of CSA coffee from Cauca are lower than those of average coffee ('Benchmark'): USD 1.40 per kilogram of parchment coffee compared to USD 1.85 for Benchmark. This difference is mainly due to the fact that CSA uses significantly less amounts of chemical fertilizers, that lead to climate change, air and water pollution. The social costs of CSA coffee are also lower than those of the Benchmark, mainly driven by the provision of more income to farmers. See below Section 4.2.2 for a detailed consideration of the social external costs of CSA coffee.

Therefore, it becomes evident that CSA meets the **sustainability** and the **decent livelihoods** criteria, as it is effective in substantially reducing both the environmental and social external costs, by helping farmers earn a living income.

4.2 DETAILED EXTERNAL COSTS PER PRODUCTION MODEL

This section presents a detailed overview of the results for the two coffee production models, with explanations of the most prominent external costs.

4.2.1 THE EXTERNAL COSTS OF AVERAGE COFFEE FROM CAUCA ('BENCHMARK')

Figure 12[19] shows the elements of the external costs for the average coffee produced in Cauca.

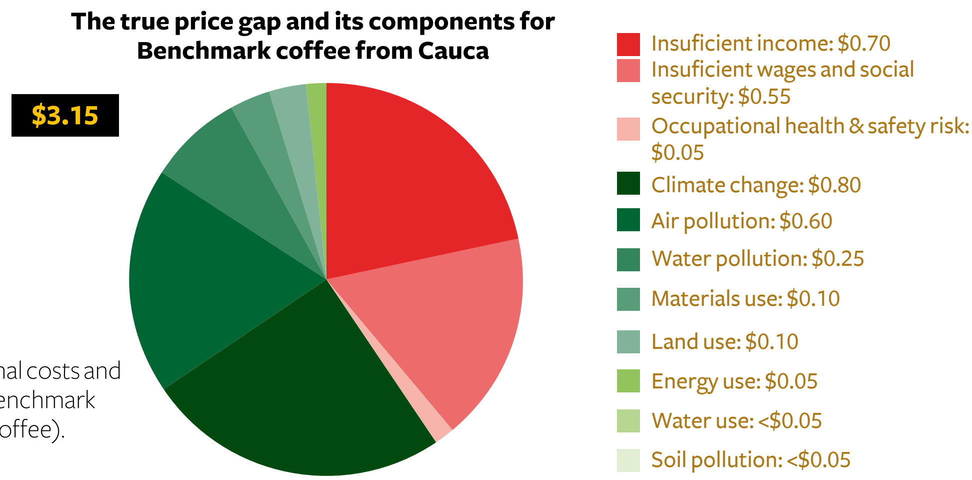

Figure 12: The external costs and its components for Benchmark (USD/kg parchment coffee).

[18] Totals may not add up due to rounding.
[19] Totals may not add up due to rounding.

CLIMATE CHANGE AND AIR POLLUTION ARE THE BIGGEST ENVIRONMENTAL EXTERNAL COSTS

The total environmental external costs of average coffee production ('Benchmark') are USD 1.85. Contribution to climate change has the biggest impact on environmental external costs, adding USD 0.80. This is largely driven by two factors: wastewater treatment of the water used for the washing of coffee and chemical fertilizer application and manufacturing. The treatment of wastewater produced at the stage of the washing of coffee with the use of fermenting tanks produces significant methane emissions. Chemical fertilizer application and manufacturing leads in addition to air, water and soil pollution. In particular, air pollution due to ammonia emissions from fertilization is significant and is the second biggest contributor to environmental external costs, adding USD 0.60. The impact of the contribution of coffee production to climate change is larger than that to air pollution. Importantly, climate change impacts the global (and not only the local) ecosystem and is particularly relevant for coffee farmers in Colombia themselves, as it affects the area suitable for coffee production.

SOIL DEGRADATION

In addition to the abovementioned environmental external costs of this study, the impact of soil degradation for Cauca was also assessed, based on secondary literature. The impact of soil erosion was based on the Revised Universal Soil Loss Equation (RUSLE Version 1.06)[20], the most popular and widespread method worldwide for that purpose, while soil quality was assessed based on IPCC guidelines. Soil erosion is estimated at USD 0.43 per kg parchment coffee and soil quality at USD 0.03 per kg parchment coffee, but estimates vary a lot, as shown in Figure 13 and Figure 14.

Two main challenges arise when assessing soil degradation. First, secondary sources provide wide-ranging results. Second, primary data such as length till water runoff and soil carbon levels are hard to collect on farm level. For these reasons, a range of estimates is provided, and the results are presented separately, namely they are not added to the other environmental external costs that are part of this study.

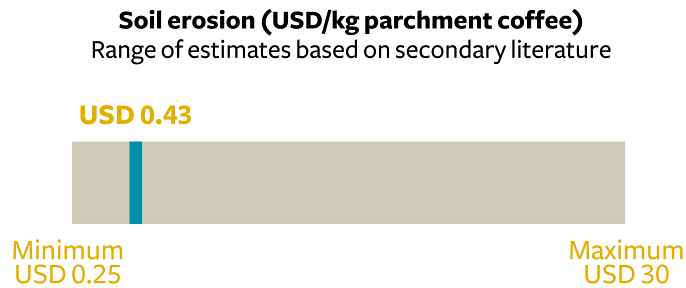

Figure 13: Range of estimates for soil erosion (USD/kg parchment coffee).

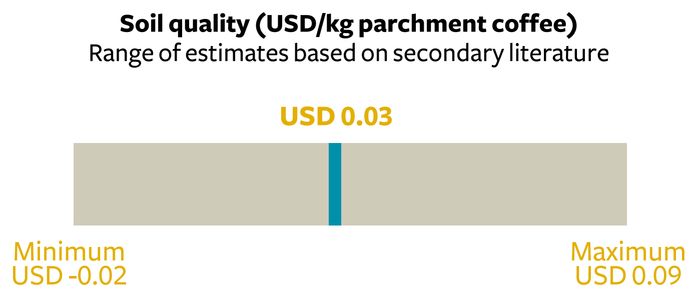

Figure 14: Range of estimates for soil quality (USD/kg parchment coffee).

SOCIAL COSTS ARE BORNE BY BOTH FARMERS AND WORKERS

Social external costs are overall smaller than environmental external costs. The social external costs are mainly built up of the underearning of farm owners and the underpayment and lack of social security of workers. Insufficient income of smallholders has a higher contribution to the total social external costs, as shown in Figure 12.

[20] USDA ARS (2016).

4.2.2 THE EXTERNAL COSTS OF CSA COFFEE FROM CAUCA, COLOMBIA

Figure 15 shows the external costs for CSA coffee. CSA coffee shows improvements in environmental external costs but has similar social external costs as the average farm in Cauca. This leads to lower total external costs than the Benchmark, at USD 2.50 per kg parchment coffee compared to USD 3.15 for the Benchmark.

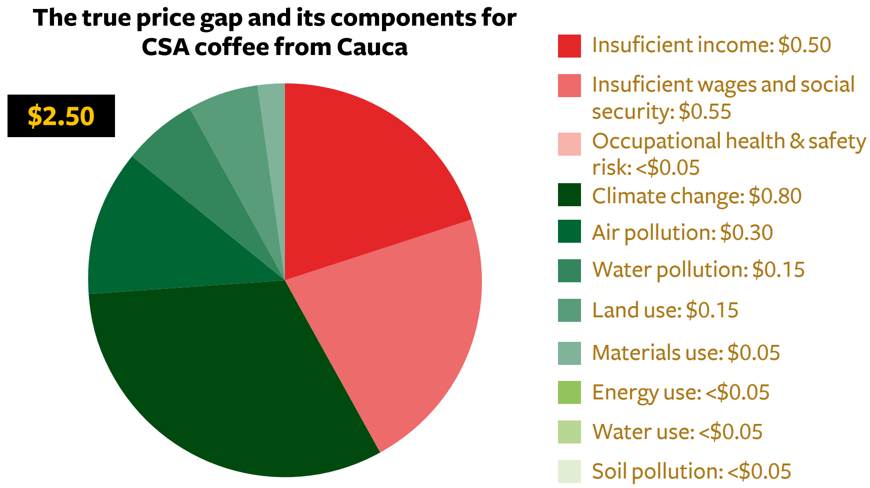

Figure 15: The external costs and its components for CSA coffee from Cauca (USD/kg parchment coffee).

LOWER USE OF FERTILIZERS REDUCES ENVIRONMENTAL EXTERNAL COSTS

Farms that apply CSA techniques have approximately 20% lower environmental external costs than the Benchmark, amounting to USD 1.40 . This is mainly due to a lower use of chemical fertilizers. This is an important conclusion and allows us to positively assess the **sustainability criterion** in the cost-benefit analysis.

Contribution to climate change and air pollution are again the largest environmental external costs. Climate change is comparable to average coffee from Cauca ('Benchmark'), but air pollution is significantly lower. As with the benchmark, contribution to climate change is largely driven by methane emissions from wastewater treatment and chemical fertilizer application and manufacturing.

