Supporting Smallholder Farmers for a Sustainable Cocoa Sector:

Exploring the Motivations and Role of Farmers in the Effective Implementation of Supply Chain Sustainability in Ghana and Côte d'Ivoire

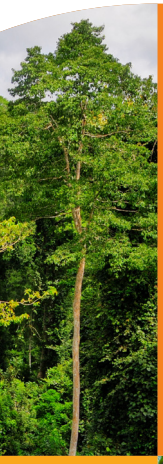

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Photo of a tropical forest in Kakum National Park, a 375 square km national park located in the central region of Ghana.

Cocoa in West Africa is primarily produced by 1.8 to 2 million smallholder farmers. Low income and poverty make farmers more vulnerable and limit their ability to invest in sustainable agricultural practices. Cocoa smallholders suffer from low productivity due to poor land management, aging and diseased trees, and progressing climate change impacts. The exposure to shocks triggered by extreme weather events, pests, and/or crop disease, as well as the implication that those shocks have for household income, may exacerbate farmers' risk aversion.

In addition, cocoa production is one of the main drivers of forest loss in West Africa. The remaining forests face mounting pressure as cocoa farmers seek better livelihoods under increasingly challenging conditions. Unsustainable practices may lead farmers to quickly deplete the nutrients in their land, or they may be pushed out of unproductive or unsuitable areas due to the Cocoa Swollen Shoot Virus Disease (CSSVD) and climate change. In parallel, many farmers aim to secure land titles on unclaimed forest land or seek to expand their growing areas to boost production.

Companies have leverage over the implementation of agricultural practices in cocoa production. A relatively small number of companies control a significant portion of the cocoa market. As smallholders generally lack resources to comply with sustainable supply chain standards set by the industry, companies have set up programs that offer training, inputs, or access to credit for farmers to secure supplies of cocoa beans that meet their standards and policy requirements.

The research undertaken in this study seeks to contribute to the effectiveness of company programs in the cocoa sector in Côte d'Ivoire and Ghana through the identification of factors that shift farmer behavior.

From December 2019 to March 2020, we conducted 432 farmer surveys in Côte d'Ivoire (San Pedro and Nava regions) and Ghana (Western North and Central regions). **Our findings show that:**

- The attendance of trainings, land ownership, and different forms of farmer support such as access to credit and agricultural inputs, together with ensuring the implementation of Good Agricultural Practices (GAP), represent main determinants towards improving cocoa farming productivity.
- Younger farmers are more likely to engage in new practices. Although older farmers attend more GAP trainings in Cote d'Ivoire, younger farmers are actually more likely to implement learned skills.

- In our Ghana sample, the barriers female farmers face exert a negative impact on their production. Female farmers reported acquiring their inputs in stores and raising their own seedlings, whereas many male farmers received access to government support and reported being provided such inputs directly by the government and NGOs – even within the same association. This confirms findings of other studies that being male, participating in a cooperative, and having access to extension services correlates with uptake of sustainable activities. Additionally, being a female farmer means a decreased likelihood of receiving resources from the government, including extension and access to credit.
- Most farmers cannot afford to invest in new practices or the inputs that are needed for improving their farm productivity. Farmers with access to credit – and farmers who actually borrow – present overall higher productivity (income per hectare). Farmers with access to credit can also diversify their income, which alleviates the seasonality aspect of cocoa farming and the vulnerable periods of time after replanting.
- Formal land ownership in our sampled farming communities in Ghana was found to increase cocoa income per hectare by 21.9 percent on average. Attendance in GAP trainings increased cocoa income per hectare in Côte d'Ivoire by 33.3 percent. In Ghana, support from companies, NGOs, and the government was found to increase productivity (from companies by 13.3 percent, NGOs by 15.4 percent, and government by 16.1 percent), in relation to farmers without support.
- In both Ghana and Côte d'Ivoire, lack of tenure security and right of ownership of trees in cocoa farms may explain the reluctance to invest in agroforestry practices. Historically, farmers have opted for full-sun cocoa farms that mature faster and present options for faster returns on investment instead of agroforestry systems. While providing optimal shade in a cocoa farm by planting non-cocoa trees can provide sustainable yields and improve farm resilience, in Ghana, farmers lacked incentives to invest in timber trees, given that the state retains ownership of non-cocoa trees.
- Migrants have less or no access to land titles, which can further contribute to deforestation. We observe in our Ghana sample that native farmers show higher productivity rates than non-native fatmers. In Côte d'Ivoire, it is impossible for migrants to own land. Instead, clearing forests within Fôrets Classées (protected areas) may be a way to "claim" land, according to a public institution in Côte d'Ivoire that we interviewed.

Our survey data hints that, in the absence of larger scale solutions, the relationship between cocoa farming and deforestation may continue to be a troublesome one. Most farmers in Ghana (80.2%) and Côte d'Ivoire (69.8%) disclose farm expansion as their top investment priority. This highlights the need and urgency to engage with cocoa communities in farm rehabilitation and replanting as a strategy to improve productivity and income instead of expanding into the remaining forestlands.

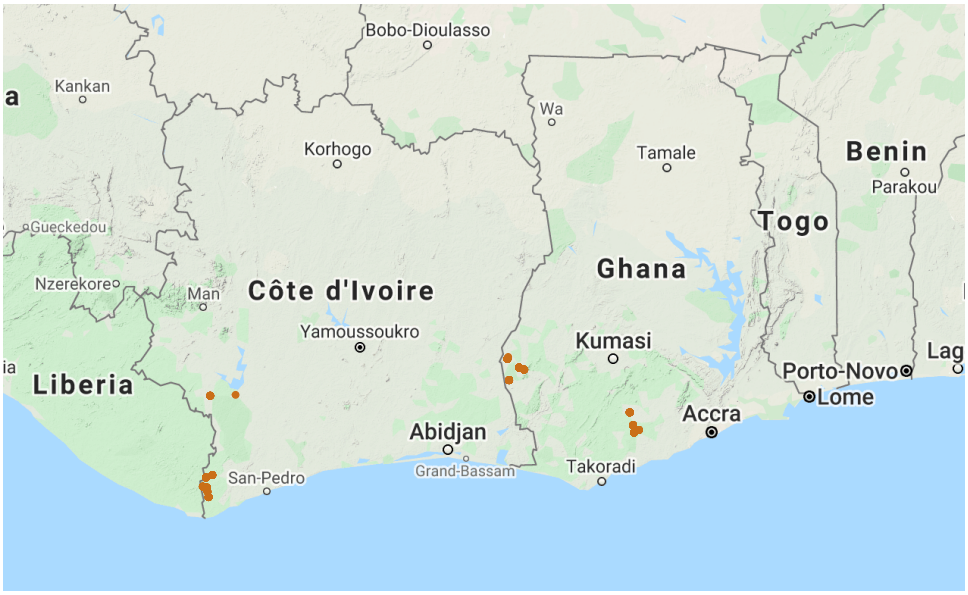
Overcoming the different challenges faced by farmers will require a sustained and comprehensive effort. For smallholders to transition towards climate and forest-friendly practices, not only are finance and inputs (e.g., planting materials, fertilizers) required, but so are knowledge of new agricultural techniques and farm management skills. Land tenure, GAP trainings (which also engage younger farmers), farmer support, and access to credit represent the main levers that policy and implementation programs should holistically target in order to improve farmers' livelihoods and address the sustainability of farming landscapes.

Our findings also illustrate that there are important differences – farm-level and structural – between farmers in the factors that influence their decisions. Support programs require a comprehensive and adaptable strategy that can be tailored to address the barriers for some farmers and the opportunities for others.

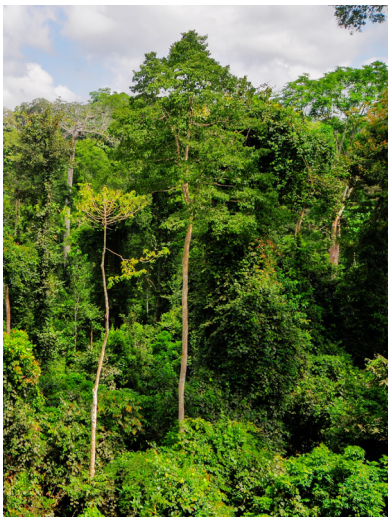
In parallel, efforts are needed to address root causes of land degradation and deforestation, such as the CSSVD, poverty, and climate change. The persistence of the CSSVD remains a problematic issue, despite efforts from the governments of Ghana and Côte d'Ivoire to eradicate the disease. Increasing the price of cocoa and/or of premium payments are also important tools towards improving the livelihoods of farmers. This is because farmers receive just six percent of the retail value of cocoa that is sold and have no influence over its price, which is set by the government. However, increasing the amount farmers are paid for cocoa also requires strong institutions, a supportive enabling environment, and appropriate policies to avoid unintended outcomes, such as incentivizing the expansion cocoa.

The results derived from this study call for the scaling and strengthening of collaborative actions by public and private actors to provide smallholders with integrated support. In particular, this research highlights the opportunities to target company support activities to reflect local implementation barriers; increase efforts to support marginalized (e.g., women, migrants) and younger farmers; and engage in a concerted effort to raise farmer income and mobilize an investment package in support of farm rehabilitation.

Map of interview regions – study sites incidcated in orange



1. Introduction



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1.1 Problem

Cocoa production is one of the most significant drivers of forest loss in West Africa.[1] Côte d'Ivoire's forest cover declined by more than half from 1990 to 2015. Up to 38 percent of this loss is attributed to cocoa cultivation.[2] Similarly, Ghana has been losing forests at a rate of 2 percent per year for decades, in large part to cocoa cultivation.[3] Ghana and Côte d'Ivoire experienced the highest percent rise in primary forest loss of any tropical country between 2017 and 2018 (60 percent and 26 percent, respectively).[4] The remaining forests face mounting pressure as cocoa farmers seek better livelihoods under increasingly challenging conditions. Unsustainable practices may lead farmers to quickly deplete the nutrients in their land, or they may be pushed out of unproductive or unsuitable areas due to the Cocoa Swollen Shoot Virus Disease (CSSVD) and climate change. At the same time, many farmers aim to secure land titles on unclaimed forest land or seek to expand their growing areas to boost production.[5]

More than 90 percent of cocoa in West Africa is produced by 1.8 to 2 million smallholder farmers.[6] Cocoa prices are set by the governments of Ghana and Côte d'Ivoire, and farmer incomes in these countries are lower than incomes in unregulated markets such as Indonesia, Nigeria, or Cameroon.[7] Low incomes and poverty make farmers vulnerable and limit their ability to invest in sustainable agricultural practices. Cocoa smallholders suffer from low productivity due to poor land management, aging and diseased trees, and climate change.[8] The exposure to shocks triggered by extreme weather events, pests, or crop disease, as well as the implications that those shocks have for household income, naturally make farmers risk averse.

Cocoa companies have started to adopt policies to reduce the forest-impact of their operations and supply chains. Many cocoa supply chain companies have adopted supply chain sustainability initiatives (SSIs)[9] in an attempt to address deforestation concerns, promote restoration, and improve productivity and farmer livelihoods (BOX 1).[10] To implement these initiatives, they rely on a mix of certification and company-specific programs (e.g., Rainforest Alliance and Mondelēz's Cocoa Life, respectively). In 2017, these efforts were brought together

1. Wessel, M., & Quist-Wessel, P. M. F. (2015). Cocoa production in West Africa, a review and analysis of recent developments. NJAS - Wageningen Journal of Life Sciences, 74–75, 1–7. http://www.sciencedirect.com/science/article/pii/S1573521415000160.; Ordway, E. M., Asner, G. P., & Lambin, E. F. (2017). Deforestation risk due to commodity crop expansion in sub-Saharan Africa. Environmental Research Letters, 12(4), 044015. https://doi.org/10.1088%2F1748-9326%2Faa6509.
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3. Fountain, A., & Hütz-Adams, F. (2018). Cocoa Barometer 2018. Retrieved May 4, 2020, from https://www.voicenetwork.eu/wp-content/uploads/2019/07/2018-Cocoa-Barometer.pdf.
4. Weisse, M., & Dow Goldman, E. (2019). It is important to note that not all of that deforestation is driven by cocoa. A significant percentage can be attributed to timber extraction, illegal gold mining, among others.
5. Kroeger, A., Koenig, S., Thomson, A., Streck, C. 2017. Forest- and Climate-Smart Cocoa in Côte d'Ivoire and Ghana, Aligning Stakeholders to Support Smallholders in Deforestation-Free Cocoa. World Bank, Washington, DC.
6. Wessel, M., & Quist-Wessel, P. M. F. (2015a).
7. Oomes, N., Tieben, B., Laven, A., Ammerlaan, T., Appelman, R., Biesenbeek, C., et al. (2016a). *Market Concentration and Price Formation in the Global Cocoa Value Chain*.
8. Kroeger et al. (2017).
9. World Bank. 2017. *Eliminating Deforestation from the Cocoa Supply Chain (English)*. Washington, D.C.: World Bank Group.
10. Ibid.

through the establishment of the Cocoa and Forests Initiative (CFI). The CFI is a partnership among the governments of Ghana and Côte d'Ivoire and dozens of cocoa, chocolate, and retail companies with the shared goals of eliminating deforestation in cocoa supply chains, protecting and restoring forests across the West African cocoa belt, and improving the livelihoods of millions of smallholder cocoa farmers.[11]

The extent to which SSIs are effective at shifting smallholder behavior and achieving conservation outcomes is difficult to assess. The effectiveness of SSIs to contribute to behavior change depends on the success of addressing key implementation and behavioral change barriers. Cocoa SSIs are successful if they formulate and provide incentives that support smallholders' capacities to implement and overcome barriers to the adoption of sustainable (zero-deforestation) agricultural practices. However, individual company SSIs cannot address structural barriers, which have to be addressed in cooperation with governments (such as through umbrella initiatives like the CFI). An understanding of farmer contexts and motivations can help scale up interventions and reach farmers who are currently not receiving support. Expanding the reach and effectiveness of these efforts is essential to create long-term sustainable livelihoods for farmers, protect remaining forests, and increase system resilience and forest cover by engaging smallholders in reforestation and agroforestry.

BOX 1

Defining supply chain sustainability initiatives

For the purpose of this report, we define supply chain sustainability initiatives (SSIs) as voluntary company efforts to eliminate environmentally detrimental practices from their supply chains. Such SSIs can take the form of aspirational goals, company pledges, codes of conduct, or sectoral standards. They can involve one or several companies and may be coordinated with NGOs (as with the Soy Moratorium in the Brazilian Amazon) or governments (as with the CFI). SSIs differ based on the adopting company's or companies' supply chain position. Upstream traders and producers can work directly with farmers or manage farms themselves to implement sustainable practices. Downstream manufacturers and retailers, on the other hand, have to work via their suppliers and tend to rely on positive and negative incentives to influence how the product in question is sourced or produced. In this report, we focus on SSIs that directly target smallholder farmers' behavior, enabling and encouraging farmers to change their production practices to eliminate deforestation and create more sustainable and productive cocoa systems. These SSIs may be incentive-based programs that involve NGO- or third party-led certification as well as roundtable or government certification. On the other hand, bans and exclusions fall under sanction-based sectoral standards. In both cases, companies have to trace their supply to the farm level (e.g., via remote sensing). Collaborative or jurisdictional (public-private) approaches are increasingly being piloted as a way to implement SSIs as they cut across landscapes and tend to be defined by policy-relevant boundaries.

11. World Cocoa Foundation. (2019). Cocoa and Forests Initiative.

1.2 Objectives

The overarching goal of this study is to contribute to the effectiveness of company SSIs in the cocoa sector in Côte d'Ivoire and Ghana through the identification of factors that motivate farmers to shift their behaviors.