CSA REDUCES SOCIAL EXTERNAL COSTS

Social costs are lower for CSA coffee, when compared to the Benchmark. The largest contributor to external costs for CSA coffee is the underpayment and lack of social security of hired workers, which amounts to USD 0.55, similarly to the Benchmark. Underearning, as reflected by insufficient income, is considerably lower than the Benchmark. However, effectively only 10% of farm owners earn a living income. Farmers earned on average ~COP 10,100,000 (USD 3,420)[21] per year in the period of the research, about 40% lower than the household living income of COP 18,190,000 (USD 6,160) per year. Due to the extensive nature of farming they do not need to work full-time on the farm, especially not outside the harvest season. On average, the coffee farming accounts for just 0.27 FTE.

4.3 THE TRUE PRICE PER PRODUCTION MODEL

The previous section showed that CSA coffee is more sustainable than Benchmark coffee, as applying CSA techniques lowers the environmental external costs. As shown in Figure 16, CSA coffee has both the lowest total external costs and the lowest true price and provides a better margin to farmers. This is not withstanding the fact that CSA coffee sells for a slightly higher price than the average coffee in Cauca, which is related to the premium that these farms receive from the verification program (VSS).

[21] This is based on total revenues per farm per year and includes direct revenues from coffee sales, in-kind revenues, such as coffee for own consumption, and any subsidies and agricultural materials received.

The true price of CSA and Benchmark coffee in Cauca

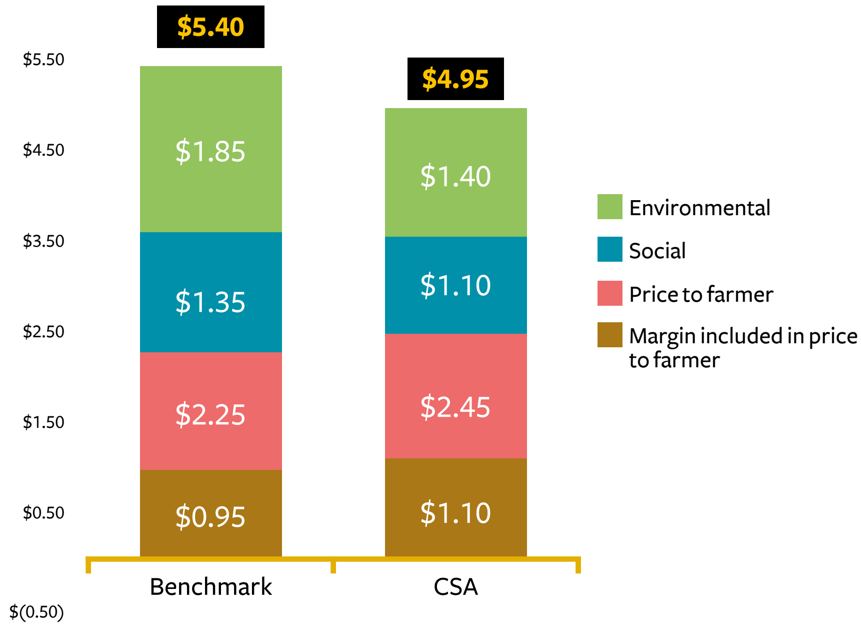

Figure 16: The true price for the two coffee production models (USD/kg parchment coffee).

4.4 CONCLUSION OF THE CHAPTER

In this chapter, we have presented the results of the true price analysis of the two coffee production models under examination, namely average coffee production in Cauca, Colombia ('Benchmark') and coffee production using CSA techniques in the same region ('CSA coffee'). The analysis shows that:

- The average coffee produced in Cauca ('Benchmark') has significant environmental external costs, amounting to USD 1.85 per kg parchment coffee.
- Applying CSA techniques reduces the environmental external costs by approximately 20%.
- Investments in CSA techniques are required to bring the environmental external costs further down.
- CSA also reduces social external costs, due to lower underearning of smallholder farmers.
- CSA is the more sustainable production model as it has the lowest external costs.

5. INVESTMENT IN MORE SUSTAINABLE COFFEE: THE TRUE-RETURN-ON-INVESTMENT

KEY MESSAGES FROM THIS CHAPTER

- Investments in CSA have a positive **Return-on-Investment (ROI) of 0.04**, thereby meeting the **profitability criterion**.
- **Investments** in **CSA** are effective from a societal perspective, as they have a positive **true ROI** of **0.74**.
- **Additional arguments** supporting investment in organic CSA are **climate change** risk, prevention against **coffee rust**, and the **higher** coffee **quality**.

The previous chapter explored the true price of coffee produced in Cauca, Colombia. This chapter focuses more specifically on the investment in CSA coffee production. It serves to assess the profitability criterion in the cost-benefit assessment.

This chapter discusses two questions:

1. Is it possible to quantify the benefits of CSA vs. conventional in terms of scalability (instead of external costs per kg of parchment coffee)?
2. Is there a (societal) business case for CSA coffee?

Section 5.1 and 5.2 discuss the first question through a qualitative assessment of arguments for investment in CSA. Section 5.3 discusses the second question in a quantitative way. We use the concept of true ROI as introduced briefly in Section 3.3 and discussed in more detail in Appendix B. Section 5.4 concludes the chapter.

5.1 ARGUMENTS FOR INVESTMENTS IN CLIMATE-SMART AGRICULTURE (CSA) TECHNIQUES

There are many arguments that support CSA as the most sustainable and profitable investment. This section discusses the following four potential benefits:

- Lower environmental impact
- Higher environmental and financial resilience of farms to climate change risk
- Better prevention of coffee rust
- Higher coffee quality

LOWER TOTAL ENVIRONMENTAL IMPACT

The environmental costs per kg parchment coffee of CSA coffee are lower compared to the Benchmark. A kilogram of CSA coffee causes USD 1.40 of environmental external costs. It also replaces a kilogram of average coffee on the market and thus prevents USD 0.45of environmental external costs that would otherwise occur.

REDUCED CLIMATE CHANGE RISK

CSA mitigates the environmental and financial risks created by climate change to farmers, traders and roasters. This is the original reason for introducing the Climate-Smart techniques into Colombian agriculture. Climate is one of the most important limiting factors for coffee production and determines the continuity of the livelihood of the farmers and the provision of high-quality beans to international markets. CSA also serves as a local effort to tackle problems posed by climate change, and therefore benefits the common good. Shade farming as practiced in CSA naturally leads to a more stable micro-climate. This can make coffee farming possible at relatively low altitudes and significantly also in changing climatic conditions. Farmers are thus protected against income reduction, that could otherwise be caused by reduced production, leading to a more stable financial management of the farm and strengthening, therefore, the economic resilience of the farmers.

BETTER PREVENTION OF COFFEE RUST

Thirdly, CSA is more effective in the prevention of coffee rust. The yields of CSA are more stable, as CSA uses new coffee varieties that are more resistant to coffee rust and applies agricultural practices that prevent or reduce the risks of coffee rust. Thereby reducing the potential impacts for the farmers, traders and roasters.

HIGHER COFFEE QUALITY

Fourthly, the quality of the coffee produced using CSA techniques is better. Shade coffee, as practiced under CSA, is slowly ripened. This improves the ripening and leads to larger and more appealing beans, with a better 'body' for the brew. Additionally, in CSA, the acidity of the soil is carefully managed. This is crucial for the calcium level in the coffee beans, which impacts the fragrance/aroma of the coffee.

In this study, only quantifying the first benefit was in scope, partly due to limited availability of robust data about the other three impacts. If anything, the quantitative analysis presented here thus underestimates the benefits of CSA.

5.2 SETTING THE SCENE: INVESTMENTS IN CLIMATE-SMART AGRICULTURE (CSA) TECHNIQUES TO IMPROVE CONVENTIONAL FARMING

Switching to CSA coffee requires investments. Part of this switch is an ordinary investment in new coffee plants, which should be a variety that is more resistant to coffee rust. A key element of Climate-Smart farming is that it takes place on renovated coffee plots where shade management is possible, and which contain the right varieties of coffee. In addition, CSA farming requires investments in specific infrastructure, for instance in biofilters.

The following section analyzes the investments in CSA techniques from a financial perspective. Refer to Section 3.3 for an introduction to the methodology used.

5.3 INVESTMENT ANALYSIS FOR THE SWITCH TO CSA USING GOOD AGRICULTURAL PRACTICES (GAPs)

This section analyzes the investments required to change from conventional farming to CSA farming that uses a set of sixteen Good Agricultural Practices (GAPs). The average coffee production in Cauca as described by the Benchmark is used as the reference for conventional farming. This refers to a farm with 1.03 hectares of coffee area, a yield of 1,098 kg parchment coffee per hectare and a sales price to farmer of USD 2.25 per kg parchment coffee. This production model is compared to CSA farming, which in this analysis is coffee production that implements a selection of sixteen GAPs, as part of transitioning from conventional to CSA farming. These farms have an average coffee area of 1.41 hectares, a yield of 938 kg parchment coffee per hectare, and a sales price to farmer of USD 2.45. See Chapter 2 for a more detailed description of the two production models.

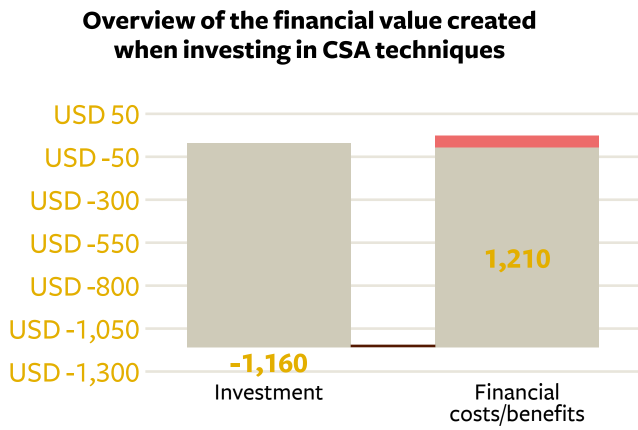

Figure 17: Overview of the financial value created when investing in CSA techniques (USD/farm). On average, farms have a coffee area of 1.41 hectares.