Specifically, we aim to:

- Assess the enabling factors and barriers to the effective implementation of corporate programs in the smallholder cocoa system of Côte d'Ivoire and Ghana;
- Identify and validate links between SSIs and smallholder adoption of and compliance with sustainable practices;
- Understand the key elements that contribute to an increase or decrease in farm productivity through the quantitative assessment of survey data;
- And develop, based on the previous points, recommendations to strengthen SSI implementation.

1.3 Structure of the report

The remainder of the report is structured in the following way.
Chapter 2 presents background on the cocoa sector, deforestation trends, and sustainability initiatives in Ghana and Côte d'Ivoire. Chapter 3 provides overarching methodology which guides our research, primarily consisting of a qualitative assessment of SSIs and farmer decision-making, a field survey with cocoa farmers, and stakeholder interviews. Chapter 4 summarizes the findings of our literature review. Chapter 5 presents the findings of our survey. We discuss the findings in Chapter 6, and place the results of our field work in the context of the literature and perspectives from stakeholders. Chapter 7 concludes the report with recommendations on how SSIs can be strengthened and more effective, taking into account the results of this study.

2. Background

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2.1 The cocoa sector in West Africa

Côte d'Ivoire and Ghana account for the large majority of world cocoa production, primarily arising from the work of an estimated 2 million smallholders.[12] Côte d'Ivoire is the world's largest cocoa producer with a 56 percent market share, followed by Ghana with a share of apprximately 26 percent.[13] In both countries, cocoa contributes significantly to the economies and provides livelihoods for about a quarter of the population.

The global cocoa supply chain – and therefore the West African supply chain – is characterized by a high concentration of market power at the processor and manufacturer level. A handful of large multinational companies control a sizable share of processing and manufacturing.[14] Barry Callebaut, Cargill, and Olam process 60 percent of the world's cocoa, and Mars, Nestlé, Mondelēz, Hershey's, Ferrero, and Lindt account for 40 percent of the global consumer chocolate market.[15]

Many cocoa farmers in West Africa live in extreme poverty. Farmers receive just six percent of the retail value of cocoa that is sold and have no influence over the price of cocoa. In both countries, the prices of cocoa beans at the farm gate – which is significantly lower than global market price – are set by national cocoa boards in response to futures markets (BOX 2).[16] In Ghana, farmers earn a per capita daily income from cocoa of about USD 0.40 to 0.45, which accounts for approximately two-thirds of the average farmers' household income.[17] This aligns with estimates of USD 0.78 per day for total farmers' household income in Côte d'Ivoire.[18] The Fairtrade Organization has calculated that a USD 2.51 per day 'living income' would be necessary to enable farmers to meet their household needs.[19] Because cocoa farming is seasonal, incomes are not consistent throughout the year, and cocoa farming families experience heightened economic vulnerability and deepened poverty during off-seasons.[20] Most farmer communities also lack basic infrastructure like roads, schools, healthcare, and farmer organizations, which further exacerbates their vulnerability.

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13. ICCO Quarterly Bulletin of Cocoa Statistics, Vol. XLV, No.3, Cocoa year 2018/19 (International Cocoa Organization). At https://www.icco.org/about-us/icco-news/408-may-2019-quarterly-bulletin-of-cocoa-statistics.html
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18. Fountain, A., & Hütz-Adams, F. (2018).
19. Ibid.
20. Barrientos, S.W & Asenso Akyere, K. (2012). Mapping sustainable production in Ghanaian cocoa, Report to Cadbury. Institute of Development Studies & University of Ghana.

BOX 2

Cocoa pricing in Ghana and Côte d'Ivoire

In both Ghana and Côte d'Ivoire, the price the farmer receives (the "farm gate" price) is set by the cocoa marketing authority. In Ghana, the Producer Price Review Committee sets the annual Farm Gate price for cocoa at the beginning of the cocoa season in October.[21] It is typically 70 to 80 percent of the Net Free-On-Board price.[22] In 2019, the farm gate price was set at 8,000 Ghana Cedi (USD 1,523.81) per ton of cocoa beans.[23] In Côte d'Ivoire, the Conseil du Café-Cacao (CCC) fixes the farm gate price at 60 percent of the value that the CCC has been able to make in pre-sales. The farm gate price in 2019 was raised by 10 percent to 825,000 CFA francs (USD 1,370) per ton.[24] Both countries have a stabilization fund which collects revenues when world cocoa prices increase and compensates for when prices decrease. However, the efficacy of this fund in ensuring stable revenues for farmers is unclear. Estimates suggest that farmers in Ghana and Côte d'Ivoire receive 20 to 25 percent lower farm gate prices than in countries with unregulated cocoa prices, such as Cameroon.[25]

Fluctuating cocoa prices hurt cocoa farmers.[26] When cocoa prices fall globally, large value chain cocoa companies generally see an increase in their profit margins, even if only temporarily, as their costs of production are reduced. Farmers and governments, in contrast, see an immediate decrease in income. Because most cocoa farmers are highly dependent on cocoa income and are price-takers, they do not have the bargaining power to influence cocoa prices, nor do they have access to safety nets like credit and savings in the event of low prices or yields.

Governments and the cocoa industry recognize that achieving sustainability means addressing structural poverty.[27] A number of sector reforms and private sector commitments have occurred in recent years to resolve the price insecurity of farmers. Notably, the governments of Ghana and Côte d'Ivoire agreed to sell cocoa with a price premium (a "living income differential") of USD 400 per ton,[28] while some companies have included livelihoods targets (such as eliminating structural poverty in their cocoa supply) in their sustainability programs.[29] The Cocoa Barometer Consortium has even called for a minimum farm gate price of at least USD 3,000 per ton.[30] However, these measures are in their early stages and their effectiveness remains to be seen.

Poverty discourages smallholders from adopting new and sustainable practices.[31] While structural adjustments and trade liberalization brought improved income for some cocoa farmers in Ghana at the end of the last century, large-scale

21. Steijn, C. P. A. (2016). Towards sustainable cocoa production: a mixed method assessment of the influence of local governance modes on the farm level impact of private cocoa certification standards in Ghana
22. The Free-On-Board price is estimated based on the world cocoa price, the projected crop size and the projected exchange rate between the Ghana Cedi and the United States Dollar.
23. Myers, A. (2019). Ghana, Côte d'Ivoire set to raise cocoa farmgate price in October. confectionerynews.com. Retrieved May 4, 2020, from https://www.confectionerynews.com/Article/2019/08/07/Ghana-Cote-d-Ivoire-set-to-raise-cocoa-farmgate-price-in-October.
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30. Fountain, A.C. and Hütz-Adams, F. (2019): Necessary Farm Gate Prices for a Living Income. Published by the Cocoa Barometer Consortium, administered by the VOICE Network.
31. Bymolt, R., Laven, A., & Tyszler, M. (2018b). *Demystifying the cocoa sector in Ghana and Côte d'Ivoire: Chapter 12: Household income, poverty, and wealth*. https://www.kit.nl/wp-content/uploads/2018/11/Demystifying-cocoa-sector-chapter9-cocoa-producer-groups-certification-training-and-credit.pdf.; Aidenvironment, NewForesight, & IIED (2015).

farmers have taken the lion's share of the gains.[32] In Côte d'Ivoire, a liberalization of the market led to an increase in profits among food traders and supply chain companies, while cocoa farmers saw their incomes decline over the last decades, often below the poverty line.[33] After paying for labor and inputs, farmers usually decide to spend the little profit they have left on household needs or paying off debts. This makes planning and saving for future seasons difficult and severely limits farmers' ability to cover the upfront costs of adopting new practices, including the forgone revenue associated with waiting for the maturity of newly planted trees.[34]

2.2 Forests, climate, and cocoa production

Ghana and Côte d'Ivoire have experienced a rapid increase in cocoa production at the expense of the environment. Cocoa is a forest-based crop that benefits from the nutrients and microenvironment that forests offer; cocoa production has always shifted to take advantage of virgin forests.[35] As a "pioneer crop," cocoa is planted after clearing a forest. Instead of investing in replanting aging plantations, farmers have often migrated to establish new cocoa farms.[36]

A push for full-sun cocoa may have led to some deforestation. For many years, farmers opted for full-sun varieties of cocoa that led to significant cocoa yield enhancements in the short term. This led farmers to remove shade trees and establish monoculture plantations or farms.[37] The short-term benefits of full-sun systems are many: they offer higher productivity and commensurate higher income while requiring less land than shade-grown systems. However, full-sun monoculture cocoa systems deplete forest soil fertility and become unproductive without proper management.

The Government of Ghana supported the productivity of cocoa farms by spraying pesticides, with mixed results.[38] In "The Cocoa Disease and Pest Control Project," initiated in 2001, the government applied insecticides and fungicides to cocoa farms across the country. This led to a boost in productivity, but also to a physical and chemical deterioration of farm soils, eutrophication, ozone layer depletion, and freshwater and terrestrial eco-toxicity.[39]

32. Toulmin, C., & Guèye, B. (2005). Is There a Future for Family Farming in West Africa? IDS Bulletin, 36(2), 23–29.; Kolavalli, S., & Vigneri, M. (2017). *The Cocoa Coast: The Board-Managed Cocoa Sector in Ghana*.
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35. Kolavalli, S., & Vigneri, M. (2017).
36. Ruf, F., Schroth, G., & Doffangui, K. (2015). Climate change, cocoa migrations and deforestation in West Africa: What does the past tell us about the future? *Sustainability Science, 10*(1), 101–111.
37. Clough, Y., Faust, H., & Tscharntke, T. (2009). Cacao boom and bust: sustainability of agroforests and opportunities for biodiversity conservation. Conservation letters, 2(5), 197-205.; Ruf, F., Schroth, G., & Doffangui, K. (2015). Climate change, cocoa migrations and deforestation in West Africa: What does the past tell us about the future? *Sustainability Science, 10*, 101–111.; Wessel, M., & Quist-Wessel, P. M. F. (2015). Cocoa production in West Africa, a review and analysis of recent developments. *NJAS - Wageningen Journal of Life Sciences*, 74–75, 1–7.
38. McKinley, J., Nalley, L., Asare, R., Dixon, B., Popp, J., & D'Haese, M. (2016). Managing Risk in Cocoa Production: Assessing the Potential of Climate-Smart Crop Insurance in Ghana. *Journal of International Agricultural Trade and Development, 10*.
39. McKinley, J. et al. (2016).

The persisting prevalence of cocoa swollen shoot virus disease (CSSVD) has been argued to be a consequence of deforestation and its associated disruption of climatic conditions.[40] Severe strains of CSSVD can lead to anywhere from 15 to 50 percent losses of cocoa yield.[41] Both Ghana and Côte d'Ivoire have been significantly impacted by the virus. There is currently no "cure" for CCSVD. Cutting and replanting infected trees is the only effective way of treating the virus.[42] Agroforestry systems can help mitigate the virus until diseased trees are replaced with more resistant varieties because stressful growing conditions like full sun and low soil moisture may increase the severity of CCSVD infections.

As a result, over 90 percent of West Africa's natural forests and surrounding ecosystems have been destroyed, risking ecological collapse.[43] An estimated six million hectares of forest in the region have been lost to cocoa production alone.[44] This loss was not all inevitable: the wide-scale adoption of intensified cocoa systems mixed with agroforestry across Côte d'Ivoire, Ghana, Nigeria, and Cameroon could have spared 2.1 million hectares of forests between 1988 and 2007, according to one estimate.[45] Apart from agroforestry, others propose combining highly-productive full-sun cocoa systems with stricter enforcement of protected areas to conserve remaining forests.[46]

Deforestation, disease, and climate change interplay in a negative feedback loop that continues to push farmers to expand into new areas. With current trends, the majority of cocoa farmers will face climate change-related issues in the near future. Rising temperatures during the dry season and seasonal droughts will further increase the prevalence of pests and diseases (e.g., CCSVD), lower bean quality, heighten the risk of fires, and cause a shift in suitable areas for cocoa production.[47] Deforestation for cocoa production also contributes to the degradation and desertification of land. These worsening environmental conditions, combined with weak land titles and a scarcity of land, may motivate farmers to migrate to the last existing pristine forest reserves.[48]

2.3 Cocoa sustainability initiatives

Many multinational cocoa companies are planning or already implementing supply chain sustainability initiatives with forest-related targets. Voluntary sector-wide sustainability efforts by governments and companies are the primary channel through which these actors engage with cocoa smallholders in Ghana and Côte

40. Torquebiau, E. (Ed.). (2016). Climate change and agriculture worldwide. Springer.; Ameyaw, G. A. (2019). Management of the Cacao Swollen Shoot Virus (CSSV) Menace in Ghana: The Past, Present and the Future. Plant Diseases - Current Threats and Management Trends. Retrieved May 4, 2020, from https://www.intechopen.com/books/plant-diseases-current-threats-and-management-trends/management-of-the-cacao-swollen-shoot-virus-cssv-menace-in-ghana-the-past-present-and-the-future.
41. Posnette A.F. (1947). Viruses of cocoa in West Africa: 1. Cocoa viruses 1A, 1B, 1C, and 1D. Annals of Applied Biology, 34:388-402.; Muller, E., Ravel, S., Agret, C., Abrokwah, F., Dzahini-Obiatey, H., Galyuon, I., et al. (2018). Next generation sequencing elucidates cacao badnavirus diversity and reveals the existence of more than ten viral species. *Virus Research*, 244: 235-251.
42. Andres, C., Blaser, W.J., Dzahini-Obiatey, H.K., Ameyaw, G.A., Domfeh, O.W., Awiagah, M.A. (2017). Agroforestry systems can mitigate the severity of cocoa swollen shoot virus disease. *Agriculture, Ecosystems & Environment*, 252,83-92.
43. Ibid.
44. Wessel, M., Quist-Wessel, P., & Foluke, M. (2015). Cocoa production in West Africa, a review and analysis of recent developments. *NJAS - Wageningen Journal of Life Sciences*, 74–75, 1–7.
45. Gockowski, J., & Sonwa, D. (2011). Cocoa Intensification Scenarios and Their Predicted Impact on CO_2 Emissions, Biodiversity Conservation, and Rural Livelihoods in the Guinea Rain Forest of West Africa. *Environmental Management, 48*(2), 307–321.
46. Kolavalli, S., & Vigneri, M. (2017).
47. Schroth, G., Läderach, P., Martinez-Valle, A. I., Bunn, C., & Jassogne, L. (2016). Vulnerability to climate change of cocoa in West Africa: Patterns, opportunities and limits to adaptation. *Science of the Total Environment, 556*, 231-241.; Kroeger, A., Koenig, S., Thomson, A., Streck, C. 2017. Forest- and Climate-Smart Cocoa in Côte d'Ivoire and Ghana, Aligning Stakeholders to Support Smallholders in Deforestation-Free Cocoa. World Bank, Washington, DC
48. Ruf, F., Schroth, G., & Doffangui, K. (2015). Climate change, cocoa migrations and deforestation in West Africa: What does the past tell us about the future?. *Sustainability Science, 10*(1), 101-111.

d'Ivoire. In 2017, company and government programs were brought together under the umbrella of the Cocoa and Forests Initiative (BOX 3).

Because a relatively small number of companies control a significant portion of the market, companies have leverage to demand a certain standard of practice in cocoa production. However, smallholders generally lack the resources to comply with sustainable supply chain standards set by the industry. Therefore, companies with SSIs offer interventions and services to smallholders and smallholder groups to secure supplies of cocoa beans that meet their standards and policy requirements. These interventions include organizing farmers into groups and providing training, credit, and farm inputs (e.g., fertilizers, agrochemicals, cocoa seedlings, equipment). Services may be offered either as a predetermined package of support or through a menu of available services.[49]

BOX 3

Cocoa support programs and strategies

The Cocoa Livelihoods Program (CLP) was first establish as CLP I, which occurred from 2009 to 2014.[50] CLP II lasted from 2014 to 2019 and focused on cocoa productivity and farm resilience as it related to food security. With more than 70 million USD in funding and the participation of 15 companies, CLP I promoted a package of training through Farmer Field Schools on best agricultural and farm management practices while providing inputs and increasing access to improved planting materials. CLP II was implemented through a matching grant mechanism to ten World Cocoa Foundation member companies, who worked with government agencies, NGOs, civil society, and donor organizations on their programming.

CocoaAction started in 2014 to align the industry on issues related to low cocoa productivity and community development, particularly education and child labor monitoring.[51] It included a joint industry-wide strategy to confront pests and diseases, environmental concerns, market challenges, access to education, child protection, and gender equality. The strategy was implemented through the provision of a 'productivity package' and a 'community package.' Farmers were also offered microcredit to increase access to crop protection and inorganic fertilizers.

In 2017, these packaegs and many other programs were brought together under the Cocoa and Forests Initiative (CFI).[52] The CFI is a joint public-private partnership between the cocoa industry and the governments of Côte d'Ivoire and Ghana to establish zero-deforestation supply chains. The CFI focuses on forest protection and restoration, sustainable production and farmer's livelihoods, and community engagement and social inclusion. The CFI also specifically aims to end sourcing from protected areas and national parks. It has galvanized the companies' commitments around a shared set of implementation mechanisms, including deforestation-risk assessments, agroforestry, training in best practices, subsidized farm inputs like seeds and fertilizer, and community-level deforestation awareness events. Under the CFI, public and private signatories agreed that "there will be no further conversion of any forest land (as defined under national regulations and using methodologies such as High Carbon Stock (HCS) and High Conservation Value (HCV) approach) for cocoa production." After the initial launch of the CFI, Colombia also signed on, publishing its action plan for the Cocoa, Forests & Peace Initiative in 2019.

49. van der Velden, I., Saab, W., Gorter, J., van Monsjou, W., Bolton, J., & Evans, G. (2017). *Driving Innovations in Smallholder Engagement: Insights in Service Delivery and Finance*. https://www.idhsustainabletrade.com/uploaded/2017/12/Smallholder_Engagement_Report_2017.pdf.
50. Cocoa Livelihoods Program. (2018, August 27). World Cocoa Foundation. Retrieved May 5, 2020, from https://www.worldcocoafoundation.org/initiative/cocoa-livelihoods-program/.Cocoa Livelihoods Program | World Cocoa Foundation https://www.worldcocoafoundation.org
51. CocoaAction. (n.d.). World Cocoa Foundation. Retrieved May 5, 2020, from https://www.worldcocoafoundation.org/about-wcf/cocoaaction/.
52. Cocoa & Forests Initiative. (n.d.). IDH - the sustainable trade initiative. Retrieved May 4, 2020, from https://www.idhsustainabletrade.com/initiative/cocoa-and-forests/.

Companies often implement their own programs in silos, risking a duplication of efforts and failing to reach scale. For example, an individual farmer can be part of multiple programs and receive support from the government, thus obscuring the impact of each individual program. In order to be effective, programs need to address smallholder problems from multiple sides in a coordinated way to ensure that the whole sourcing area is covered.[53]

Where they are functional, cooperatives play an important role in provision of extension services to smallholder farmers. Cooperatives also provide an entry point for corporations, which may choose to target their sustainability programs at cooperatives in order to reach a broader range of smallholders. However, only a minority of West African cocoa farmers are organized. In Côte d'Ivoire, 20 to 50 percent of farmers – responsible for just over half of total production – are a part of registered cooperatives.[54] However, most of these cooperatives are not functioning properly, typically due to a lack of capacity and funds, knowledge gaps, poor infrastructure, and mistrust of institutions. The majority of farmers in Ghana are not formally organized (85 percent according a 2011 study[55]), although they are automatically registered with the Ghanaian Cocoa Coffee and Sheanut Farmers Association (GCCSFA).[56] The GCCSFA is governed by a system of district and regional Chief Cocoa farmers from the cocoa growing districts and regions,[57] but this organization is not known to represent the interests of cocoa smallholders.[58]

53. Flanagan, A. C., Midgley, S. J., Stevens, P. R., & McWhirter, L. (2019). Smallholder tree-farmers and forest certification in Southeast Asia: productivity, risks and policies. *Australian Forestry, 82*(1), 18–28. https://www.tandfonline.com/doi/full/10.1080/00049158.2018.1560569.
54. Bymolt, R., Laven, A., & Tyszler, M. (2018c). *Demystifying the cocoa sector in Ghana and Côte d'Ivoire: Chapter 9: Cocoa producer groups, certification, training and credit*. https://www.kit.nl/wp-content/uploads/2018/11/Demystifying-cocoa-sector-chapter9-cocoa-producer-groups-certification-training-and-credit.pdf.; Aidenvironment, NewForesight, & IIED (2015).
55. Baah, F., & Anchirinah, V. (2011). Looking for convergence: Stakeholders' perceptions of cocoa extension constraints in Ghana. *Journal of Science and Technology (Ghana), 30*(3). http://www.ajol.info/index.php/just/article/view/64626.
56. Laven, A., & Boomsma, M. (2012). Incentives for sustainable cocoa production in Ghana. 49.
57. Asibey-Bonsu, P. (2012). *Farmer's organizations in West and Central Africa: high expectations, hard realities. Ghana Country report*.
58. Laven, A., & Boomsma, M. (2012). Incentives for sustainable cocoa production in Ghana. 49.

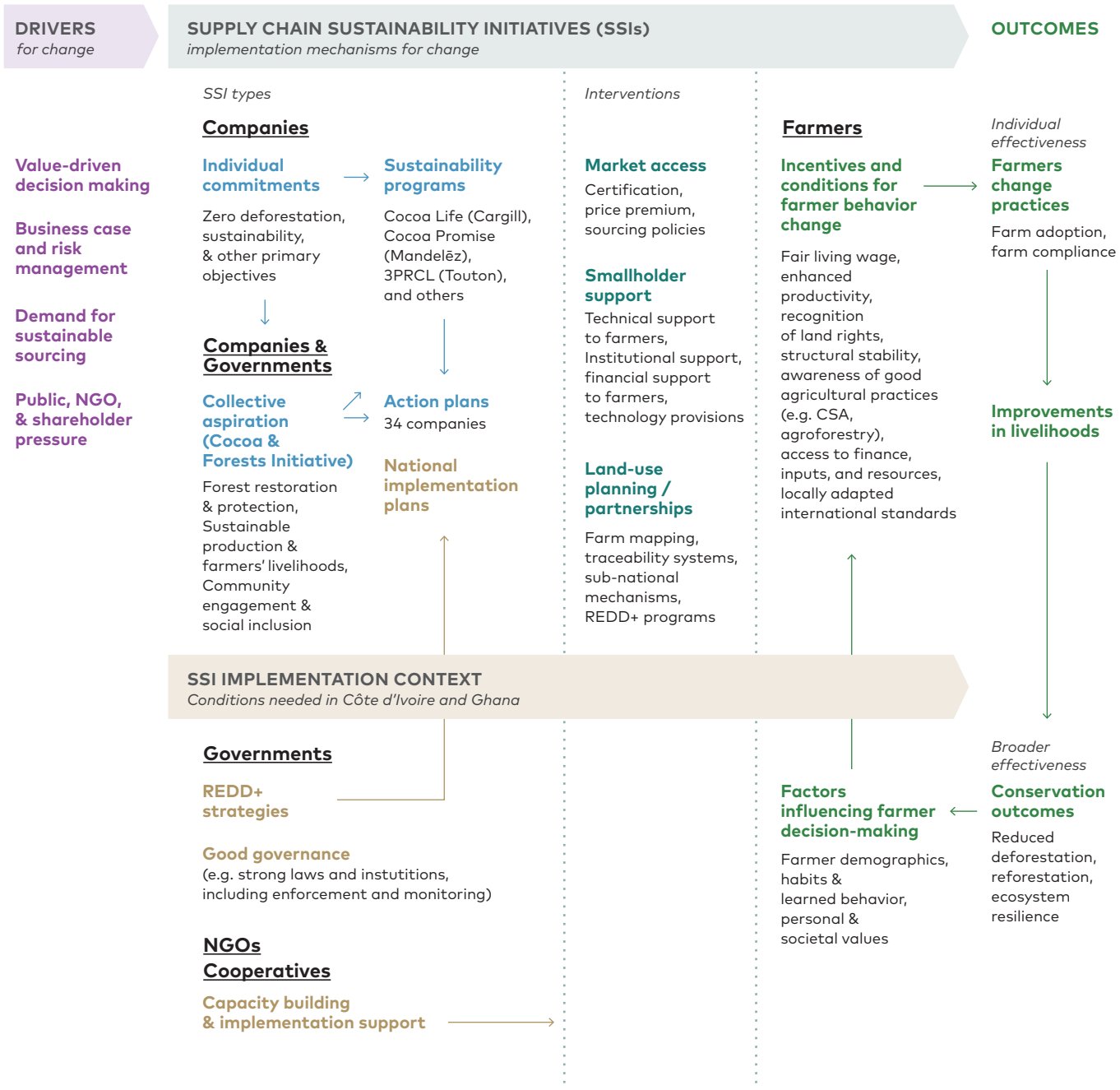
3. Methodology

3.1 Theory of Change

As a framework for this study, we adapted a Theory of Change for sustainable agricultural supply chains and applied it to the cocoa sector in Ghana and Côte d'Ivoire.[59] Our Theory of Change illustrates the dynamics and pathways that influence the effective implementation of supply chain sustainability initiatives (FIGURE 1).

FIGURE 1

Theory of Change for sustainable cocoa supply chains



59. Supply Chain Sustainability Research Fund. (n.d.). Theory of Change. Retrieved May 4, 2020, from https://www.supplychainresearch.eco/theory-of-change.

Individual SSIs in Ghana and Côte d'Ivoire are now captured under the collective aspiration of the CFI. Companies have been supporting and implementing cocoa programs for over a decade. In doing so, they have pursued a variety of different approaches, devised different indicators, and varied widely in the frequency (or existence) of progress reporting.[60] Companies have also adopted a diversity of approaches and methods for implementing their programs, complicating efforts to draw comparisons in outcomes. The CFI helps to harmonize individual company efforts by defining basic rules for engagement to help organize and target company efforts. Under the CFI, companies and governments develop plans and programs for implementing SSIs (e.g., sustainability programs, action plans), which are then translated into action via interventions such as codes of conduct, standards (e.g., certification), and tools (e.g., traceability systems).

How SSIs are implemented depends on the position of companies in the cocoa supply chain. Upstream companies (e.g., Barry Callebaut, Olam, Cargill, Mondelēz) generally have on-the-ground support programs. They may work directly with farmers, channel their support through farmer organizations such as cooperatives, or conduct activities via NGOs or governmental agencies. Downstream, consumer-facing companies (e.g., Hershey, Mars, Nestlé) mostly rely on and support their upstream supply chain partners in program implementation to meet their overarching sustainability policy goals.[61]

Farmers may be more willing to adopt practices if they can see their value or if they have the security to take risks. Increasing their willingness requires the removal of barriers that may be farm-level (e.g., individual-specific biases such as gender, farm location, absence of risk mitigation tools) or structural (e.g., systemic challenges such as lack of market access and public transparency) (SEE CHAPTER 4), as well as the establishment of a stable and strong institutional and legal setting and secure livelihoods. The enabling conditions may be different for each farmer as they depend on their individual situation, understanding, and perception of the benefits and costs associated with sustainable practices. SSI interventions operate on various levels to provide support and incentives (e.g., training, inputs, finance) to smallholders and address the farm-level and structural barriers they face.

A change in farmer practices should ideally result in individual and conservation benefits. Addressing structural barriers, such as price to increase the income of farmers, can also lead to the ability of farmers to be self-reliant in the long-term. In addition, conservation outcomes (e.g., ecosystem resilience) have positive knock-on effects for enhancing farmer livelihoods and their abilities to adapt to climate change.

3.2 Approach

Our research was conducted in three stages: a qualitative assessment of SSIs and farmer decision-making in the existing literature; primary data collection through field surveys with cocoa-farming households and semi-structured interviews with local stakeholders (e.g., supply chain program implementers, company representatives); and data analysis. The research methodology was designed by the research team with input from local consultants in Ghana and Côte d'Ivoire, as well as from an Advisory Board consisting of six scientific and academic experts.

60. Bakhtary, H., Matson, E., Mikulcak, F., Streck, C., & Thomson, A. (2020). *Company Progress in Engaging Smallholders to Implement Zero-Deforestation Commitments in Cocoa and Palm Oil*.
61. Ibid.

For the purposes of this study, we use the term Good Agricultural Practices (GAP) as a proxy for sustainable (and/or zero-deforestation) practices. We refer to GAP not with respect to a particular production standard or auditing system, but as a reference to basic environmental and operational conditions necessary for the safe, healthy, and quality production of cocoa. Examples of GAPs in the context of cocoa production include:

- Replanting/planting of hybrid trees,
- Farm rehabilitation,
- Fertilizer use and soil management,
- Pruning,
- Pest and disease management,
- Weed management,
- Shade management,
- Harvest management, and
- Agroforestry.

GAP also encompasses climate-smart cocoa practices, which are being promoted within the industry to increase cocoa productivity while reducing greenhouse gas emissions and increasing resilience. Climate-smart cocoa activities seek to increase the carbon content in the soil and in above-ground cocoa systems and are adapted to regional climate impacts.[62]

3.2.1 Qualitative assessment

In the first stage of our study, we mapped supply chain sustainability initiatives in the cocoa sector in Ghana and Côte d'Ivoire and reviewed literature on the factors influencing farmer decision-making. Our assessment focused on exploring the implementation context and dynamics around SSIs, as well as behaviors of relevant actors in the cocoa sector – or what incentivizes or drives smallholder behavior and behavior change with a particular view on changes towards more sustainable agricultural practices. We included academic and grey literature in our review as well as public documents (e.g., company action plans). We also reviewed the structural drivers of and constraints to adoption of sustainable farming practices in other sectors of food production – coffee and palm oil in particular. Findings informed the design of our field surveys and interpretation of survey results.

3.2.2 Field surveys

We developed a survey to collect data on cocoa farmer practices and the socio-economic and contextual factors likely to influence their behavior. Our field survey was designed to support the main objectives of this study (SECTION 1.2), in particular the identification of important factors that are either enabling positive changes in cocoa farms or that are acting as barriers in relation to the implementation of sustainable cocoa systems. The survey consisted of a combination of 175 multiple choice and open-ended questions (SEE ANNEX 1).

62. Bunn, C., Fernandez-Kolb, P., Asare, R., & Lundy, M. (2019). Climate Smart Cocoa in Ghana.

The questions were grouped into 13 categories:

1. Household information
2. Farm history and characteristics
3. Labor on the farm
4. Associations/cooperatives
5. Cocoa production cycle
6. Inputs
7. Productivity
8. Market access
9. Buyer relations
10. Pricing
11. Supply chain interventions
12. Planning and investments
13. Challenges

We conducted 432 surveys with farmers from December 2019 to March 2020. In Côte d'Ivoire, we conducted 200 surveys with smallholders in the San Pedro (50%) and Nawa (50%) regions. In Ghana, we conducted 232 individual surveys with smallholders in the Western North (62%) and in the Central (38%) regions (FIGURE 2). These regions have been identified as areas of high forest risk and priority for supply chain interventions by companies and the governments of Côte d'Ivoire and Ghana. These survey areas within those regions were selected for our study for two main reasons:

- Their proximity to areas of forest and deforested and degraded lands, and
- Their representativeness, including heterogeneity of cocoa-growing households and supply chain interventions, as they are amongst the most established cocoa growing regions in their respective countries.