Due to lack of specific data on the timeframe of implementation of the GAPs, we do not consider a specific timeframe for the analysis. With this assumption, we consider the timeframe to be one year and calculate costs and benefits for that period , which refers to the year 2017[22].

As shown by the grey block in Figure 17, the transition from conventional to CSA farming requires a significant investment, approximately 850 USD per hectare in the selected coffee farms. This investment is however worthwhile for the farmers, from a financial point of view, as it produces a payback of 850 USD in the first year and an extra income of USD 50 for them, as shown by the pink block. Overall, the investments in CSA techniques have a positive ROI of 0.04 in financial terms. As mentioned this ROI does not include the quantified benefits of reduced climate risks, coffee rust prevention and higher quality beans.

Figure 18 provides insight into the non-financial benefits of the investment. As shown by the green block, the investment generates positive natural capital benefits of approximately USD 530 per farm. The social capital benefits are USD 280 per farm, as shown by the red block.

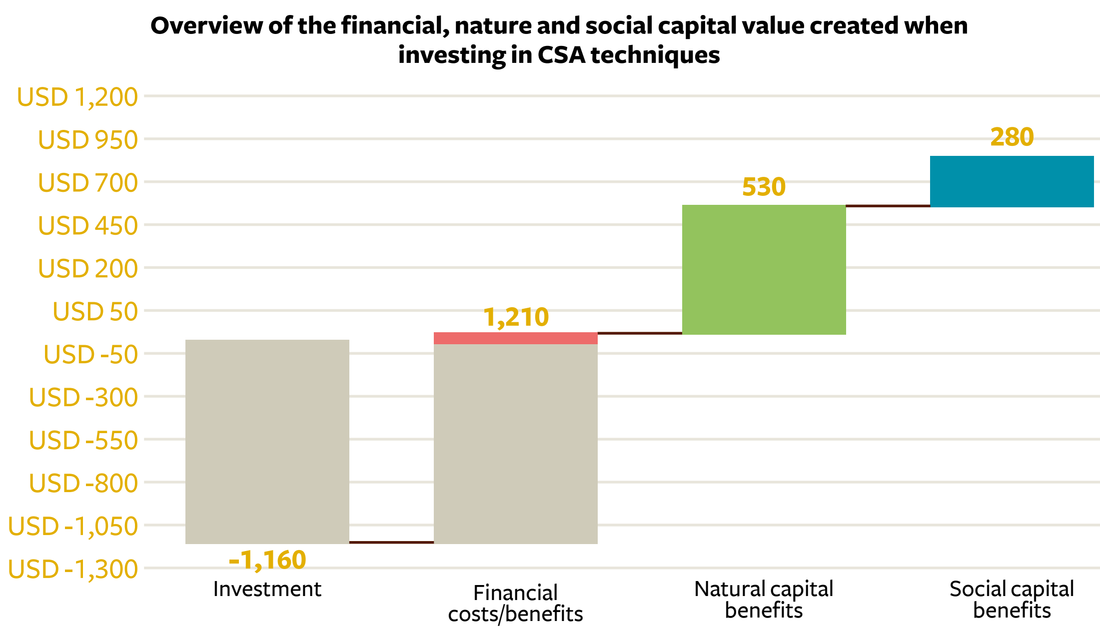

Figure 18: Overview of the financial, natural and social capital value created when investing in CSA techniques (USD/farm). On average, farms have a coffee area of 1.41 hectares.

The analysis confirms the benefits of implementing CSA techniques. Especially the natural capital benefits generated by the investment are clear. For example, avoiding the use of pesticides that are in the Banned Pesticides List lowers on average the true price gap by USD 0.19, while avoiding land conversion lowers on average the true price gap by USD 0.25. These examples show the benefits of the implementation of the GAPs for natural capital. For a complete list of all the GAPs considered in this study, see Appendix F.

As only three of the GAPs are related to social capital, the influence of the GAPs on this type of capital is smaller, as shown in Figure 18. Overall, the investment in CSA techniques has a positive true ROI of 0.74. This number indicates the considerable externalized value created by the CSA techniques compared to the relatively limited financial ROI.

[22] Wage costs, where applicable, refer to 2018.

The ROI and true ROI of the investment, describing the ratio between costs and benefits, are given below.

Type of Return-on-Investment	Value
ROI (financial)	0.04
True ROI (financial + natural + social)	0.74

All in all, if in the most conservative calculation, the investments in CSA meet the profitability criterion as well as the cost-effectiveness criterion. The ROI and true ROI of CSA are positive. However, the investments required for the farmers are quite significant. Farmers need to be supported to be able to make the transition. Both technical (assistance, training) and financial support (tailor-made financial products, incentives) is needed to help the farmers adopt new practices and move towards CSA.

5.4
CONCLUSIONS OF THE CHAPTER

The analysis in this chapter shows that investment in CSA coffee is worth pursuing. In short:

- Coffee production following CSA techniques reduces environmental impact.
- Investing in CSA has a positive ROI, thereby meeting the profitability criterion.
- Investing in CSA has a positive true ROI, thereby meeting the cost-effectiveness criterion.
- Strong qualitative arguments further support investment specifically in CSA: reduced climate change risk, increased resilience to coffee rust, and improved coffee quality.

This clearly shows that investment in CSA farming is worthwhile. However, the question of how farmers can finance the transition remains. Smallholder farmers already earn much less than a living income.

Supporting farmers to make the transition to CSA is an opportunity for (impact) investors and for companies downstream in the value chain, as it provides better financial and true ROI, it reduces climate risks, and it contributes to safeguarding access to high-quality arabica beans. Farmers will benefit from better and more stable incomes and the impact on environment and natural capital is reduced. For investors aiming at impact on environmental issues, the switch to CSA farming is especially relevant.

6. RECOMMENDATIONS ON THE USE OF TRUE PRICE AND THE TRUE ROI FOR PRICING AND INVESTMENT DECISIONS BY STAKEHOLDERS ACROSS THE VALUE CHAIN

KEY MESSAGES FROM THIS CHAPTER

- **CSA coffee** is the **more sustainable coffee** system investigated in this research. Still, **additional steps** can be made at farm, market and government level.
- Investigating alternatives to **replace copper-containing** fungicides can reduce the impact on soil and water. (Semi-) mechanization and higher prices might facilitate a **reduction of underpayment** of hired workers. Social externalities are further reduced by increasing access to **social security**.
- Moving **from compliance-driven to cost-benefit driven investments**, integrating external costs in ROI calculations can help to scale CSA.
- Investing in CSA has a **positive financial return** and **even higher societal returns**, making it an **interesting case for impact investors** to consider.
- Governments and the financial sector can contribute to a scale up of CSA with positive incentives such as **preferential credit rates, better loan conditions or payments for environmental services** and by stimulating **innovation through research**.

The analysis in Chapter 4 showed that CSA coffee has the lowest true price of the two production models analyzed. On the other hand, Chapter 5 confirmed that investing in CSA coffee has a positive true ROI. Yet, it has not been possible to monetize the full range of positive impact created by CSA as data on specific indicators is not completely available for the selected region and timeframe. Therefore potential benefits of using the true price calculation and True ROI calculation are undervalued in this study.

In this Chapter, we give a set of recommendations on how to use true pricing and the true ROI to inform pricing and investment decisions, in order to scale CSA coffee and further decrease the social and environmental external costs related to (CSA) coffee production.

6.1 RECOMMENDATIONS ON THE USE OF TRUE PRICE TO INFORM PRICING DECISIONS

The insights from the true price analysis can be used by various stakeholders across the coffee supply chain, such as traders, roasters and consumers, to make pricing decisions. Below we summarize how the true price can be used by these stakeholders to help scale CSA coffee.

6.1.1 TAKE PROCUREMENT DECISIONS BASED ON COST-BENEFIT DRIVEN MODELS, RATHER THAN ON COMPLIANCE-DRIVEN MODELS ALONE

True pricing of CSA helps to compare different origins and production models. Within a global trend of emerging company-specific sustainability standards, the inclusion of assessments of external costs will empower the procurement policies of the main green coffee buyers at global level. Sourcing CSA coffee with lower external costs will lower the risks over time for buyers and farmers. Furthermore, in order to have recommended to move from a compliance-driven to a cost-benefit driven agenda, and at the same time integrate external costs, to help scale CSA across different coffee origins.

6.1.2 INCORPORATE THE COSTS OF THE INCREASING CLIMATE RISKS FOR COFFEE PRODUCTION IN CURRENT RISK ANALYSIS MODELS

Including true pricing of CSA coffee into risk analyses will improve risk management by buyers and investors in the coffee supply chain. It allows to identify, control and reduce risks in the supply chain due to future cost increases (such as climate change costs) and regulation.

6.1.3 INCREASE THE AWARENESS OF EXTERNAL COSTS AMONG END CONSUMERS

The wave of certifications in the sector has made end consumers aware of sustainability criteria in the production process, but it is unclear how to compare numerically the sustainability impact between providers, origins or production models. Purchase decisions are often taken based on price and quality. Communicating the monetized value of the sustainability impact of CSA and other company specific standard and/or Good Agricultural Practices would benefit consumer awareness about the true value of sustainable and conventional products.

6.1.4 USE THE TRUE PRICE TO OPTIMIZE THE OPERATIONS AND COMMUNICATION OF VALUE CHAIN ACTORS

For producers and their farms, true pricing allows for the optimization of resource efficiency and the reduction of production costs. For providers, it can help to adapt existing inputs and services (and to develop new ones) that reduce the external costs for farmers. For roasters, retailers and sellers, this framework enables the improvement of the measurement and communication of the social and environmental performance of their coffee origins.

6.2 RECOMMENDATIONS ON THE USE OF THE TRUE ROI TO INFORM INVESTMENT DECISIONS

It is in the interest of government, market and other stakeholders in the coffee sector to use the insights from the true ROI analysis to inform their investment decision and tackle challenges such as those described below.

6.2.1 THE TRUE ROI ANALYSIS SHOWS THAT INVESTING IN CSA CAN BE A MORE INTERESTING INVESTMENT TO PURSUE FOR IMPACT INVESTORS

The traditional ROI analysis can help to determine the financial return of an investment and therefore decide whether an investment is worth pursuing. The true ROI analysis additionally reveals the societal benefits of the investment.

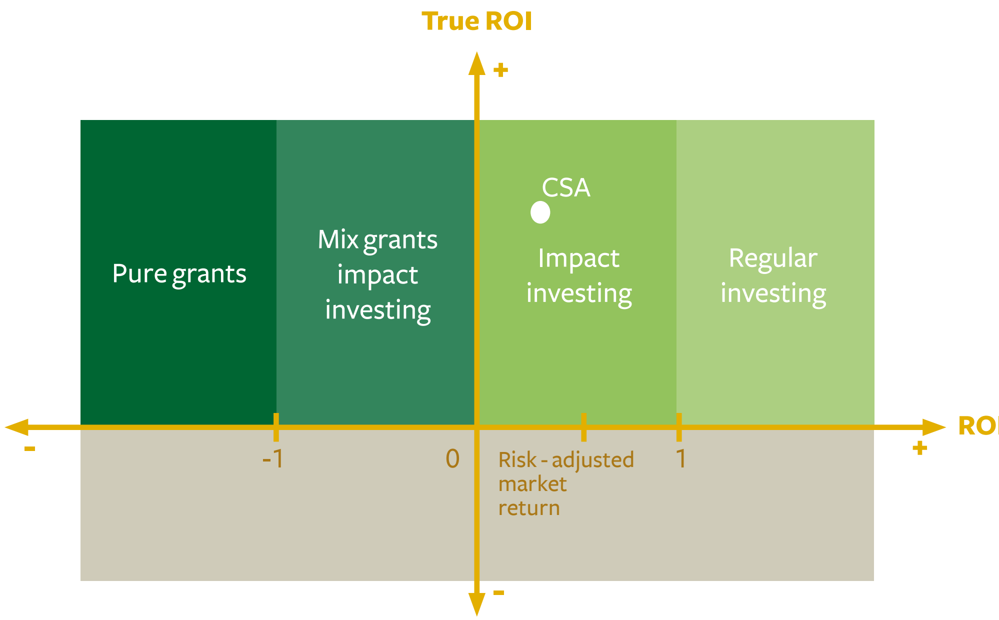

Figure 19: Investing in CSA is an interesting investment to pursue for impact investors.

As shown in Figure 19, investing in CSA is an interesting investment to make; although the ROI of 4% calculated in the present study might be below the risk-adjusted market return, the true ROI of CSA is higher, meaning that the benefits of the investment accrue to society as a whole. Investing in CSA is therefore worthwhile to consider for impact investors.

6.2.2 INVESTMENT FRAMEWORKS DO NOT CONSIDER THE POSITIVE OR NEGATIVE EXTERNALITIES WITHIN THEIR ROI CALCULATIONS

For the mobilization of more investments in CSA coffee production it is required to complement the current investment frameworks with quantified information on externalities. Improved datasets on externalities will allow investors to take better informed decisions both from a risk and a benefit perspective.

6.2.3 USE THE TRUE ROI ANALYSIS TO IMPROVE INCENTIVES TO FARMERS AND BUYERS FOR CSA

Current governmental policies have little eye for the external costs of coffee production. Using the insights from the true price and true ROI analyses can guide governments towards offering positive incentives to CSA production in the form of preferential credit rates, better loan conditions or payments for environmental services to reduce the net costs on public goods in production areas. On the market side, it is worthwhile to investigate positive incentives for buyers of CSA coffee in the form of fiscal incentives based on sustainability performance, preferred access to finance schemes or re-selling schemes for tradeable sustainability "goods" such as carbon credits.

6.2.4 BUNDLE AND TARGET PUBLIC INVESTMENTS IN THE COFFEE SECTOR

Current investments by governmental entities in the coffee sector are spread among a wide variety of actors at international, national and local level. Additionally, investments are done through different thematic lines. Calculating external costs can support a better alignment between public investments by providing an integrated view of the costs associated with the thematic lines under which public entities provide investments.

CONCLUSION

KEY MESSAGES FROM THIS CONCLUSION

- **Investing in CSA pays off, as CSA scores positive on each of the five criteria of the cost-benefit analysis** defined in the Introduction:
  - It is more **sustainable**, as shown by the lower external costs compared to the alternative.
  - It helps **provide a better livelihood**, as smallholder farmers in the CSA system have a lower underearning gap, as opposed to smallholder farmers in the alternative.
  - It is **feasible** with regards to the market price. The market price of CSA coffee is similar to the alternative and not higher than what the market is willing to pay.
  - It is **profitable** to farmers, as the required investments have a positive ROI.
  - It is **cost-effective** to society, as the required investments have a positive true ROI.
    - The **total external costs of CSA coffee** ($2.50) are **lower** than that of Benchmark ($3.15).
    - The **ROI of short-term investments in CSA** (0.04) and the **true ROI of short-term investments in CSA** (0.74) are positive after year 1.
- **Switching** to CSA, however, **requires** significant **investments**, both up-front and in early years, when farmers are without harvest. **Support** from (**impact**) **investors**, **traders** and **roasters** can help to speed up the transition.

This report has tested the true price approach to evaluate the external costs of Climate Smart Agriculture, focusing on coffee production in the Colombian department of Cauca.

The current dominant frameworks in assessing sustainability are compliance-driven. From a compliance perspective, it is hard to quantify the benefits of the CSA approach – let alone to integrate it into a single perspective that also contains the related costs. A cost-benefit-driven approach is better suited for this perspective. The conventional cost-benefit analysis, that calculates all costs and benefits to the producer, is positive at the bottom line for CSA but is incapable to show the full potential of it.

By including external costs into the equation we can quantify the benefits of Climate Smart Agriculture for the coffee sector. True pricing offers a solution as it assesses environmental and social costs and expresses these in monetary terms, so they can be compared to the other elements of cost-benefit analysis.

In the Introduction, we defined five criteria to assess (investments in) CSA in a cost-benefit analysis that also considers externalities:

a. Sustainability. The approach should be effective in reducing externalities, both of social and environmental nature.

b. Ability to provide decent livelihoods to farmers. Smallholder farmers, whose livelihoods are under severe pressure, should see their household income increase, preferably towards making a living income.

c. Feasibility (in the market place). Coffee prices are very competitive. The CSA approach should not lead to considerably higher prices, unless this can be clearly related to a higher-quality product and the market is willing to pay that.

d. Profitability (to the farmer). If investments are required to make the switch to CSA farming, the investments should be under control.

e. Cost-effectiveness (to society). The investments should not only benefit the farmer, but also provide benefits to nature, by providing large natural capital benefits per dollar invested.

We showed that the calculation of the true price and the true ROI of CSA coffee and its main alternative provide a structured way to score the five criteria.

RESULT 1: THE EXTERNAL COSTS OF CSA COFFEE

We first answer the question of how the total external costs of coffee production under CSA compares to Benchmark coffee production. To answer this question, we analyzed the impact of growing coffee using CSA techniques at a sample of 60 farms in the department of Cauca. The impact was compared to the impact of average coffee production without the use of CSA techniques in the same department.

Our analysis came to the following results of the external costs for the two coffee production models in Cauca (Figure 20):

- The Benchmark for coffee production in Cauca is associated with environmental and social external costs. The most important of these costs are related to climate change and air pollution, driven by fertilizer use and methane emissions from wastewater treatment, and the underearning of farmers and underpayment and lack of social security of hired workers.
- CSA coffee reduces both environmental external costs.

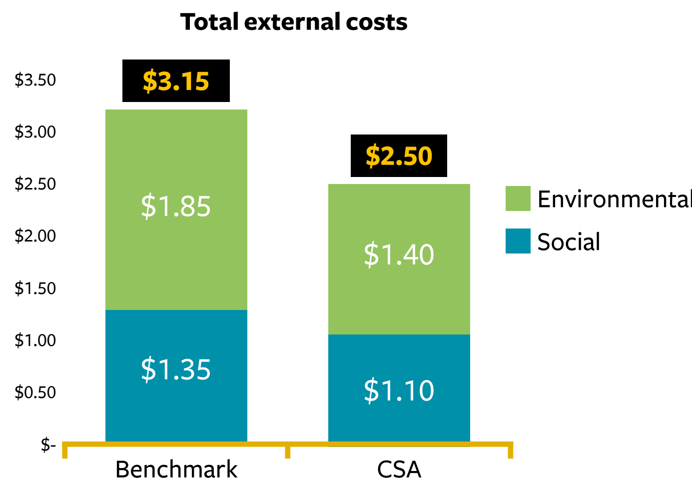

Figure 20: The external costs of coffee from the two production models in Cauca (USD/kg parchment coffee).