FIGURE 2

Map of interview regions – study sites incidcated in orange

In Côte d'Ivoire, surveys were organized via cooperative leaders, while in Ghana, they were organized through the community leadership. In Côte d'Ivoire, cooperatives are strongly promoted, and some major cocoa companies only buy and support farmers through cooperatives. Farmers were initially selected at random from lists of cooperative members in Côte d'Ivoire or within the community in Ghana. Since there is generally a low number of female-headed farms, some women (farm owners or widows that are now heads of household) were purposefully sampled to ensure adequate representation. The surveys were undertaken at the home of the farmers in the local language using a conversational style. Surveys were conducted with the heads of the household, though other members of the household were sometimes present. The surveys were conducted by at least two enumerators: one person leading the conversation with the interviewee and another person listening and entering the data.

We used focus group discussions to corroborate the responses obtained through the individual surveys and to gather additional information on specific demographics. Focus group discussions were held in each region with groups of women, men, youth, and community leaders in Ghana, and with farmers in each cooperative in Côte d'Ivoire. A selection of 20 questions were extracted from the larger survey and presented to the group for open discussion. The discussions were led by one facilitator with a second present to take notes.

3.2.3 Data analysis

For both countries, the answers obtained from the survey questionnaire rendered two datasets with a large amount of quantitative and qualitative information. In order to analyze the information, an exploratory assessment was first performed where distributions of different variables were visualized, different correlational relationships were found, and key variables were slowly identified. Using our Theory of Change and literature review as a starting point, we analyzed a number of variables in our survey data that could be linked to driving improved agricultural practices (e.g., use of inputs, replanting of aging and diseased trees) among farmers. The factors that we identified as contributing to increasing farm productivity in cocoa farms of Ghana and Côte d'Ivoire are detailed in ANNEX 2 (MODEL 1, MODEL 2, AND MODEL 3). Some of these factors relate to farm characteristics (e.g., size of farm) and demographic attributes (e.g., gender, education, resident status), while others relate to legal and institutional aspects (e.g., land tenure, access to credit), different degrees of support (e.g., through cooperatives, companies, or NGOs), or specific farming practices. We assessed the relative influence of these factors by testing individual relationships across different variables and also through the models, which holistically consider the simultaneous interaction of multiple variables.

Productivity was selected as a proxy to understand the differences in outcomes across cocoa farms. In order to assess whether different farming practices, demographic characteristics, legal considerations, etc. are exerting a positive or negative change in the cocoa farms, it was necessary to find a proxy variable that was adequately able to represent the changing outcomes. In this study, a productivity variable was considered for this purpose to represent the dependent variable, namely the cocoa income per hectare. The analysis attempts to address what, among the dozens of variables surveyed, the key factors are that determine whether farms increase or decrease the income productivity of cocoa systems in the two regions.

We used linear models to identify and understand the key factors affecting cocoa productivity. To identify and understand the variables that best explain the outcome variable, several models were created for both countries. Specifically, based on the exploratory analysis, a mixture of 24 and 19 continuous and categorical variables were selected, respectively, for Ghana and Côte d'Ivoire which were deemed to represent possible relevant candidates. For Côte d'Ivoire, given that a very clear distinction exists amongst two subgroups of the dataset, an additional third model was built that addresses exclusively the better performing subgroup. A simple stepwise linear regression algorithm was applied to the original set of candidate variables to obtain the final model with a reduced number of variables. This is a forward and backward stepwise algorithm that considers the model selection based on the reduction of Akaike's Information Criterion (AIC), and is implemented using the MAAS package in R. The objective is to identify a low number of key features that explain an adequate level of the outcome variable.

For the analysis we considered farm characteristics, demographic attributes, legal and institutional aspects, different forms of farmer support, and different farming practices. For the case of Ghana, the model was developed considering the following 24 initial variables: location, gender, age, resident status, education, ownership, size of farm, age of trees, pruning, replanting, shading, diseases, manure/compost, inorganic fertilizer, labor, GAP training, government support, tenure documentation, NGO support (technical), NGO support (input), NGO support (financial), borrowing, credit access, and crop insurance. For Côte d'Ivoire, the original set of 19 variables considered was: location, gender, age, resident status, education, ownership, size of farm, age of trees, pruning, replanting, shading, diseases, manure/compost, inorganic fertilizer, labor, GAP training, input support from coop, technical support from coop, and borrowing. The small differences in variables considered for both countries reflect on-the-ground realities and differences in how the survey was implemented in both countries. The same set of questions were not fully relevant for both samples; for example, there was a broader range of types of farmer support in Ghana, whereas the farms sampled in Côte d'Ivoire relied almost exclusively on cooperative support.

3.2.4 Stakeholder interviews

We used semi-structured stakeholder interviews as a complementary qualitative data collection tool to support the interpretation of the farmer data and to place the survey results into context. We conducted interviews via phone with public, private, and civil society sector representatives that are active in the cocoa supply chain. Ahead of the interviews, which were each conducted by two to three employees of Climate Focus based in Berlin, the scope of the research was presented to the interviewee, and informed consent was obtained to enable anonymized use of the data gathered. The interviews were set to 45 to 60 minutes and included about ten guiding questions. The guiding questions followed a similar pattern in every interview but were adjusted to the role of the organization in the sector. After the completion of the interview, an agreement for follow-up questions was arranged.

We reached out to 17 stakeholders active in the cocoa sector in Côte d'Ivoire, of which eight agreed to an interview. The team interviewed representatives of two civil society organizations involved in the implementation of sustainable supply chain interventions, one AgriTech company, three cocoa companies, one donor agency, and one public institution. Selection of interview respondents was done following a purposive sampling approach. After identifying stakeholder organizations in Côte d'Ivoire who engage with cocoa smallholders, the potential

interviewees were selected based on the condition that the person holds a relevant (cocoa-related) position in the stakeholder organization and reside in Côte d'Ivoire. Those relevant positions included persons who are Program Managers of cocoa sustainability initiatives in Côte d'Ivoire and Country Representatives of the organization. After contacting the selected interviewees via e-mail, a date for the video call was arranged.

Similarly, we reached out to 26 stakeholders active in cocoa sector in Ghana, of which ten agreed to an interview. The team interviewed representatives of five civil society organizations involved in the implementation of sustainable supply chain interventions, two AgriTech companies, and three cocoa companies. The approach for selecting and interviewing the stakeholder was the same as with the Côte d'Ivoire stakeholders.

4. Factors influencing farmer decision-making

ALAIN INTRAINA/ISTOCK

Cocoa production in West Africa suffers from low yields, pests and diseases, aging tree stock, and shrinking available land suitable for cultivation. Therefore, improved production methods are required to improve yields and productivity of cocoa farms to avoid expansion into new land at the cost of the remaining forests. These improved agricultural practices include those intended to enhance soil fertility, improve cocoa tree health, and enhance productivity. At present, the implementation of these practices is rare in Ghana and Côte d'Ivoire. In Ghana, for example, only about one third of farmers use fertilizers. The use of fungicides to combat black pod disease, which can result in significant yield and tree loss if untreated, and the application of weed control are even lower, at 7.5 percent and 3.7 percent, respectively.[63] In Côte d'Ivoire, adoption is low for weeding, soil conservation practices, fertilizer use, field buffer zones, crop protection products, waste management, disposing diseased pods, inputs use, shade trees, pruning, and soil and water management.[64]

Farmer and farm characteristics, as well as the surrounding context, influence the likelihood of smallholder behavior change. Individual, or farm-level, factors include habits and learned behavior, personal and societal values, social commitments, costs, and benefits. Structural factors relate to enabling conditions like customs, laws and regulations, access to finance and inputs, and consumer and global buyer preferences (TABLE 1).[65] Interventions such as economic rewards, provision of advice and capacity building, and voluntary collective actions also affect farmer behavior.

TABLE 1

Factors influencing farmer decision-making

FARM-LEVEL	STRUCTURAL
Farmer age and gender	Cocoa prices and income
Technical knowledge and skills	Access to finance and labor
Farm ownership and tenure	Availability of extension services
	Farmer organizations (cooperatives)
	Governance (institutions, corruption, rule of law)

The level of influence these factors have on farmer decision-making depends on the specific pressures that farmers face. Farmers' behavior is usually limited by where they are most constrained; in some cases, this may relate to biophysical farm characteristics. In other situations, the reason may be social.[66] Regardless,

63. Aneani, F., Anchirinah, V., Owusu-Ansah, F., & Asamoah, M. (2012). Adoption of Some Cocoa Production Technologies by Cocoa Farmers in Ghana. *Sustainable Agriculture Research, 1.*
64. Ingram V., Waarts Y., van Vugt S.M., Ge L., Wegner L., Puister-Jansen L. (2013). Towards sustainable cocoa: Assessment of Cargill and Solidaridad cocoa farmer support activities in Côte d'Ivoire 2008-2012. LEI, Wageningen UR. Wageningen.
65. Liu, T., Bruins, R. J. F., & Heberling, M. T. (2018). Factors Influencing Farmers' Adoption of Best Management Practices: A Review and *Synthesis. Sustainability, 10*(2), 432.; Meijer, S. S., Catacutan, D., Ajayi, O. C., Sileshi, G. W., & Nieuwenhuis, M. (2015). The role of knowledge, attitudes and perceptions in the uptake of agricultural and agroforestry innovations among smallholder farmers in sub-Saharan Africa. *International Journal of Agricultural Sustainability, 13*(1), 40–54.
66. Mutyasira, V., Hoag, D. & Pendell, D. (2018). The adoption of sustainable agricultural practices by smallholder farmers in Ethiopian highlands: An integrative approach, *Cogent Food & Agriculture,* 4:1.

the limiting factors for farmer decision-making are highly context-dependent.[67] Imminent market or climatic pressures may drive an urgent response, but these behavior changes may be temporary.[68] Therefore, it is important to differentiate between behavior change responding to short-term stress and to lasting, long-term impacts.

The majority of available literature on farmer behavior in Ghana and Côte d'Ivoire focuses on subsets of the population of cocoa growing communities. As the circumstances of cocoa farmers may vary across different regions in these countries, the degree to which a certain factor affects farmer decision-making and behavior is likely to vary as well. Here, we outline these factors as they are available in the literature on cocoa farmers in these two countries.

4.1 Farm-level factors

4.1.1 Farmer age and gender

Cocoa farmers in West Africa are aging; younger farmers (ages 25 to 35) see cocoa production as an unviable occupation, raising concerns about the future of production. The mean age of cocoa farmers in Côte d'Ivoire is more than 45 years while in Ghana, it is more than 50 years. Older farmers have generally lower uptake of innovative practices, and their farms are associated with lower yield and output.[69] Despite having more experience in cocoa farming, older farmers in Ghana do not have higher average cocoa yields and incomes, primarily because younger farmers are more open to innovation.[70] Therefore, as the cocoa farmer population ages in these countries, the role of younger farmers in rejuvenating the cocoa sector is growing in importance. However, younger people perceive cocoa farming as hard work with little returns, and many of them are leaving to nearby towns and cities for education and job opportunities.[71]

Gender inequality is a farm-level and structural factor that impacts the ability of women to adopt new practices. Women participate in all stages of the cocoa supply chain, making up a significant portion of cocoa labor and farm managers. In Ghana, 25 percent of cocoa farmers are women; in Côte d'Ivoire, women own 25 percent of cocoa plantations and make up 68 percent of labor force.[72] They play an active role in certain cocoa production practices such as pruning, fermentation, and drying. When women are hired for their labor, they are paid significantly less than men.[73] They also have generally lower education levels and are expected to undertake household chores as well, giving them little opportunity

67. Niles, M.T., Lubell, M., & Brown, M. (2014). How limiting factors drive agricultural adaptation to climate change. *Agriculture, Ecosystems and Environment, 200*.; Tschora, H. & Cherubini F. (2020. Co-benefits and trade-offs of agroforestry for climate change mitigation and other sustainability goals in West Africa, *Global Ecology and Conservation, 22*: e00919.; Lan, L., Sain, G., Czaplicki, S., Guerten, N., Shikuku, K.M., Grosjean, G., et al. (2018). Farm-level and community aggregate economic impacts of adopting climate smart agricultural practices in three mega environments. *PLoS ONE 13*(11): e0207700. https://doi.org/10.1371/journal.pone.0207700
68. Feola, G., Lerner, A. M., Jain, M., Montefrio, M. J. F., & Nicholas, K. A. (2015). Researching farmer behaviour in climate change adaptation and sustainable agriculture: Lessons learned from five case studies. *Journal of Rural Studies, 39*, 74–84..
69. Oomes, N. et al. (2016b).
70. Barrientos, S.W & Asenso Akyere, K. (2012). Mapping sustainable production in Ghanaian cocoa, Report to Cadbury. Institute of Development Studies & University of Ghana.; Daniel, A. T., & Alex, A. (2017). Socioeconomic profile and farm management practices of smallholder cocoa farmers in three cocoa producing districts in Southwestern Ghana. *African Journal of Agricultural Research, 12*(15), 1259–1268.
71. Löwe, A. (2017). *Creating opportunities for young people in Ghana's cocoa sector*. Retrieved from https://www.odi.org/sites/odi.org.uk/files/resource-documents/11635.pdf.; Bymolt, R., Laven, A., & Tyszler, M. (2018a). *Demystifying the cocoa sector in Ghana and Cote d'Ivoire: Chapter 3: Demographics*. Retrieved March 5, 2020, from https://www.kit.nl/wp-content/uploads/2018/10/Demystifying-cocoa-sector-chapter3-respondents-and-households-demographics.pdf.; Daniel, A. T., & Alex, A. (2017).
72. Martson, A. (2016). *Women's Rights in the Cocoa Sector: Examples of emerging good practice* (Oxfam Discussion Papers) [Oxfam Discussion Papers].
73. Ibid.

to learn to manage a cocoa farm.[74] Women also provide labor on the farms that belong to their families, but are not recognized for their roles because they lack ownership and land titles.[75] This lack of formal access to land limits their access to finance and farm inputs, inhibiting their equitable participation in cocoa farming.[76] Furthermore, transporting cocoa to marketing centers and negotiating sales – the only link from farm to market – is almost exclusively done by men, limiting both the agency of women in the sector and their access to the market.[77]

In Ghana, female farmers – those who are the heads of their households or who run the farms – have 25 to 30 percent lower productivity and income than their male counterparts.[78] Being male, participating in a cooperative, and having access to extension services correlates with uptake of sustainable activities.[79] Many sustainability interventions do not consider the heterogeneity of female farmers and their distinct challenges, further exacerbating gender inequalities.[80] Female farmers are less likely to receive resources from the government, and to benefit from extension services. Additionally, they often lack access to credit because of the inherent societal biases towards women.[81] For example, female farmers in Ghana tend to receive significantly less agricultural advice from the Ghana Cocoa Board (COCOBOD) extension officers relative to men.[82] Women also incur higher costs for managing a cocoa farm as they depend on hired labor more than male farmers do.[83] However, a study in Ghana also shows that women tend to use hired labor and land more efficiently than men,[84] which means that supporting female farmers will pay off in the transition to sustainable practices. Women are also more responsive to development projects promoting the cultivation of cocoa and other crops.[85]

4.1.2 Technical knowledge and skills

Lack of technical knowledge and expertise is one of the main reasons for unsustainable practices among cocoa farmers in West Africa. Farm management practices like planting cocoa and non-cocoa trees; choosing species variety; planning farm operations; using rehabilitation techniques like grafting, shade management, and pruning; using fertilizer correctly; understanding pests and diseases; and proper application of pesticides and fungicides require a higher level of technical knowledge than many smallholders currently possess.[86] Without