We conclude that the CSA model meets the sustainability and feasibility criteria and barely meets the decent livelihood criterion, as it does not provide all farmers with a living income.

RESULT 2: THE (TRUE) RETURN-ON-INVESTMENT FOR INVESTMENTS IN CSA

To test the last criteria (profitability and cost-effectiveness), we assess how well investments in CSA pay off compared to a realistic alternative. In Chapter 5, we have asked ourselves how the Return-on-Investment of investments in CSA techniques compares to the alternative of conventional coffee farming, as represented by the Benchmark.

We concluded that investing in CSA farming has a higher return, both for farmers and for society. Figure 21 zooms in on the financial, natural and social costs and benefits of CSA investments.

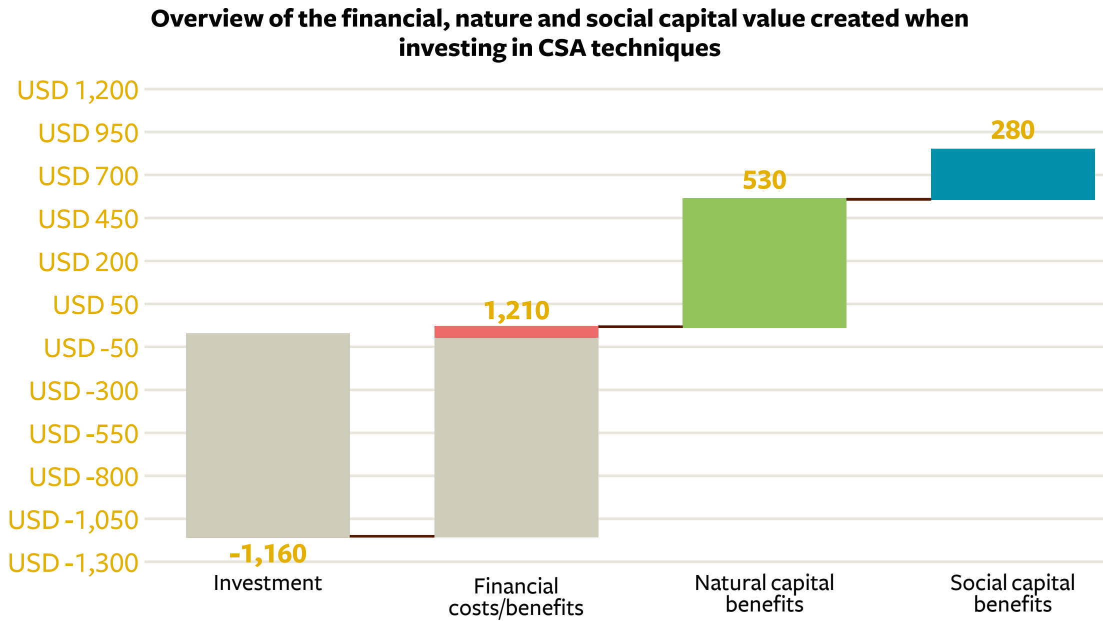

Figure 21: Overview of the financial, natural and social capital value created when investing in CSA techniques (USD/farm). On average, farms have a coffee area of 1.41 hectares.

CSA creates a significant value to the farmer and to society. However, in order to do so, a significant up-front financial investment is required. The ROI and true ROI take this investment into account: the true ROI gives a measure of how much value is created for every dollar invested. Even though a quite significant investment is required, the ROI and true ROI are positive for CSA farming, as shown in the table below.

Type of Return-on-Investment	Value
ROI (financial)	0.04
True ROI (financial + natural + social)	0.74

This means that investments in CSA meet the profitability and cost-effectiveness criteria of the cost-benefit analysis. However, the investments required to the farmers (the grey block in Figure 21) are quite significant. Farmers need to be supported to be able to make the transition. This provides a compelling call to action.

Chapter 6 contains a number of suggestions for actions that can be taken now. In order to make a further improvement in the true price possible, actors in the market could consider to change their procurement decisions from a pure compliance-driven to a cost-benefit driven model, implement investment frameworks that consider externalities and incorporate the costs of the increasing climate risks for coffee production.

Based on the results of this analysis we hope to provide better insights to the different actors in the coffee supply chain:

- For procurement professionals, it provides a way to compare the costs and benefits of different production systems and thereby source products with lower external costs.
- For investment officers, it provides valuable data and insights to better control and to reduce the risks associated with investments in coffee at farm level.
- For producers and their farms, the true pricing and true ROI allow for the optimization of resource efficiency and the reduction of production costs.
- For providers, it helps to adapt existing inputs and services (and to develop new ones) that reduce the costs for farmers.
- For roasters, retailers and sellers, this framework enables the improvement of the measurement and communication of the social and environmental performance of their coffee.

Lastly, governments can contribute to further growth of CSA practices. They could improve the capacity to innovate, improve incentives to farmers and buyers to choose for CSA and bundle and target public investments in the coffee sector.

BIBLIOGRAPHY

Administration, S. a. (1978). *Predicting Rainfall Erosion Losses: A Guide to Conservation Planning*. Hyattsville, Maryland, USA: United States Department of Agriculture: Science and Education Administration . Retrieved from https://naldc.nal.usda.gov/download/CAT79706928/PDF

Angima, S., Scott, D., O'Neill, M., Ong, C., & Weesies, G. (2003). Soil erosion prediction using RUSLE for central Kenyan highland conditions. *Agriculture, Ecosytems and Enviroment*, 296-308.

Applications & Services. (2018). Retrieved from European Soil Data Centre (ESDAC): https://esdac.jrc.ec.europa.eu/ApplicationAndServices

Aristizabal, J. C. (2012). R*iesgos laborales y el Agro Colombiano*. Retrieved from Federacion de Aseguradores Colombianos (fasecolda): http://www.fasecolda.com/files/1814/4909/2479/Aristizabal._2012._Riesgos_laborales_y_el_agro_colombiano.pdf

Carvalho, C., Fernandes, R., Carvalho, G., Barreto, R., & Evans, H. (2011). Cryptosexuality and the Genetic Diversity Paradox in Coffee Rust, Hemileia vastatrix. PLoS ONE, 6(11).

Castro Quintero, A., Lince Salaza, L., & Riaño Melo, O. (2017). Determinación del riesgo a la erosión potencial hídrica en la zona cafetera del Quindío, Colombia. *Revista de Investigación Agraria y Ambiental*, 8(1), 17-26. doi:10.22490/21456453.1828

Comite de Cafeteros del Cauca. (2018, January 18). *Informe de Gestión 2017*. Retrieved from https://issuu.com/cafedecolombiacauca/docs/informe_de_gesti__n_2017

Comite de Cafeteros del Cauca. (n.d.). *Nuestro Cafe*. Retrieved from Cauca Federacionde Cafeteros: https://cauca.federaciondecafeteros.org/fnc/nuestro_cafe/category/118

DANE - Republica de Colombia. (n.d.). *Encuesta Nacional de Ingresos y Gastos, 2006-2007*. Retrieved from https://formularios.dane.gov.co/Anda_4_1/index.php/catalog/204

de Adelhart Toorop, R., de Groot Ruiz, A., van Maanen, E., Brounen, J., Casanova Pérez, L., & García Rodríguez, R. (2017). *The Ture Price of Climate Smart Coffee: Quantifiying the potential impact of climate-smart agriculture for Mexican coffee*. Solilaridad and True Price.

FAO. (n.d.). *Climate-Smart Agriculture: History*. Retrieved April 4, 2017, from Food and Agriculture Organization of the United Nations web site: http://www.fao.org/climate-smart-agriculture/overview/history/en/

Federacion Nacional de Cafetero de Colombia. (2012). *2012 FNC Sustainability Report*. Retrieved from Federacion Nacional de Cafetero web site.

Federacion Nacional de Cafeteros de Colombia. (2017). *83 Congreso Nacional de Cafeteros*. Retrieved from Federacion Nacional de Cafeteros web site: https://www.federaciondecafeteros.org/static/files/IGG_2017.pdf

Federacion Nacional de Cafeteros de Colombia. (2017). *Informe del Gerente General 2017*. Retrieved from Federacion Nacional de Cafeteros web site: https://www.federaciondecafeteros.org/static/files/IGG_2017.pdf

Federacion Nacional de Cafeteros de Colombia and Cenicafé. (2015). *Beneficio del cafe en Colombia*. Retrieved from Cenicafé web site: https://www.cenicafe.org/es/publications/Beneficio-del-cafe-en-Colombia.pdf

Federacion Nacional de Cafeteros de Colombia. (n.d.). *Estadisticas Historicas*. Retrieved from Federacion Nacional de Cafetero web site: https://www.federaciondecafeteros.org/clientes/es/quienes_somos/119_estadisticas_historicas/

Global Rainfall Erosivity. (2018). Retrieved from European Soil Data Centre (ESDAC): https://esdac.jrc.ec.europa.eu/themes/global-rainfall-erosivity

IDH & True Price. (2016). *The True Price of Coffee from Vietnam*. Retrieved from http://trueprice.org/wp-content/uploads/2016/04/TP-Coffee.pdf

Interagency Working Group on Social Cost of Carbon. (2013). *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis*. U.S. Environmental Protection Agency.