74. Waarts, Y., Ge, L., Ton, G., & Mheen, J. van der. (2013). *A touch of cocoa: baseline study of six UTZ-Solidaridad cocoa projects in Ghana*. Retrieved April 16, 2020, from http://edepot.wur.nl/305316.
75. Martson, A. (2016).; Bymolt, R. et al. (2018a).
76. Barrientos, S., Owusuaa Bobie, A. (2016). Promoting Gender Equality in the Cocoa-Chocolate Value Chain: Opportunities and Challenges in Ghana. Global Development Institute Working Paper, University of Manchester.; Vigneri, M., & Holmes, R. (n.d.). When being more productive still doesn't pay: gender inequality and socio-economic constraints in Ghana's cocoa sector. 21.
77. Martson, A. (2016).
78. Hiscox, M., & Goldstein, R. (2014). Gender Inequality in the Ghanaian Cocoa Sector. Harvard University. At https://www.cocoalife.org/~/media/CocoaLife/News%20Articles%20PDF/Ghana%20Gender%20Assessment%20by%20Harvard%20University.pdf
79. Djokoto, J. G., Owusu, V., & Awunyo-Vitor, D. (2016). Adoption of organic agriculture: Evidence from cocoa farming in Ghana. *Cogent Food & Agriculture, 2*(1), 1242181.
80. Friedman, R., Hirons, M. A., & Boyd, E. (2019). Vulnerability of Ghanaian women cocoa farmers to climate change: a typology. *Climate and Development, 11*(5), 446–458.
81. Zamasiya, B., Kefasi, N., & Mukamuri, B. (2017). Factors influencing smallholder farmers' behavioural intention towards adaptation to climate change in transitional climatic zones: A case study of Hwedza District in Zimbabwe. *Journal of Environmental Management*, 198, 233–239.
82. Maguire-Rajpaul, V. A., Khatun, K., & Hirons, M. A. (2020). Agricultural Information's Impact on the Adaptive Capacity of Ghana's Smallholder Cocoa Farmers. *Frontiers in Sustainable Food Systems, 4*. Retrieved April 27, 2020, from https://www.frontiersin.org/articles/10.3389/fsufs.2020.00028/full#h5.
83. Barrientos, S.W & Asenso Akyere, K. (2012). Mapping sustainable production in Ghanaian cocoa, Report to Cadbury. Institute of Development Studies & University of Ghana
84. Vigneri, M., & Holmes, R. (n.d.).
85. Ruf, F., & Schroth, G. (Eds.). (2015). Economics and ecology of diversification: the case of tropical tree crops.
86. Kroeger, A., Koenig, S., Thomson, A., Streck, C. with contributions from W., Paul-Harvey, & Bakhtary, H. (2017). *Forest- and Climate-Smart Cocoa in Côte d'Ivoire and Ghana, Aligning Stakeholders to Support Smallholders in Deforestation-Free Cocoa*.

these technical skills and knowledge, smallholders are less likely to implement the interventions in a successful and sustainable manner. Therefore, enhancing smallholder skills and access to relevant information is a prerequisite for their adoption of these practices. In addition, sharing agricultural information can improve cocoa farmers' adaptive capacities.[87]

Adopting and implementing sustainable practices requires knowledge of modern agricultural techniques and farm management skills. Insufficient knowledge of pest and disease management has resulted in the death of a substantial amount of cocoa trees.[88] Most farmers also lack appropriate technical knowledge to implement agroforestry practices.[89] In Ghana, a study on impacts of six sustainability projects found that farmers with higher levels of education implemented sustainable practices in a better manner relative to those with lower education levels, indicating that increasing farmers' level of education leads to improved agricultural practices.[90] Knowledge and education also help farmers to make better financial decisions.[91] Access to useful agricultural information can also improve their capacity to adapt to the impacts of climate change like drought.[92]

Access to modern farm management knowledge and skills would also help farmers deal with risks and uncertainties of investing in their farms. Often, farmers are uncertain whether new practices will result in higher yields, income, and profits or whether the farm and trees will be threatened by pests, droughts, and changing weather. In particular, when replanting their farms, farmers must find other sources of income for the period of three to five years before cocoa trees mature.[93] This uncertainty and the associated risks make the implementation of new practices unattractive for cocoa farmers.[94] On the other hand, having a good understanding of the financial implications that investing in their farms may have on their short-term income and long-term household finance would help farmers deal with these uncertainties.[95]

4.1.3 Farm ownership and tenure

Tenure security and land ownership can be important factors in smallholder farm management and investment decisions. Formal and transferable land rights generally incentivize landowners to invest in their land, particularly in the long-term.[96] In some cases, the perception of tenure security may be enough to motivate farmers to invest in the sustainability of the land. For example, in Côte d'Ivoire, a study found that farmers with insecure tenures tended to invest more in their farms when their trees were young as a means of retaining control over the land when the trees matured.[97]

87. Maguire-Rajpaul, V. A., Khatun, K., & Hirons, M. A. (2020). Agricultural Information's Impact on the Adaptive Capacity of Ghana's Smallholder Cocoa Farmers. *Frontiers in Sustainable Food Systems, 4*. Retrieved May 4, 2020, from https://www.frontiersin.org/articles/10.3389/fsufs.2020.00028/full.
88. Wessel, M., & Quist-Wessel, P. M. F. (2015b). Cocoa production in West Africa, a review and analysis of recent developments. *NJAS - Wageningen Journal of Life Sciences*, 74–75.
89. Kroeger, A., Bakhtary, H., Haupt, F., & Streck, C. (2017). *Eliminating Deforestation from the Cocoa Supply Chain*. Retrieved July 19, 2019, from http://elibrary.worldbank.org/doi/book/10.1596/26549.
90. Waarts, Y. et al. (2013).
91. Bymolt, R. et al. (2018a).
92. Maguire-Rajpaul, V. A. et al. (2020).
93. Oomes, N. et al. (2016b).
94. Oomes, N., Tieben, B., Laven, A., Ammerlaan, T., Appelman, R., Biesenbeek, C., et al. (2016). *Market Concentration and Price Formation in the Global Cocoa Value Chain*.
95. Kroeger, A., Koenig, S., Thomson, A., Streck, C. with contributions from W., Paul-Harvey, & Bakhtary, H. (2017). *Forest- and Climate-Smart Cocoa in Côte d'Ivoire and Ghana, Aligning Stakeholders to Support Smallholders in Deforestation-Free Cocoa*.
96. Besley, T. (1995). Property Rights and Investment Incentives: Theory and Evidence from Ghana. *The Journal of Political Economy, 103*(5), 903–937.
97. Bros, C., Desdoigts, A., & Kouadio, H. (2019). Land Tenure Insecurity as an Investment Incentive: The Case of Migrant Cocoa Farmers and Settlers in Ivory Coast. *Journal of African Economies, 28*(2), 147–175.; Tondoh, J. E., Kouamé, F. N., Martinez Guéi, A., Sey, B., Wowo Koné, A., & Gnessougou, N. (2015).

Unclear land and tree tenure is a barrier to both tree rehabilitation and replanting as well as to the adoption of agroforestry systems. Until recently, farmers in Ghana were not allowed to own the trees on their land.[98] In the 1990s and 2000s, farmers were excluded from timber markets, often without tree tenure or land rights, meaning they had little incentive, farmers had little incentive to keep trees standing that gave them no financial return.[99] Indeed, this lack of security may have encouraged them to deforest and adopt full-sun cocoa practices to capitalize on higher returns in the short run. At the same time, some farmers chose to maintain shade trees and participate in informal timber sales.[100] Moves to formalize timber governance may have negative implications for farmers unless customary patterns of access and authority are considered.[101]

The vulnerability of migrant farmers makes them more likely to deforest and less likely to invest into farming operations. In Ghana, under the customary land tenure system, the right to use land in perpetuity and the right to transfer it is held by the community and its members.[102] Migrants are typically only granted temporary permissions to cultivate land by the local chief.[103] Migrants can use the land through lease agreements like sharecropping, where they give a portion of their yield to the holder of the permanent use rights (e.g., the chief). These sharecropping arrangements are rarely documented in writing, which makes sharecroppers' rights uncertain and insecure and acts as a disincentive to invest in the farm.[104] Furthermore, because sharecroppers do not have ownership or use-rights over timber and non-timber trees in the farm, they have little incentive to plant trees other than cocoa. Similarly, the sharecropper must obtain permission to cut or replant any trees or else the land use rights revert back to the owner.[105] This dynamic acts as a disincentive for replanting or rehabilitating old diseased trees.[106] In Côte d'Ivoire, land disputes between traditional land users and migrants as well as lack of institutional oversight are increasingly pushing migrants into illegally claiming land in national parks **(SEE SECTION 2.2)**.[107]

Traditional inheritance arrangements also influence a farmer's decision to invest in the farm. In Ghana, after a father's death, the cocoa farm is divided among the children. Plots, therefore, tend to become smaller with each generation, reducing incomes and total yields while disincentivizing further investment.[108] This dynamic decreases farmers' ability to support their livelihoods, further entrenching them in the cycle of poverty.[109] In Côte d'Ivoire, young men generally have more chances of receiving land by inheritance than young women do. In some areas (e.g., Krobous) and in certain ethnic groups (e.g., Abbeys), women are even forbidden to own land.[110]

98. Fountain, A., & Hütz-Adams, F. (2018).
99. Ruf, F. O. (2011). The Myth of Complex Cocoa Agroforests: The Case of Ghana. *Human Ecology, 39*(3), 373.
100. Hirons, M., McDermott, C., Asare, R., Morel, A., Robinson, E., Mason, J., et al. (2018a). Illegality and inequity in Ghana's cocoa-forest landscape: How formalization can undermine farmers control and benefits from trees on their farms. *Land Use Policy, 76*, 405–413.
101. Ibid.
102. Asamoah, M., & Owusu-Ansah, F. (2017). *Report on land tenure and cocoa production in Ghana - A CRIG/WCF Collaborative Survey* (p. 53).
103. Tropenbos. (2018).
104. USAID. (2015). *Assessment of Land Tenure-Related Constraints to Cocoa Productivity in Ghana*.
105. Ibid.
106. Ibid.
107. Fountain, A., & Hütz-Adams, F. (2018).
108. Steijn, C. P. A. (2016). Towards sustainable cocoa production: a mixed method assessment of the influence of local governance modes on the farm level impact of private cocoa certification standards in Ghana
109. Amanor, K. S. (2001). Land, labour and the family in southern Ghana: a critique of land policy under neo-liberalisation ; [a report from the research programme The Political and Social Context of Structural Adjustment in Africa]. In Research Report / Nordiska Afrikainstitutet: Vol. 116.; Spichiger, R., & Stacey, P. (2014). Ghana's Land Reform and Gender Equality. Retrieved from JSTOR.
110. FLA (2015). Evaluer la situation actuelle des femmes et des jeunes agriculteurs et l'état nutritional de leurs familles dans deux communautés productrice de cacao en Côte d'Ivoire. Rapport prepare par Fair Labour Association, Juillet 2015. At https://www.fairlabor.org/sites/default/files/documents/reports/femmes_et_des_jeunes_nutrition_dans_communautes_de_dacao_juillet_2015.pdf

There are tradeoffs to both formal and customary tenure arrangements. In Ghana, farmers with formal ownership rights are more likely to invest in their farms, and therefore have higher productivity, compared to farmers without tenure security who work the land as sharecroppers.[111] At the same time, they may forego short-term investments (e.g., fertilizer use) during times of financial hardship without any fear of losing their control over the land.[112] Field studies indicate that changes in land tenure have shifted patterns of land access in favor of wealthier individuals and to the disadvantage of women, youth, and poor people regardless of ethnicity, allowing some traditional authorities and local powerful elites to capitalize and advance their own interests.[113] Similarly, in Côte d'Ivoire, only nationals are allowed to own land, and therefore many cocoa farmers who work on a farm do not actually have the right to own it, even if their families have been in the country for generations.[114] In cases where land documentation as a proof of ownership is needed to access formal finance, this may deepen livelihood disparities.[115]

Farmer decisions to adopt sustainable practices may be influenced by other factors in conjunction with tenure. Though ownership positively impacts technology adoption, land fertility, and yield,[116] tenure alone does not result in the adoption of sustainable practices. Other factors such as access to finance, agricultural inputs, and targeted extension services play a key role in how tenure affects adoption of sustainable practices including soil improvements, on-farm tree planting, and conservation of naturally-occurring tree species.[117] For tenure security to result in improved farm management, farmers generally need access to financial resources and additional incentives to invest in the farm.[118]

4.2 Structural factors

4.2.1 Cocoa prices and income

The price of cocoa beans directly affects smallholders' cocoa income and their investment decisions. Prices determine whether farmers see practices such as replanting and fertilizer and pesticide application as profitable.[119] Compared to liberal cocoa markets like Indonesia,[120] farm gate prices are low in Ghana and Côte d'Ivoire, where marketing boards take a share of the Free-On-Board price (SEE SECTION 2.1, BOX 2).[121] The real value that farmers receive may be even lower due to inflation in these countries.[122]

111. Asamoah, M., & Owusu-Ansah, F. (2017). *Report on land tenure and cocoa production in Ghana - A CRIG/WCF Collaborative Survey* (p. 53). Retrieved from http://www.worldcocoafoundation.org/wp-content/uploads/files_mf/1492612620CRIGLandTenureSurveyFinal41217.pdf.; Ayamga, M., Yeboah, R. W. N., & Ayambila, S. N. (2016). An analysis of household farm investment decisions under varying land tenure arrangements in Ghana. *Journal of Agriculture and Rural Development in the Tropics and Subtropics (JARTS), 117*(1), 21–34.
112. Asaaga, F. A., Hirons, M. A., & Malhi, Y. (2020). Questioning the link between tenure security and sustainable land management in cocoa landscapes in Ghana. *World Development, 130*, 104913.
113. Asaaga, F. A., & Hirons, M. A. (2019). Windows of opportunity or windows of exclusion? Changing dynamics of tenurial relations in rural Ghana. *Land Use Policy, 87*, 104042.
114. Fountain, A., & Huetz-Adams, F. (2015).
115. Hatløy, A., Kebede, T. A., & Adabe, P. J. (2012). Towards Côte d'Ivoire Sustainable Cocoa Initiative (CISCI). Baseline study report. Institute for Applied International Studies (Fafo) October.
116. Udry, C. (2010). The economics of agriculture in Africa: Notes toward a research program. African Journal of Agricultural and Resource Economics, 5(1), 284-299.; Foster, A. D., & Rosenzweig, M. R. (2010). Microeconomics of technology adoption. Annu. Rev. Econ., 2(1), 395-424.; Goldstein, M., & Udry, C. (2008). The Profits of Power: Land Rights and Agricultural Investment in Ghana. Journal of Political Economy, 116(6), 981-1022.; Asamoah et al. (2017) Farmers' knowledge and utilization of CRIG recommended technologies and perceptions of government policies to enhance cocoa productivity. International Symposium on Cocoa Research (ISCR).
117. Asaaga, F. A. et al. (2020).
118. Roth, M., Adarkwah Antwi, Y., & O'Sullivan, R. (2017). Land and Natural Resource Governance and Tenure for Enabling Sustainable Cocoa Cultivation in Ghana. 60.
119. Bymolt, R. et al. (2018).
120. Oomes, N., Tieben, B., Laven, A., Ammerlaan, T., Appelman, R., Biesenbeek, C., et al. (2016).
121. Bymolt, R. et al. (2018).
122. Oomes, N. et al. (2016).