Lasco, R. D., Ogle, S., Raison, J., Louis, V., Wassmann, R., & Yagi, K. (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Voulume 4 Agricutlure, Forestry and Other Land Use). In S. Eggleston, L. Buendia, K. Miwa, T. Ngara, & K. Tanbe (Eds.), *2006 IPCC Guidelines for National Greenhouse Gas Inventories : Volume 4: Agriculture, Forestry and Other Land Use* (Vol. 4, pp. 5.6-5.55). Hayama, Japan: Institute for Global Environmental Strategies (IGES) and The Intergovernmental Panel on Climate Change (IPCC).

Lince Salaza, L., & Castro Quintero, A. (2015). Erosividad de la lluvia en la región cafetera de Quindío, Colombia. *Cenicafé*, 66(1), 25-31.

Mendes Júnior, H., Henrique, A., Reis dos Santos Júnior, W., Silva, M., Santos, B., & Mincato, R. (2018). Water Erosion in Oxisols under Coffee Cultivation. *Revista Brasileira de Ciência do Solo, 42*. doi:10.1590/18069657rbcs20170093

Ministerio de Salud y Protección Social - Republica de Colombia. (2012). I*ndicadores Basicos 2012* (*IBS*). Retrieved from https://www.minsalud.gov.co/Documentos%20y%20Publicaciones/IBS%202012.pdf

Moore, F., & Diaz, D. (2015). Temperature impacts on economic growth warrant stringent mitigation policy. *Nature Climate Change 5,* pp. 127-131.

Panagos, P., Borrelli, P., Meusburger, K., Yu, B., & Kilk, A. (2017). Global rainfall erosivity assessment based on high-temporal resolution rainfall records. *Scientific Reports, 7*. doi:https://doi.org/10.1038/s41598-017-04282-8

Prasannakumar, V., Vijith, H., Abinod, S., & Geetha, N. (2012). Estimation of soil erosion risk within a small mountainous sub-watershed in Kerala, India, using Revised Universal Soil Loss Equation (RUSLE) and geo-information technology. *Geoscience Frontiers*, 209-215. doi:https://doi.org/10.1016/j.gsf.2011.11.003

Ramirez Ortiz, F., Hicapie Gomez, E., Sadeghian, S., & Perez Gomez, U. (2007). Erosividad de las lluvias en la zona cafetera central y occidental del departamento de Caldas. *Cenicafé*, 58(1), 40-52.

Ramirez-Villegas, J., Salazar, M., Jarvis, A., & Navarro-Racines, C. (2012). A way forward on adaptation to climate change in Colombianagriculture: perspectives towards 2050. *Climatic Change*, 611:628. doi:10.1007/s10584-012-0500-y

Ruppenthal, M., Leihner, D., Hilger, T., & Castillo F, J. (1996, January). Rainfall Erosivity and Erodibility of Inceptisols in the Southwest Colombian Andes. *Expiramental Agricutlure*, 32(1), 91-101. doi:10.1017/S0014479700025904

Santamaria, M. C. (2017). *Estrategia de Renovacion de Cafetales 2017*. Retrieved from Ministro de Hacienda y Credito Publico: http://www.minhacienda.gov.co/HomeMinhacienda/ShowProperty;jsessionid=h9PvQkr9xg_kSH9TABC0XCSAO4ijDWThSlUpGlutOIk2-6l0HBzU!529010900?nodeId=%2FOCS%2FP_MHCP_WCC-089821%2F%2FidcPrimaryFile&revision=latestreleased

Steemers, S. (2016). *Coffee Sustainability Catalogue 2016: A collective review of work being done to make coffee sustainable*. Global Coffee Platform, IDH Sustainable Trade Initiative, Speciality Coffee Association of America, and Sustianable Coffee Challenge. Retrieved from https://www.globalcoffeeplatform.org/assets/files/Coffee-Sustainability-Catalogue/Coffee-Sustainability-Catalogue-2016.pdf

True Price, Deloitte, EY, PwC. (2014). *The Business Case for True Pricing. Why you will benefit from measuring, monetizing and improving your impact*. Retrieved from True Price: http://trueprice.org/wp-content/uploads/2015/02/True-Price-Report-The-Business-Case-for-True-Pricing.pdf

US IAWG. (2013). *Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866*. Washington, DC: Interagency Working Group on Social Cost of Carbon, United States Government.

USDA ARS. (2016). *About the Universal Soil Loss Equation*. Retrieved from https://www.ars.usda.gov/midwest-area/west-lafayette-in/national-soil-erosion-research/docs/usle-database/research/

Wage Indicator. (2017, October). *Living Wage Series Colombia October 2017*. Retrieved from Wage Indicator web site: https://wageindicator.org/main/salary/living-wage/colombia-living-wages-2017-country-overview

Wage Indicator. (2018). *Minimum Wages in Colombia*. Retrieved from Wage Indicator web site: https://wageindicator.org/salary/minimum-wage/colombia/

APPENDIX A. TRUE PRICE ANALYSIS

Chapters 1 and 3 introduced the concept of a true price. In this Appendix, we present some of the more technical elements of the methodology.

THE IMPACT PATHWAY

To calculate a true price, it is useful to define an 'impact pathway'. The impact pathway translates inputs to outputs and costs to society.

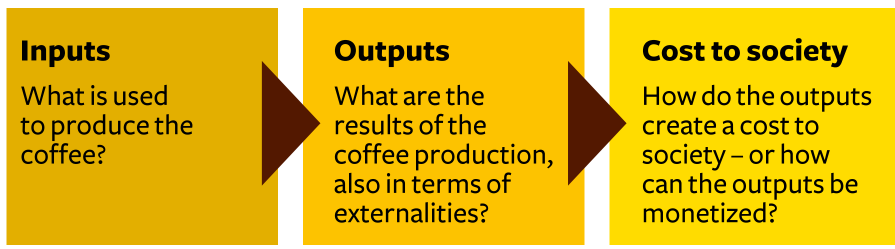

Figure 1: The 'impact pathway' to calculate external costs.

Calculating external costs using the impact pathway follows three steps.

1. Make an inventory of relevant environmental and social data (inputs).
    - Examples of environmental data are energy use per hectare and types and quantities of fertilizers used per hectare.
    - Examples of social data are hourly wage of workers and working hours per week.

2. Measure environmental and social external costs of production (outputs): convert all gathered input data to actual environmental and social footprints.
    - Examples of natural capital are contributions of emitted gases to climate change and contributions to eutrophication. They can, for instance, be expressed in tons of CO_2-equivalent and in kg Nitrogen eutrophication (marine).
    - Examples of social external costs are the number of workers in Full-Time Equivalent (FTE) that are underpaid and the amount by which they are underpaid in dollars per FTE.

3. Calculate the costs of each externality to society. This involves multiplying all environmental and social footprints with their corresponding costs to society. The step is also referred to as *monetizing* the external costs. It is discussed in more detail below.
    - Examples of costs to society to monetize external costs for natural capital are the Social Cost of Carbon or the costs to remediate eutrophication.
    - Underpayment – an example of a social externality – can be monetized by expressing the total gap between the actual salaries and the living wage. Depending on the situation, it might be increased by a penalty.

ENVIRONMENTAL EXTERNAL COSTS

The calculation of costs to society is based, where possible, on acknowledged international standards. In this study, the true price method for monetizing external costs was employed. This uses a combination of damage and abatement cost techniques.

For environmental costs, monetization uses existing approaches. A simple example is the impact of greenhouse gas emissions on society. This is often monetized by multiplying the emissions (in kg CO_2-equivalent) by the Social Cost of Carbon

(SCC, in Dollars per kg CO_2-eq.). The SCC is an estimate of the monetized damages associated with an incremental increase in carbon emissions for a given year.

Recent SCC estimates can be found predominantly in a range from USD 45 to USD 230 per ton of CO_2-equivalent at 2018 price level[23]. This range can be explained by the variation in complexity of calculation models (and included effects on society) and the applied timeframes and discount rates. This study uses a cost of ~USD 130 per ton of CO_2 equivalent which is around the average of the range. This value is given by the Interagency Working Group on Social Cost of Carbon[24] as the 95th percentile of the estimate for 2015 at a 3% discount rate, corrected for inflation (the original value is USD 105).

A similar approach is applied to soil, water and land pollution, as well as to the use of scarce resources (water, energy and materials). For reversible damage, we use remediation costs. If damage is irreversible, a compensation approach is taken.

Land use (or land occupation) refers to the fact that original forests have been cleared to make way for coffee farms. Typically, this has happened a couple of decades ago, but in some regions in Colombia, it is still ongoing. The external costs contain the decline of the ecosystem value, e.g. through biodiversity loss.

An overview of all environmental external costs included in this study and their respective footprint and monetization approach is shown in the below table.