Most income from cocoa is used to meet basic household needs leaving no funds for farm investments.[123] Limited income means farmers do not have enough savings and surpluses to invest in increasing yield and productivity by implementing better agricultural practices. Few farmers have the opportunity to diversify their income streams which could increase total farm income.[124] This keeps farmers in a vicious cycle where they do not earn sufficient income because they do not have enough resources to invest in their farms to increase their income. Farmer productivity and income can therefore be raised by financially assisting them in replanting, rehabilitating old farms, adopting good agricultural practices, and applying fertilizer, fungicide, and pesticides.[125]

In both Ghana and Côte d'Ivoire, government interventions have often suppressed incentives to invest in improved cocoa practices in recent years. For example, following an oversupply of cocoa in the 2016/2017 season, the government of Côte d'Ivoire – in an effort to keep prices stable and cocoa supply low – took measures to reduce supply, including banning the distribution of high-yielding seedlings.[126] This ban is still in place as of the end of 2019, compromising the effectiveness of productivity-enhancing support strategies. Similarly, the Ghanaian COCOBOD ended a program that distributed free fertilizers and pesticides to farmers to slow production.[127]

4.2.2 Access to finance and labor

Smallholder farmers in West Africa cannot afford agricultural investments without support. Farmers are generally poor while agricultural inputs are expensive.[128] Certain farming techniques like pruning, spraying, and the application of fertilizer require extra labor, which means farmers need to further invest in hiring. Access to finance enables farmers to purchase agricultural inputs and tools such as pesticides, fertilizers, and cutlasses and hire labor, all of which would improve their production practices.[129] It would also enable them to diversify their crops.[130]

Financing of cocoa farms through conventional banks or mobile money remains largely absent.[131] Many farmers are unable to meet the requirements – such as having both an existing bank account and the capacity to use it, savings, and proof of assets (e.g., land registration) – to access conventional financial services like credit.[132] The few farmers who have access to credit rely on local farmer organizations, relatives, friends, and fellow farmers for this service, and those

123. Kumi, E., & Daymond, A. J. (2015). Farmers' perceptions of the effectiveness of the Cocoa Disease and Pest Control Programme (CODAPEC) in Ghana and its effects on poverty reduction. American Journal of Experimental Agriculture, 7(5), 257-274.
124. Carodenuto, S. (2019). Governance of zero deforestation cocoa in West Africa: New forms of public–private interaction. *Environmental Policy and Governance, 29*(1), 55–66.
125. Kroeger, A., Koenig, S., Thomson, A., Streck, C. with contributions from W., Paul-Harvey, & Bakhtary, H. (2017). *Forest- and Climate-Smart Cocoa in Côte d'Ivoire and Ghana, Aligning Stakeholders to Support Smallholders in Deforestation-Free Cocoa*.
126. Ionova, A., & Aboa, A. (2018, May 1). Côte d'Ivoire suspension of cocoa seed plans raises quality concerns. Reuters. https://www.reuters.com/article/ivorycoast-cocoa-yields-idUSL8N1S3A8Y.
127. World Cocoa Foundation. (2019). *World Cocoa Foundation Cocoa Livelihoods Program Phase II: Endline Evaluation Final Report – Main Report*. https://www.worldcocoafoundation.org/wp-content/uploads/2018/08/CLP-II-Endline-Evaluation-Report_Main-Report.pdf.
128. Oomes, N. et al. (2016b).
129. Barrientos, S.W & Asenso Akyere, K. (2012). Mapping sustainable production in Ghanaian cocoa, Report to Cadbury. Institute of Development Studies & University of Ghana.
130. Nelson, V., Opoku, K., Martin, A., Bugri, J., & Posthumus, H. (2013). Assessing the poverty impact of sustainability standards: Fairtrade in Ghanaian cocoa. London: DfID UK. At https://www.gov.uk/dfid-research-outputs/final-report-assessing-the-poverty-impact-of-sustainability-standards-fairtrade-in-ghanaian-cocoa
131. Bymolt, R. et al. (2018a).
132. Fountain, A., & Huetz-Adams, F. (2015).; Bymolt, R. et al. (2018).

who have savings keep them either at home or with relatives.[133] For example, in Ghana, Village Saving Loan Associations (VSLAs) allow smallholders to access funds through informal community-saving schemes where farmers pool a fixed amount of cash that they can access it at the time of need. VSLAs have been shown to lead to improvements in financial inclusion, household business outcomes, women's empowerment, resilience, food security, and income.[134]

Removing and planting new trees requires extensive skill and experience and is inherently risky.[135] The ability to adopt GAPs is also linked to access to skilled, knowledgeable, and affordable labor. Row spacing and maintenance of new trees, as well as the correct removal of old ones, are labor-intensive tasks which also carry considerable risk of damaging nearby trees. In cocoa communities in both Ghana and Côte d'Ivoire, labor is increasingly scarce and expensive.[136] As a result, female and/or older farmers, who usually depend on hired labor, are at risk of losing their yields and income.[137] Similarly, larger farms in Ghana are also less productive than smaller farms if there is labor scarcity or because some farmers cannot afford to hire enough labor to maintain the farm.[138] While outside the scope of this study, the inability to afford hired labor is also linked to the issue of child labor in the cocoa sector.[139]

4.2.3 Availability of extension services

Farmers' ability to change practices also depends on the availability of extension services and inputs, which can help improve farm productivity and income.[140] Extension is a primary tool for making agriculture and its related activities – in addition to other ecomonic practices – more effective and efficient in meeting the needs of farmers and their communities in a sustainable manner.[141] COCOBOD in Ghana and the Conseil du Café et Cacao (CCC) in Côte d'Ivoire provide a variety of direct extension services to farmers and also have support programs in place to combat cocoa diseases and provide inputs.[142] The government is not the only source of extension for cocoa farmers. In both Ghana and Côte d'Ivoire, cocoa farmers receive support from NGOs and private companies to access improved farm technologies, farm management practices, and access to markets.[143] In addition, cocoa companies support the training of public extension officers.

However, these services and inputs are inadequate and poorly timed, causing them to not reach farmers at the scale they need.[144] Only easier-to-reach farmers

133. Balineau, G., Bernath, S. & Pahuatini, V. (2017). Cocoa farmers' agricultural practices and livelihoods in Côte d'Ivoire. Insights from cocoa farmers and community baseline surveys conducted by Barry Callebaut between 2013 and 2015. Technical Reports, No. 24. AFD, Paris.
134. Karlan, D., Savonitto, B., Thuysbaert, B., & Udry, C. (2017). Impact of savings groups on the lives of the poor. *Proceedings of the National Academy of Sciences, 114*(12), 3079–3084.
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136. Vigneri, M., Serra, R., & Cardenas, A. L. (2016). *Researching the Impact of Increased Cocoa Yields on the Labour Market and Child Labour Risk in Ghana and Côte d'Ivoire*. Retrieved from https://cocoainitiative.org/wp-content/uploads/2016/12/market_research_full_web.pdf.
137. Barrientos, S.W & Asenso Akyere, K. (2012). Mapping sustainable production in Ghanaian cocoa, Report to Cadbury. Institute of Development Studies & University of Ghana.
138. Daniel, A. T., & Alex, A. (2017).
139. Barrientos, S.W & Asenso Akyere, K. (2012). Mapping sustainable production in Ghanaian cocoa, Report to Cadbury. Institute of Development Studies & University of Ghana.
140. Ibid.
141. Danso-Abbeam, G., & Baiyegunhi, L. J. S. (2020). Technical efficiency and technology gap in Ghana's cocoa industry: accounting for farm heterogeneity. *Applied Economics, 52*(1), 100–112.
142. Oomes, N., Tieben, B., Laven, A., Ammerlaan, T., Appelman, R., Biesenbeek, C., et al. (2016). *Market Concentration and Price Formation in the Global Cocoa Value Chain*.
143. Kroeger, A., Koenig, S., Thomson, A., Streck, C. with contributions from W., Paul-Harvey, & Bakhtary, H. (2017). *Forest- and Climate-Smart Cocoa in Côte d'Ivoire and Ghana, Aligning Stakeholders to Support Smallholders in Deforestation-Free Cocoa*.
144. Oomes, N. et al. (2016b).

have access to these services and inputs. Farmers in remote areas lack access, and many farmers do not receive support when needed, mainly because of the government's lack of capacity and the absence of coordination among actors providing them.[145] In some cases, this also results in the inefficient use of inputs, such as when farmers receiving these inputs do not know how to use them adequately.[146] Similarly, extension support by companies is neither widespread nor sufficiently staffed to reach enough smallholders for landscape-scale impact through the adoption of good agricultural practices.[147] Inputs need to be reliable, on time, at the needed location, sufficient in amount, and good in quality, and the distribution needs to be transparent.[148] Instead, existing efforts rarely offer a comprehensive suite of services that could transform smallholder practices at scale.

4.2.4 Farmer organizations

Membership in a farmer group helps farmers achieve higher productivity and income. Though some farmers see membership fees as a disadvantage of such groups, they provide farmers with better social contacts, increased knowledge exchange amongst one another, and a forum to discuss problems at the community level.[149] They also provide farmers with access to inputs and trainings and other technical assistance such as access to spraying machines and chain saws, which are costly and hard to access.[150] In Côte d'Ivoire, the need for resources and skills to adopt new practices makes the cooperative a good instrument for promoting new technologies in sustainable practices, but a lack of cocoa farmers' confidence in cooperatives remains an obstacle.[151] In addition, the aggregation and organization of cocoa farmers in West Africa is generally low (SEE SECTION 2.3).

4.2.5 Governance

Governments have failed to enforce laws that prohibit the clearance of forest and protected areas for cocoa cultivation. In Ghana, cocoa-driven deforestation regularly occurs in prohibited areas, such as National Parks and protected reserves.[152] In Côte d'Ivoire, more than a million people live illicitly in national parks and Forêts Classées (protected areas), including tens of thousands of cocoa squatters.[153] Local authorities are often aware of these unauthorized villages, which may even have schools and clinics.[154] This precarious situation adds human rights and livelihood implications of potential eviction to the complexity of other issues in the cocoa sector.[155] As much as 40 percent of cocoa in Côte d'Ivoire may come from protected areas.

145. Oomes, N. et al. (2016).
146. Hütz-Adams, F., Huber, C., Knoke, I., Morazán, Dr. P., & Mürlebach, M. (2016). *Strengthening the competitiveness of cocoa production and improving the income of cocoa producers in West and Central Africa*.
147. Asare, R. A. (2013). *Understanding and Defining Climate-Smart Cocoa: Extension, Inputs, Yields, and Farming Practices*.
148. Hütz-Adams, F. et al. (2016).
149. Ingram V., Waarts Y., van Vugt S.M., Ge L., Wegner L., Puister-Jansen L. (2013). Towards sustainable cocoa: Assessment of Cargill and Solidaridad cocoa farmer support activities in Côte d'Ivoire 2008-2012. LEI, Wageningen UR. Wageningen.; Waarts, Y. et al. (2013).
150. Donovan, J., Stoian, D., Foundjem, D., & Degrande, A. (2016). Fairtrade Cocoa in Ghana: Taking Stock and Looking Ahead. At http://www.worldagroforestry.org/publication/fairtrade-cocoa-ghana-taking-stock-and-looking-ahead
151. Meless Siméon, A., Djibli Vincent, D., & Guédé Bayard, B. (2019). Cocoa Farming and Difficulties in Adopting the Innovations of Intensive Agriculture in Boguedia (Côte d'Ivoire). *American Journal of Agriculture and Forestry, 7*(5), 177.
152. Tropenbos. (2018).
153. Fountain, A., & Huetz-Adams, F. (2018).
154. Ibid.
155. Aboa, A., & Bavier, J. (2016, September 6). Ivory Coast evicts thousands of cocoa farmers to save forests. Reuters. Retrieved May 4, 2020, from https://uk.reuters.com/article/us-ivorycoast-forests-cocoa-idUKKCN11C0IB.

Poor governance and weak law enforcement are also barriers to the successful implementation of sustainability programs and behavior change among farmers. Overall, the enforcement of compliance with regulations is generally weak, particularly issues such as land use regulation in forest areas,[156] child labor and workers conditions,[157] and cocoa smuggling.[158] Private regulation seeks to address some of these problems. For child labor issues, the Cocoa Industry Protocol was established in 2001.[159] For land use and deforestation issues, several regional and national standards for sustainable cocoa are being developed. In addition, voluntary market certifications such as Rainforest Alliance or UTZ have expanded to address the existing gaps in law enforcement.[160]

In Ghana, the cocoa sector remains controlled by public institutions, with a mixed report in goods and services provision. Since the 2000s, the sector has been liberalized which has led to global cocoa companies assuming more power.[161] However, public institutions continue to control prices and delivery of services (i.e., extension, infrastructure). In Ghana, corruption contributes to the mismanagement of public investment and therefore constrains infrastructure improvement and public service provisioning. Ultimately, it also generates criminality in the supply chain as the deficiencies of public institutions support the structural causes of poverty.[162] Furthermore, corruption in the weighing of cocoa during sales to buyers, which is common in the sector, allows illegal cocoa to enter the supply chain and detracts from farmer incomes.[163]

In Côte d'Ivoire, cocoa sector governance has shifted from a largely state-controlled approach to include a more active role for cocoa companies. Until the 1990s, the government of Côte d'Ivoire kept a strong grip on the cocoa sector. During the period of socio-political and military crisis from 2002 to 2012, the sector shifted towards a more corporate governance structure which was focused on maximizing revenues.[164] During this period, Côte d'Ivoire presented the characteristics of a "failed state".[165] Peace building in the last ten years has generally been seen as a great success. However, in some regions, tensions between village chiefs and local authorities has led to a resurgence of conflicting power dynamics.[166]

156. Obeng, S.K, Owusu, M., Asumang, D., Owusu, O., Mawutor, S., & de Koning, P. (2018). *Scoping Study on the Relevance of FLEGT-VPA for Sustainable Agro-commodity (cocoa) Initiatives in Ghana*. Retrieved from https://www.tropenbos.org/resources/publications/scoping+study+on+the+relevance+of+flegt-vpa+for+sustainable+agro-commodity+(cocoa)+initiatives+in+ghana.
157. Schrage, E., & Ewing, A. (2005). *The Cocoa Industry and Child Labour*. Retrieved from https://www.justice.gov.il/Units/Trafficking/MainDocs/The_Cocoa_Industry_and_child_labour.pdf.
158. Amankwah-Amoah, J., Debrah, Y. A., & Nuertey, D. (2018a). Institutional Legitimacy, Cross-Border Trade and Institutional Voids: Insights from the Cocoa Industry in Ghana. *Journal of Rural Studies, 58*, 136–145.
159. Schrage Elliot, & Ewing Anthony. (2005).
160. Uribe-Leitz, E., & Ruf, F. (2019). Cocoa Certification in West Africa: The Need for Change. In M. Schmidt, D. Giovannucci, D. Palekhov, & B. Hansmann (Eds.), *Sustainable Global Value Chains* (pp. 435–461). Retrieved March 10, 2020, from https://doi.org/10.1007/978-3-319-14877-9_24.
161. Giel, T., Hagelaar, G., Laven, A., & Vellema, S. (2008). Chain governance, sector policies and economic sustainability in cocoa. Retrieved from https://library.wur.nl/WebQuery/wurpubs/fulltext/681.
162. Amankwah-Amoah, J., Debrah, Y. A., & Nuertey, D. (2018b). Institutional Legitimacy, Cross-Border Trade and Institutional Voids: Insights from the Cocoa Industry in Ghana. *Journal of Rural Studies, 58*, 136–145.
163. Laven, A. & Van Heck, P. (2015). Ideation of Small Medium Enterprise services in cocoa growing communities in Ghana.
164. Giel ton et al. (2008).
165. Muilerman, S., & Vellema, S. (2017). Scaling service delivery in a failed state: cocoa smallholders, Farmer Field Schools, persistent bureaucrats and institutional work in Côte d'Ivoire. *International Journal of Agricultural Sustainability, 15*(1), 83–98.
166. Grajales, J. (2020). From war to wealth? Land policies and the peace economy in Côte d'Ivoire. *Review of African Political Economy*, 1–17.

5. Survey results

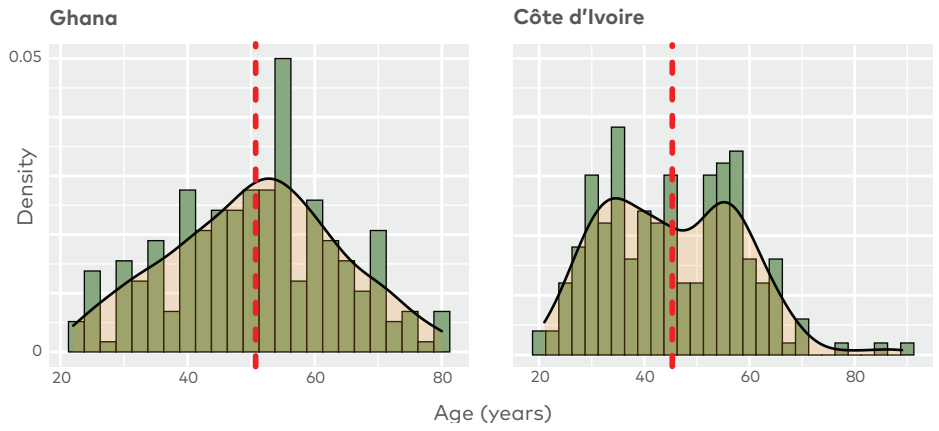
Note: The following section addresses the quantitative part of our results based on the analysis of survey data and stakeholder interviews **(SECTIONS 3.2.2 AND 3.2.3)**. In this chapter, references to C and G are intended to mean the surveyed communities, which are not representative of the entire countries.

Of the 200 and 232 farmers we interviewed in Côte d'Ivoire and Ghana, 93.5 percent and 62.1 percent were male, respectively.
Although purposive sampling was applied in both countries to ensure female representation in the respondents, the difference in our data between the countries suggests that the gender imbalance among farmers is higher in the Côte d'Ivoire sample. Given the small number of female-headed farms surveyed in Côte d'Ivoire, the quantitative analysis of gender issues throughout this study will focus on the Ghana sample. In regards to the age distribution of farmers, we observe generally a younger farming population in Côte d'Ivoire (45 years old on average vs 51 in Ghana) **(FIGURE 3; TABLE 2)**, in line with previous findings.[167] Only 5.2 percent of farmers in Ghana were between the ages of 20 to 29 years, compared to 11.1 percent in Côte d'Ivoire.

FIGURE 3

Age distribution of head farmers in Ghana and Côte d'Ivoire

As observed, Côte d'Ivoire farmers are younger (mean age, 45) in relation to their Ghanaian counterparts (mean age, 51). The black line represents the overall density distribution. Similar to a histogram, it gives the probability of finding a given value of x; the red line is the average; and the green bars is the age frequency.



In Ghana, more than half of the interviewed farmers had a secondary education and alternative income sources. The majority of the interviewed farmers in Côte d'Ivoire (65.3%) had no education and only 9.1 percent attended either secondary school or vocational training. In contrast, 55.2 percent of respondents in Ghana declared having completed secondary education and only 22.4 percent have no education at all. Total farm income was higher in Côte d'Ivoire (USD 2,482) than in Ghana (USD 1,067). The reported income is slightly lower than in other sources for Côte d'Ivoire and about half of what other sources report in Ghana.[168] In Côte d'Ivoire, 67.3 percent of the farmers fully depended on cocoa cultivation (Ghana 33.6%). In Ghana, the majority of sampled farmers had a diversified income: from vegetable farming (34.5%), to trade or other business (20.7%), and animal keeping (22.0%). These three occupations also represent the majority of occupations other than cocoa farming in Côte d'Ivoire, albeit to a lesser degree.

167. Bymolt, R., Laven, A., & Tyszler, M. (2018a). *Demystifying the cocoa sector in Ghana and Côte d'Ivoire: Chapter 3: Demographics*. Retrieved March 5, 2020, from https://www.kit.nl/wp-content/uploads/2018/10/Demystifying-cocoa-sector-chapter3-respondents-and-households-demographics.pdf.
168. Bymolt, R. et al. (2018).

5.1 Cocoa practices of surveyed farmers

In Ghana, 81.5 percent of the surveyed farmers reported owning their farms, either through formal or customary arrangements; farms were larger, and they were more likely to be near forests. In Côte d'Ivoire, only 13.1 percent of the respondents indicated that they own their farms. In Côte d'Ivoire, more farms had a deforestation history (74.4 percent of the respondents vs 21.1 percent in Ghana disclosed forest as the previous land use). Indeed, surrounding forest areas are now less common in Côte d'Ivoire (4.5% of farms) than in Ghana (22.4%). In addition, the sampled farms in Côte d'Ivoire were larger (5.2 ha on average) than in Ghana (3.8 ha). In Côte d'Ivoire, 63.2 percent of the cocoa trees were ten years or younger (Ghana 15.6%), which further suggests the recent establishment of the farms. These findings suggest a relationship between lack of title and deforestation (as in Côte d'Ivoire) compared with larger and more stable farms in Ghana.

TABLE 2

Demographics of farmers in Côte d'Ivoire and Ghana

shown as percent of respondents	CÔTE D'IVOIRE	GHANA
VARIABLE	TOTAL	TOTAL
Gender		
Male	93.5%	62.1%
Female	6.5%	37.9%
Age		
Age (20–30 years)	13.1%	8.6%
Age (31–40 years)	28.1%	15.1%
Age (41–50 years)	18.6%	24.6%
Age (51–60 years)	28.6%	28.9%
Age (+60 years)	11.6%	22.8%
Resident (native)	18.2%	53.4%
Education		
No education	65.3%	22.4%
Primary	25.6%	20.7%
Secondary/Vocational School	9.1%	55.2%
Tertiary	0	1.7%
Average income (1st to 3rd quartile)	USD 2,482.40 (1,491.40–3,065.70)	USD 1,067 Category * 6.2 (4-8)
* Farmers' income in Ghana was recorded by categories. N=1, 2,...11 categories reflect 1,000, 2,000,...,11,000 Ghanaian Cedi. One Ghanadian Cedi equals USD 0.17. The mean 6.2 from the table corresponds to USD 1,067.		
Other occupation		
Vegetable farming	17.6%	34.5%
Trade/business	10.6%	20.7%
Animal keeping	9.0%	22.0%
Mining	0	0
Bar	0	0.4%
Shop	1.0%	0.9%
Salaried job	0.5%	3.0%
No other occupation	67.3%	33.6%

In Ghana, more surveyed farmers had attended GAP trainings, and more farmers had the ability to hire labor. Of the surveyed farmers in Ghana, 76.3 percent had attended GAP training during the last year, compared to just 33.2 percent in Côte d'Ivoire. The percentage among the surveyed farmers that received training in Ghana is uncharacteristically high; other studies found that the majority of farmers had never seen an extension agent.[169]

About three fourths (74.6%) of the interviewed farmers in Ghana hired labor, compared to just 24.6 percent in Côte d'Ivoire. In Ghana, manure and compost use was higher (29.7% vs 20.6%) and inorganic application lower (44.8% vs 79.4%). However, shading practices using non-cocoa trees are slightly more used in Côte d'Ivoire (63.4% vs 52.3%). Finally, the yields were higher for Côte d'Ivoire than for Ghana (370 kg/ha vs 300.8 kg/ha). The farming systems and agricultural practices of the farms surveyed in Côte d'Ivoire and Ghana are presented in TABLE 3.

TABLE 3

Farming systems and agricultural practice characteristics of farmers in Côte d'Ivoire and Ghana

shown as percent of respondents	CÔTE D'IVOIRE	GHANA
VARIABLE	TOTAL	TOTAL
Farm		
Farm ownership	13.1%	81.5%
Farm size	5.2 ha	3.8 ha
Previously forest	74.4%	21.1%
Surrounding forest areas	4.5%	22.4%
Farming system		
Tree age (1–5 years)	31.6%	2.3%
Tree age (5–10 years)	30.6%	13.3%
Tree age (10–15 years)	3.6%	23.7%
Tree age (15–20 years)	2.0%	18.5%
Tree age (20–25 years)	6.7%	23.7%
Tree age (>25 years)	25.5%	18.5%
Shading (no shade)	47.7%	36.6%
GAP trainings	33.2%	76.3%
Agricultural and management practices		
Organic fertilizer use	20.6%	29.7%
Inorganic fertilizer use	79.8%	45.8%
Weeding	100%	100%
Pruning	92.0%	98.3%
Hire labor	24.6%	74.6%
Yield	370.5 kg/ha	300.8 kg/ha

169. Hirons, M., Robinson, E., McDermott, C., Morel, A., Asare, R., Boyd, E., et al. (2018). Understanding Poverty in Cash-crop Agro-forestry Systems: Evidence from Ghana and Ethiopia. *Ecological Economics, 154*, 31–41.

5.2 Productivity changes

In Côte d'Ivoire, farmers see their yield declining, while respondents in Ghana see a trend to stable or improving yields. Nearly half of farmers surveyed in Ghana consistently said they did better in the past year (TABLE 4); in Côte d'Ivoire, nearly two thirds of farmers consistently said they did worse. Observing the response across time, an increasing number of farmers in Ghana report perceiving positive changes, while it is stable or slightly worse for Côte d'Ivoire. For the farmers interviewed in Ghana, knowledge, training, and available inputs represent the most repeated reasons behind these perceived changes in productivity, while in Côte d'Ivoire, farmers state experience, inputs available, and weather-related reasons (TABLE 5). Additionally, the presence of younger trees in Ghana can be another reason explaining these perceived changes.

The production limitations farmers reported facing were consistent between countries (TABLE 6). Farmers named the tree age (60.3% of farms in Ghana valued this reason vs 64.8% in Côte d'Ivoire), lack of input application (65.5% vs 64.3%), and changing weather patterns (78.9% vs 65.3%). Further reasons relate to the lack of good seedlings in Ghana (24.6% vs 1.0% in Côte d'Ivoire), the absence of GAP trainings (22.8% vs 46.2%), and the insufficiency of labor (36.1% vs 38.2%).

TABLE 4

Farmer perception on productivity changes

shown as percent of respondents	SAME	BETTER	WORSE
Last year			
Ghana	25.9%	45.7%	28.4%
Côte d'Ivoire	8.5%	28.6%	62.8%
Last 3 Years			
Ghana	39.2%	44.0%	16.6%
Côte d'Ivoire	8.0%	31.2%	60.8%
Last 5 years			
Ghana	50.3%	28.9%	20.7%
Côte d'Ivoire	11.1%	30.7%	58.3%

TABLE 5

Argumentation for farmer perception on productivity changes

shown as percent of respondents	GHANA	CÔTE D'IVOIRE
In-depth knowledge about farming	47.0%	3.0%
Training received	55.2%	0
Experience	28.4%	20.1%
Inputs available	45.3%	19.6%
Youth team services	0.9%	1.0%
Government intervention	21.1%	0.5%
Weather	30.0%	23.9%

TABLE 6

Farmer perspectives on production limitations

shown as percent of respondents	GHANA	CÔTE D'IVOIRE
Old trees	60.3%	64.8%
Changing weather patterns	78.9%	65.3%
Lack of input application (or not on time)	65.5%	64.3%
Lack of good seedlings	24.6%	46.0%
Lack of GAP	22.8%	46.2%
Lack of labor	36.1%	38.2%

Nearly all farmers report that they wish to invest in their farm in the future. However, the desire to invest does not necessarily mean that farmers will invest or have the funds to invest. Most farmers wish to expand their farm (80.2 percent of farmers in Ghana vs 69.8 percent in Côte d'Ivoire), which is likely a negative outcome in relation to the protection of the surrounding natural environment. Additionally, farmers wish to invest in inputs (Ghana 81.0% vs Côte d'Ivoire 52.8%), other crops (5.2% vs 3.0%), animals (10.8% vs 2.5%), and replanting (28.0% vs 66.9%). The comparatively larger wish to invest in inputs in Ghana matches the Ghanaian sample's lower use of fertilizer at present, while the replanting investments are consistent with the proportion of trees that appear in younger categories. Farmers in Côte d'Ivoire have younger trees (possibly in part because they established their farms more recently). Respondents from stakeholder interviews in Ghana indeed highlight that aging trees is one of their largest challenges.

A surprisingly small number of farmers is planning to invest in non-cocoa shade trees (15.5% in Ghana vs 1.0% in Côte d'Ivoire). Planting trees is a cornerstone of GAP in cocoa farming systems, but agroforestry practices are currently infrequent within the communities surveyed. It is also consistent with the use of full-sun varieties that are marketed in Ghana. While safeguarding remaining forests is certainly critical, the integration of non-cocoa shade trees is arguably the key strategy for SSI implementation in both countries. This shows that significant work is required in shifting farmer attitudes towards more shade trees.

5.3 Factors influencing farmer behavior

5.3.1 Land tenure

Ownership and tenure documentation are very clearly associated with positive increases in cocoa productivity. The mean cocoa income per ha of the surveyed farmers in Ghana with documented land ownership is 15.5 percent larger than those without land (FIGURE 4). This positive dynamic is also observed in our model, which accounts for the range of identified variables contributing to farming productivity (Model 1 Adjusted R-squared: 0.49). Indeed, tenure documentation presents the largest coefficient in the model. Having ownership increases productivity by 21.9 percent on average, all other variables held constant. This suggests that farmers with documented ownership are more likely to both engage in long-term investments in their farm and adopt good agricultural practices. Additionally, considering both formal or customary arrangements, our results suggest that farmers with ownership are more likely to have healthier farms. Diseases were reported on 30.7 percent of farms with ownership against 48.8 percent without ownership. A similar dynamic is displayed for Côte d'Ivoire (38.2% vs 65.4%).

A farmer's resident status and age play a role in formal or customary ownership. Our results suggest that native farmers in Ghana are more likely to have ownership (92.7%) in relation to migrants (68.5%). In addition, farmers with ownership tend to be older (52.5 years old on average) than their counterparts (43 years old) (FIGURE 5). Interestingly, however, this does not translate into older farmers having higher productivity than younger ones. Older farmers are comparatively less likely to engage in changing practices despite their more favorable contexts identified in the data, such as larger farm sizes, higher total income, and more secure land rights. Finally, it should be noted that 40.2 percent of farmers reporting to have ownership of their land do not actually have tenure documents.

FIGURE 4

Farm performance (cocoa income per ha) by land tenure documentation

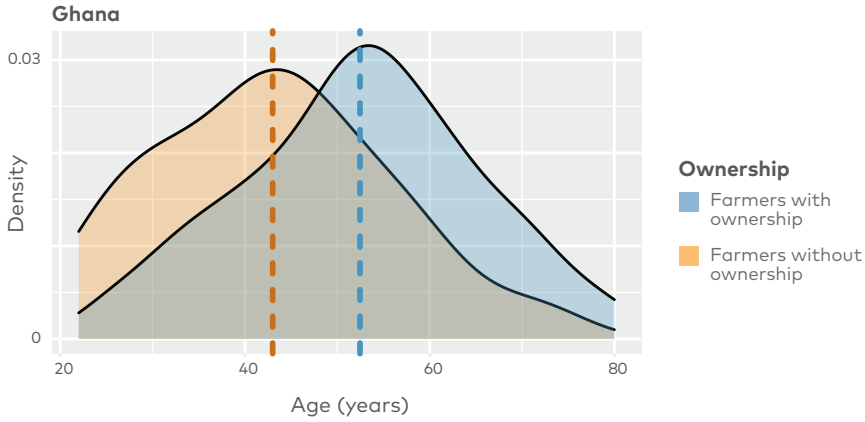
As observed, farms with land tenure documentation clearly outperform farms without ownership (mean cocoa income per ha: 0.82 vs 0.71). The black line represents the overall density distribution, similar to a histogram. It gives the probability of finding a given value of x. The dashed lines depict the average. This figure is depicting the data; it is not the output of a model.