EXTERNAL COST	FOOTPRINT	MONETIZATION
Climate change	GHG emissions (kg CO_2eq/kg parchment coffee)	Restoration cost
Air pollution	Acidifying pollutants emissions (kg SO_2/kg parchment coffee) & Ozone layer depleting emissions (kg CFC11eq/kg parchment coffee)	Remediation cost & damage to ecosystems
Water pollution	Marine eutrophication (kg Neq/kg parchment coffee) & Freshwater eutrophication (kg Peq/kg parchment coffee)	Remediation cost & damage to ecosystems
Soil pollution	Terrestrial ecotoxicity (kg 1,4DBeq/kg parchment coffee)	Remediation cost & damage to ecosystems
Land use and transformation	Land occupation & land conversion (hectares/kg parchment coffee)	Restoration cost & interest on land occupation
Energy use	Energy use (MJ/kg parchment coffee)	Replacement cost
Water use	Water use (m^3/kg parchment coffee)	Replacement cost
Materials use	Scarce material use, e.g. aluminum, copper, etc. (kg/kg parchment coffee)	Market price of relevant materials
Soil degradation	Soil erosion (tons soil lost/hectare); Soil quality (tons C change/kg parchment coffee)	Damage cost of soil lost; Restoration cost

SOCIAL EXTERNAL COSTS

The technique used to value the social costs follows the same logic as environmental costs. Where possible it is based on remediation of the costs and where necessary on compensation. If the social externality involves a breach of a local law or internationally acknowledged standard, a penalty is added.

An overview of the social external costs included in this study and their respective footprint and monetization approach is shown in the below table.

[23] US IAWG, 2013 and Moore & Diaz, (2015).
[24] Interagency Working Group on Social Cost of Carbon, (2013).

EXTERNAL COST	FOOTPRINT	MONETIZATION
Insufficient income	Underearning gap (USD/kg parchment coffee)	Restoration cost & Real interest rate & International penalty floor
Insufficient wages and social security	Underpayment gap (USD/kg parchment coffee)	Restoration cost & Real interest rate & International penalty floor
Occupational health & safety	Non-fatal incidents (incidents/kg parchment coffee); Fatal incidents (incidents/kg parchment coffee)	Restoration cost & Penalty & Prevention cost

Two of the social external costs in this research are underpayment (of hired workers) and underearning (of smallholder entrepreneurs). In both cases, the actual wages or incomes need to be compared to an objective standard: the living wage.

The living wage contains basic expenses that every worker should be able to make to have a decent living, such as food, housing, clothing, transportation, education, healthcare and communication costs. In addition, it contains 5% of unexpected events to account for unforeseen expenses, as well as any applicable taxes.

The living wage is based on a reference or model household. In Cauca, such a household has two and a half children. In line with the national statistics (based on employment rate), an FTE of 1.50 per household is used.

Please note that in this study living wage and living income are used interchangeably. For a more comprehensive description of the living income, see Appendix E.

APPENDIX B. TRUE PRICING IN INVESTMENT ANALYSIS

As already discussed in Section 3.3, the true pricing approach (monetizing external costs) can also be applied to other economic metrics than prices. In investment analysis, the concept of Return-on-Investment (ROI) is central. This focuses traditionally only on flows of financial capital. The true ROI considers in addition the relevant flows of natural and social capital.

This Appendix first reviews the well-known concept of Return-on-Investment, then introduces the true ROI.

RETURN-ON-INVESTMENT

The Return-on-Investment, or ROI, is a key element of investment analysis. The amount of money to be invested is often limited. In that case, the ROI helps to indicate which investments are most 'efficient', i.e., create most value per dollar invested. Traditionally, the ROI is defined as

$$\text{ROI} = \frac{(\text{Total financial gain} - \text{Initial investment})}{\text{Initial investment}}$$

The ROI indicates how many times the costs of an investment can be multiplied. If someone has two investments available, one with an ROI of 5 and one with an ROI of 10, he/she would ideally pursue both investments. However, if he/she has limited money to invest, he/she would start with the investment with she would start with the investment with the ROI of 10: every dollar pays itself back 10 times here.

TRUE ROI

The ROI can be extended to a true ROI by including natural and social externalities:

$$\text{True ROI} = \frac{\left(\text{Total financial, natural and social capital gain} - \text{cost of investment}\right)}{\text{Cost of investment}}$$

The true ROI can be used as a measure of the total impact of an investment. A true ROI larger than zero means that net value is created for society in the form of financial, social or natural capital. If two investments have different true ROIs, then the investment with the largest value has the highest leverage to create value. A single dollar invested, gives the highest output in terms of societal value.

APPENDIX C. SOURCES AND DATA

This study uses both primary and secondary data to calculate the true prices and the elements of the investment analysis. Secondary data is dominant in the assessment of the true price Benchmark, while primary data is dominant in the assessment of the 60 farms supported by member organizations of the Sustainable Trade Platform that implement CSA techniques.

DATA SOURCES (BENCHMARK)

Conventional coffee production in Cauca is based on secondary data such as publications of the National Federation for Coffee Growers of Colombia and Cenicafé, Colombia's national coffee research center.

We used data representing the average of coffee production in Cauca. When no regional averages for Cauca were available, we used averages from the sample of the 60 CSA farms, corrected for the farm size and the yield of the Benchmark, where needed. Secondary data is supplemented by expert opinion, when there is a need.

DATA SOURCES AND DATA COLLECTION (CSA FARMS)

CSA coffee is based on primary data collected on a sample of 60 smallholder farms supported by PCS organizations. Data collection was performed by Solidaridad during June-July 2018 and concerns the year 2017. Primary data is supplemented by expert views.

APPENDIX D. KEY ASSUMPTIONS OF THE TRUE PRICE AND INVESTMENT MODELS

The true price model and the investment model are mainly built upon primary data for CSA farms and secondary data for the Benchmark. These are supplemented by expert opinions, where needed. Several assumptions were used to build the models. The most important ones are listed below.

PART OF ANALYSIS	ASSUMPTION	MOTIVATION
Fertilizer use (true price analysis)	The share of nutrients that leach out or wash away from organic waste, left on the land as fertilizer, is lower than for regular fertilizer (both chemical and organic).	Organic waste left on the coffee plots (e.g. leaves), degrades slowly. Some nutrients leach out and wash away, but to a lesser extent than for external fertilizer, where the nutrients are presented in a form where they can be quickly absorbed. This leads to a limited contribution to soil and water pollution.
Land use (true price analysis Benchmark)	The average age (years since land transformation) of Benchmark farms is >50 years.	This estimate is based on expert opinion.
Land use (true price analysis CSA farms)	A farm age of 60 years is assumed when the average farm age is >50 years.	Land use impacts are considered only when the transformation occurred in the past 20 years.
Social security (true price analysis CSA farms)	Unemployment savings and paid sick leave are deemed necessary for all external workers. Pensions and paid annual leave, however, are here limited to formally contracted workers and, therefore, are not applicable to informal labor.	Since all external labor in the sample of 60 CSA farms is informal, the farmer is assumed to have no responsibility for their pensions and annual leave, as they can cover those themselves, due to being self-employed.
Social security (true price analysis CSA farms)	External workers do not receive employer-paid social security contributions.	All external labor in the sample of 60 CSA farms is informally employed. We assume they only receive direct wages and in-kind benefits, where applicable.
Health & Safety (true price analysis)	A penalty for the lack of insurance for non-fatal and fatal occupational incidents is used only for external labor.	The insurance for family labor is deemed the own responsibility of the farmer.

PART OF ANALYSIS	ASSUMPTION	MOTIVATION
Health & Safety (true price analysis)	It is assumed that all workers have received Health & Safety training when the farm is certified and that none of the workers have received that when the farm is not certified.	It is typical for certified farms to receive a Health & Safety training as part of the requirements they need to fulfil to gain certification.
Health & Safety (true price analysis)	It is assumed that none of the labor in the coffee farms is performed in an unsafe or unhealthy environment.	The work on coffee farms does not happen in an unsafe or unhealthy environment.
Health & Safety (true price analysis)	It is assumed that all certified farms have been audited for Health & Safety and that none of the non-certified farms have been audited.	It is typical for certified farms to be audited as part of the process of being certified.
Subsidies (true price analysis)	Subsidies from the government can contribute to the farmer P&L. Primary data was used for the subsidies for the traditional farms and projections for the renovated and CSA farms. For the benchmark, we used the total number of subsidies given, divided by the total number of farms.	This is the most direct effect to calculate the average number of subsidies in each of the samples. Note that the benchmark includes farms that do not receive any subsidies.
Working hours (true price analysis)	Both family and external laborers are assumed to work 5 days per week and 8 hours per day.	The 5-day working week is common in the coffee sector in Colombia and was validated by expert opinion. For the calculation of the hours in an FTE in a year a 6-day working week is considered, as this is the legal maximum as per article 161 of the Labor Code.
Farmer income (true price analysis CSA farms & Benchmark)	Farmers working less than 1 FTE on coffee cultivation may have other sources of income. Work paying 120% of the minimum wage is assumed for 50% of the additional hours. This assumption should be refined with primary data or expert opinion.	The philosophy of true pricing dictates that smallholder farmers should earn a living income. If they work less than full-time on coffee production, other sources of income can also be used to make the living income. The analysis uses data on other sources of income when available, as well as an estimate for income that can be generated when working outside of the farm.
Farmer income (true price analysis Benchmark)	It is assumed that the amount of coffee that Benchmark farms sell in the local market is zero.	This amount was negligible in the sample of CSA farms and no complete data exist on the amount sold in the local market versus the amount exported.
Timeframe of GAPs implementation (investment analysis)	The implementation of GAPs for the transition from conventional to CSA coffee farming can be spread over years. We do not include, however, a specific timeframe in the analysis, as the timeframe in which this happened is not known. With this assumption, we effectively assume that the period is one year.	One year is a typical timeframe used in investment analysis.
Costs of GAPs (investment analysis)	The costs of all GAPs are considered as costs per year. GAP 16 involves costs for renovating the coffee plots, which includes the costs for one planting cycle and two pruning cycles, each one considered to be done in intervals of seven years. Therefore, the costs are included as average costs per year by dividing each by seven years.	Renovation is implemented at a part of the farm and it typically consists of one planting and two pruning cycles. Since we did not have exact data on the parts of each farm that were renovated, a timeframe of seven years for each cycle is considered to calculate an average cost per hectare.

APPENDIX E. THE LIVING INCOME IN RURAL COLOMBIA

Two key social external costs are underpayment (of hired workers) and underearning (of smallholder entrepreneurs). These are determined by comparing actual income to a living income. A living income is defined as an income that provides a decent living to an average household. A living wage is a specific type of living income that applies specifically to people working as employees. The living wage for a given country can be different from the living income if, for example, taxation (income tax for the living wage and profit tax for the living income) or social security arrangements are different for subordinate employment as opposed to self-employment. In this study the living wage and the living income are the same and both concepts are used interchangeably.

The living income is based on international standards on what constitutes a decent living. The living income for rural Cauca was calculated using a combination of True Price's method, that is an integral part of the true pricing methodology, and the living wage method of Anker & Anker (2017)[25]. See the same manual for an in-depth discussion of the concept of living wage.

The method of this study enables determination of a living income based on a combination of primary data and national statistics, upon availability. Relevant data points could be used from Wage Indicator and national statistics from the latest household expenditure survey (ENIG 2006-2007). Data for Cauca or for rural Colombia are used, based on available data.

The living wage method consists of three basic steps. Firstly, a reference household size and the number of FTE (Full-Time Equivalent) per household are calculated. The total living income is calculated per household. The household size is based on the average number of two and a half children per couple. In addition, elderly parents are included, which on average contributes to 0.25 elderly people. For hired labor, the living income is calculated per FTE, based on the average number of persons per household that are part of the labor force in a country. An FTE is determined by the total working hours per year if a person would work all days and weeks in a year, minus the weekend days and public and paid holidays specified by law. Based on that, an FTE of 1.50 is calculated.

REFERENCE FAMILY SIZE AND FTE	UNIT	VALUE
Adults per household	# people	2
Children per household	# people	2.50
Retirees	# people	0.25
Reference family size	# people	4.75
FTE (full-Time equivalent)	FTE/household	1.50

Secondly, the basic living basket that is calculated includes basic living costs: food, housing, clothing, transportation, healthcare, education, communication, recreation services and culture, restaurants and hotels, miscellaneous goods and services, and a 5% for unexpected events.

Thirdly, the gross living income is calculated by adding social security (retirement insurance, unemployment insurance and sick leave insurance) and taxes. We use tax rates for income tax, as entrepreneurs can pay themselves income instead of profit. The lowest income tax bracket of 0% is above the living income, which results in an income tax of 0. The resulting living wage is ~USD 6,160 per household or ~USD 4,100 per FTE. This is higher than the minimum wage of ~USD 3,340[26].

[25] R. Anker & M. Anker, (2017).
[26] The minimum wage is based on the legal monthly minimum wage for the year 2017, plus a monthly transport allowance of COP 83,140.

LIVING INCOME	UNIT	COP	USD
Food	household/month	520,000	180
Housing	household/month	190,000	60
Clothing	household/month	75,000	30
Transportation	household/month	87,000	30
Health care	household/month	36,000	10
Education	household/month	24,000	10
Communication	household/month	36,000	10
Recreation services and culture	household/month	42,000	10
Restaurants and hotels	household/month	131,000	40
Miscellaneus goods and services	household/month	95,000	30
Net living baskets	household/month	1,236,000	420
Unexpected events (5%)	household/month	62,000	20
Total living basket	household/month	1,300,000	440
Total living basket	household/year	15,600,000	5,290
Retirement insurance	household/year	810,000	270
Living wage with pension	household/year	16,410,000	5,560
Unemployment insurance	household/year	1,430,000	480
Sick leave insurance	household/year	350,000	120
Living wage with insurance and pension	household/year	18,190,000	6,160
Income tax	household/year	-	-
Living wage with insurance and pension, incl.tax	household/year	18,190,000	6,160
Total pension contribution to household	household/year	-	-
Gross living wage per household	household/year	18,190,000	6,160
Gross living wage per FTE	FTE/year	12.100.000	4,100

The method in this study differs from Anker & Anker with respect to the social security needs of individuals. While Anker & Anker calculate the number of social security expenses based on the social security tax paid to the state by employees, here the actual future income needs in case of retirement, unemployment and sickness are estimated, such that these needs will also be covered in the living income of self-employed people. All numbers are expressed at the price level of the year 2017 and are rounded.

The table below provides a detailed explanation of how each living income element is calculated.

Food	Food basket is based on a model diet of 2,100 kcal per day.
Housing	Housing costs are based on costs for an average urban area, adjusted using the ratio for rural/urban housing expenditure from national expenditure data.
Clothing	Clothing costs are based on national rural expenditure data.
Transportation	Transportation costs are based on national rural expenditure data.
Healthcare	Healthcare costs are based on national rural expenditure data.
Education	Education costs are based on national rural expenditure.
Communication	Communication costs are based on national rural expenditure data.
Recreation services and culture	Recreation services and culture costs are based on national rural expenditure data. The category is included in line with the Anker method.
Restaurants and hotels	Restaurants and hotels costs are based on national rural expenditure data. The category is included in line with the Anker method.
Miscellaneous goods and services	Miscellaneous goods and services costs are based on national rural expenditure data. The category is included in line with the Anker method.
Unexpected events	Unexpected events consist of 5% of the basic living basket.
Retirement insurance	The retirement insurance is based on, amongst others, the living income, the number of years worked, the number of pension years, and the number of adults per household.
Unemployment insurance	The unemployment insurance is based on labor insecurity, unemployment duration, and required living wage.
Sick leave insurance	The sick leave insurance is based on average number of sick days per year and the required living income including pension.
Pension contribution	The income from pensions is based on number of pension-receiving retirees per household and the amount of state-guaranteed pension.

APPENDIX F. GOOD AGRICULTURAL PRACTICES (GAPs)

In the investment analysis of Chapter 5, we analyzed the financial, environmental and social return of sixteen Good Agricultural Practices (GAPs) implemented by the sample of 60 farms in Cauca. The list of practices draws on the standards of Rainforest Alliance, Fairtrade Labelling Organizations, and UTZ Certified. The selection of the relevant practices was done by Solidaridad and True Price and was based, among others, on the relevance of the practices for the Colombian coffee sector and on the inclusion of a variety of topics, such as waste management, soil management, pest control, etc. The selected practices are primarily environmental, while three of them concern social topics, such as wages and occupational health & safety. An overview of the GAPs can be seen in the below table.

Practice 1	Farmer does not use pesticides as listed on the Banned Pesticides List.
Practice 2	Farmer uses organic fertilizers (and by-products available at farm level) [and only uses inorganic fertilizer when nutrients are still lacking;].
Practice 3	Farmer has implemented practices to optimize green vegetation on the land (in order to reduce erosion and improve the land's fertility, structure and the soil's organic matter as well as minimize the use of herbicides).
Practice 4	Farmer pays hired workers at least the applicable minimum wage.
Practice 5	All workers who handle pesticides use personal protective equipment (PPE) and protective clothing that is prescribed for the pesticide used and its method of application.
Practice 6	All workers have access to safe drinking water.
Practice 7	Farmer has implemented measures to reduce energy use (e.g. buying new equipment that uses less energy).
Practice 8	Farmer has implemented a pest management program (to control pests) which prioritizes the use of physical, mechanical, cultural and biological controls as opposed to the use of agro-chemicals.

Practice 9	Farmer does not burn waste in the open. The farmer is allowed to burn waste in an incinerator designed for this purpose if the farmer has the appropriate documentation for using this incinerator and if the farmer uses the incinerator as instructed by the user manual.
Practice 10	Farmer stores waste and disposes waste only in designated areas (the use of dumps is prohibited).
Practice 11	Farmer stores obsolete pesticides securely (in a way that leakage is prevented) or disposes obsolete pesticides in a manner that minimizes exposure to humans, the environment, and food products.
Practice 12	Waste water from coffee processing has a physical treatment before reaching a river or adjoining gorges.
Practice 13	When agrochemical products (fertilizers and pesticides) are applied, a minimum distance of 5 meters from water sources is kept.
Practice 14	No deforestation or degradation of the primary forest has happened in the last 5 years.
Practice 15	No mattock or other tools that remove soil are used to weed the coffee plantation.
Practice 16	The coffee furrows are placed opposite of the direction of the slope (for example, sowing in a triangle or in double furrows).

THE TRUE PRICE OF CLIMATE-SMART COFFEE

Quantifying the potential impact of Climate-Smart Agriculture for Colombian coffee

www.facebook.com/solidaridadnetwork

twitter.com/solidaridadnetw

www.linkedin.com/company/solidaridad

CHANGE THAT MATTERS

Solidaridad

True Price™