* Category unit explained in Table 2.

FIGURE 5

Relationship between ownership and age of farmers in Ghana

As observed, farmers with ownership tend to be older than farmers without ownership (mean age 42 vs 52). Ownership here includes both formal or customary arrangements. This figure is depicting the data; it is not the output of a model.



5.3.2 Improved practices

Improved farming practices translate to a higher farm productivity. Farmers attending GAP trainings presented better performance in relation to their counterparts (FIGURE 6); specifically, mean average performance (cocoa income per ha) was 4.5 percent and 22.6 percent higher in farms participating in trainings in Ghana and Côte d'Ivoire, respectively. These results are confirmed for Ghana in MODEL 1. As observed, support from NGOs, government, and companies in relation to GAPs had a clear positive effect on farm performance.

The importance of Good Agricultural Practices is further confirmed by the Côte d'Ivoire models. Results suggest that attending GAP training increases productivity significantly by 33.3 percent (Model 2 Adjusted R-squared: 0.26; and by 56.8% in Model 3 Adjusted R-squared: 0.24). The relatively high percentages presented in this section can be interpreted in the context of the large range existing in cocoa income productivity across farms. Focusing on the subset of Côte d'Ivoire farms that participate in cooperatives (MODEL 3), we find that farms not engaging in any shading practice substantially reduce their productivity in relation to farmers using full shading practices (by 48.8%), and that replanting of cocoa trees also increases farm performance (by 54.9%). The distribution of performance by farmers using different shading practices can be observed in FIGURE 7. Interestingly, replanting in Ghana was found to vary by age: the mean age of farmers that do not replant was higher (59.9 years old) than farmers that do replant (49.7 years old). Similarly, farmers engaging in shading practices were found to be younger on average (44.9 years old) than farmers not using any shading practices (52.8 years old).

FIGURE 6

Farm performance by attendance of GAP trainings

As observed, there is a clear positive effect of GAP attendance on cocoa income per ha for Côte d'Ivoire (mean cocoa income per ha of 354,035.9 vs 288,782.5). This figure is depicting the data; it is not the output of a model.

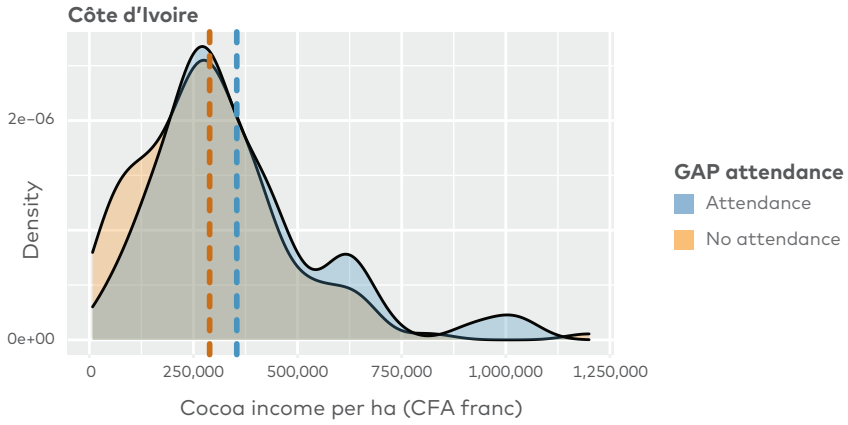
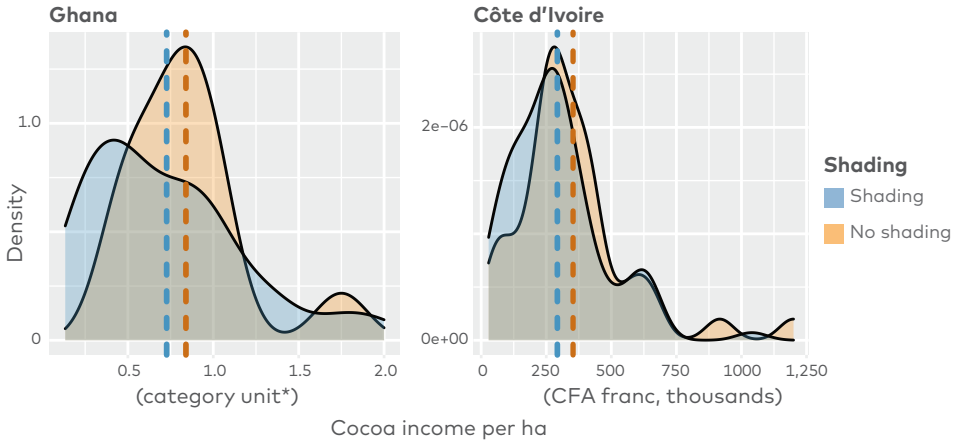


FIGURE 7

Farm performance by shading practices

As observed, shading clearly outperforms no shading practice for both countries (mean cocoa income per ha in Ghana: 0.84 vs 0.72; in Côte d'Ivoire 352,952.2 vs 289,564.6). This figure is depicting the data; it is not the output of a model.

* Category unit explained in Table 2.

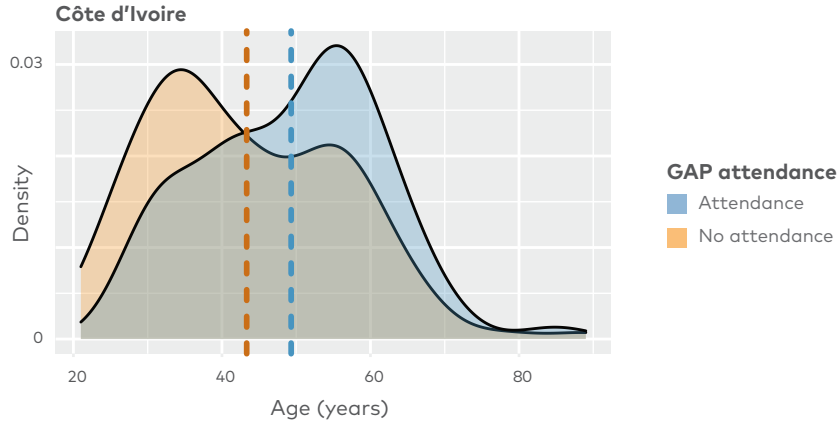


In Côte d'Ivoire, the findings suggest that although older farmers are more likely to attend Good Agricultural Practices trainings (FIGURE 8), younger ones are more likely to implement the learned skills. These findings could suggest that cooperatives engaging in GAP trainings in Côte d'Ivoire could be disproportionately and unknowingly targeting older farmers that are more established as a result of older farmers having more time and being more likely to accept the invitations sent out to cooperative members. Cooperatives engaging in GAP trainings in Côte d'Ivoire could therefore be missing the benefits of engaging younger populations that are more likely to change their practices.

FIGURE 8

Relationship between GAP training attendance and age of farmers in Côte d'Ivoire

As observed, older farmers are more likely to attend than younger farmers. Mean age 49 vs 43. This figure is depicting the data; it is not the output of a model.



5.3.3 Farmer support and access to credit

Support for farmers increases the adoption of Good Agricultural Practices and zero-deforestation practices while also increasing farm productivity. In Ghana, farmers with access to credit present 15.7 percent higher average performance in comparison to their counterparts (FIGURE 9). In the same direction, farmers declaring having borrowed recently also show a better performance (FIGURE 10). Accounting for the interaction with other variables, MODEL 1 shows the importance that different forms of farmer support (NGO, companies, government) have in overall productivity. For instance, farmers receiving support from NGOs in terms of inputs increase their performance on average by 15.4 percent. It is clear that, in the absence of these different forms of support, farmers would need access to credit for the implementation of GAPs to move forward. Farmers with ties to NGOs and access to credit are more likely to invest in long-term improvements in their farm and are more likely to have access to the needed agricultural inputs required to increase their farm productivity. Analogous to land tenure, farmers in Côte d'Ivoire declare not having access to credit, and therefore its importance does not show up in the model; however, the considerations from Ghana are likely to also apply to their circumstances.

Although the mode of payment to farmers differs by country, farmers across communities consistently invest from their savings. Farmers in Ghana receive payments in cash, mobile, and credit (84.1%, 14.9%, and 1.0% respectively). The picture is slightly more mixed for Côte d'Ivoire: 100 percent of farmers are paid in cash and 41.8 percent of them are also paid in credit. Although the amount of time involved in the definition of credit is likely to vary amongst farmers, these responses suggest that farmers in Côte d'Ivoire could be more likely to receive later payments. A large majority of farmers surveyed wish to further invest in their farm. In Ghana and Côte d'Ivoire respectively, 84 percent and 98 percent of farmers declare they wish to invest in the future from their savings. In practice, however, the ability to invest will largely be decided by access to credit with regards to GAP and the necessary farming inputs for sustainable cocoa farming systems, the ability to invest will be largely decided by access to credit.

FIGURE 9

Farmers performance by access to credit

As observed, farms in Ghana with access to credit clearly outperform farms without access. Mean cocoa income per ha 0.81 vs 0.7. This figure is depicting the data; it is not the output of a model.

* Category unit explained in Table 2.

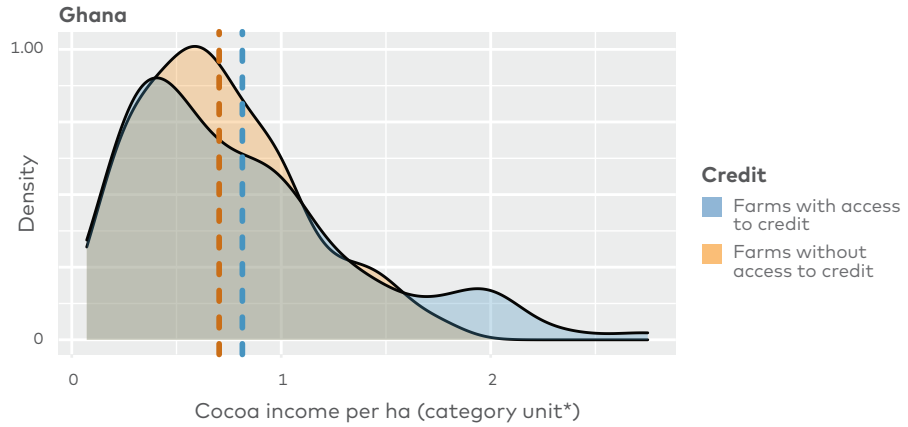
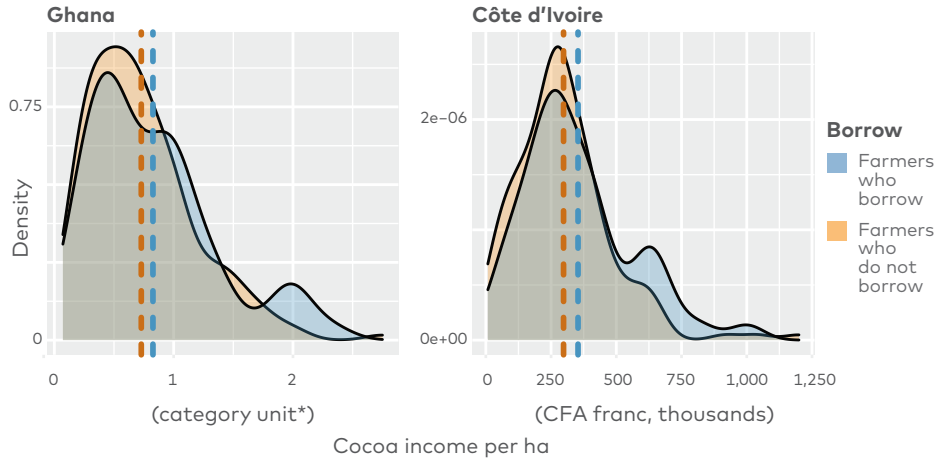


FIGURE 10

Farm performance by farmers who borrow

As observed, farmers who borrow in both countries tend to present better performance. Mean cocoa income per ha (Ghana 0.82 vs 0.72; Côte d'Ivoire 353381.8 vs 297871.8). This figure is depicting the data; it is not the output of a model.

* Category unit explained in Table 2.



5.3.4 Deforested lands

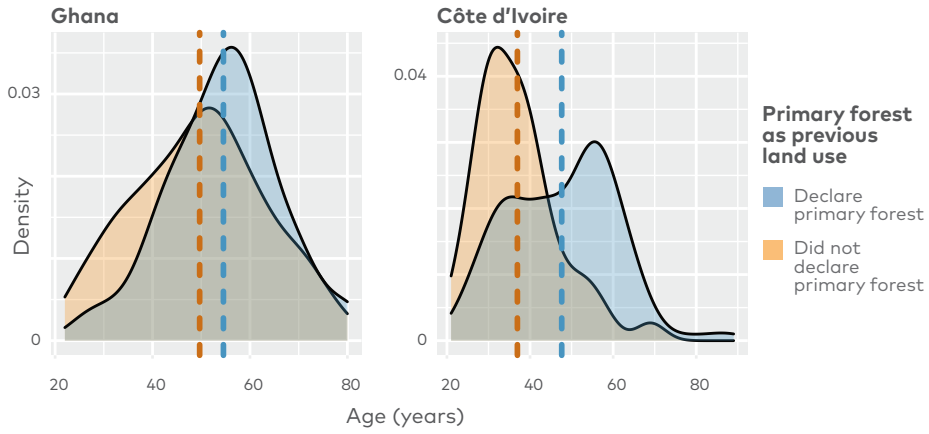
Older farmers have more plots on deforested lands. Farmers declaring primary forest as the land use previous to the establishment of the cocoa farm tend to be older in Ghana (54.6 years old vs 49.7 years old) and in Côte d'Ivoire (47.6 years old vs 37.0 years old) (FIGURE 11). Of course, this could be a response to historic landscape dynamics, where the newcomer farmers have less forest to deforest than those who arrived first.

In Ghana, farmers with crop insurance, who tend to be younger, deforested less than those without insurance, who tend to be older. (12.1% of farmers with insurance deforested vs 22.6 percent of farmers without insurance). These observations are backed by literature that suggests crop insurance as a potential tool to reduce deforestation by reducing smallholders' need to encroach into forests.[170]

FIGURE 11

Primary forest loss by age in Ghana and Côte d'Ivoire

As observed in both countries, farmers declaring primary forest as the previous land use corresponds to older populations (Ghana 55 vs 50; Côte d'Ivoire 48 vs 37). This figure is depicting the data; it is not the output of a model.



5.3.5 Gender, resident status, and age

Gender was found to represent a significant negative effect on farm productivity in Ghana (MODEL 1). In Côte d'Ivoire, there were not enough female-headed farms to make a meaningful assessment. In Ghana, female-headed farms tend to be smaller in size (28.8 percent smaller on average in Ghana) and female heads attend slightly more GAP trainings (80.7% vs 73.6% for males) yet present a lower farm performance. This is surprising, given that smaller farms tend to outperform larger ones (FIGURE 12) and farmers attending GAP trainings in Ghana present overall better performance (FIGURE 6). Accounting for other variables

170. McKinley, J. et al. (2016).

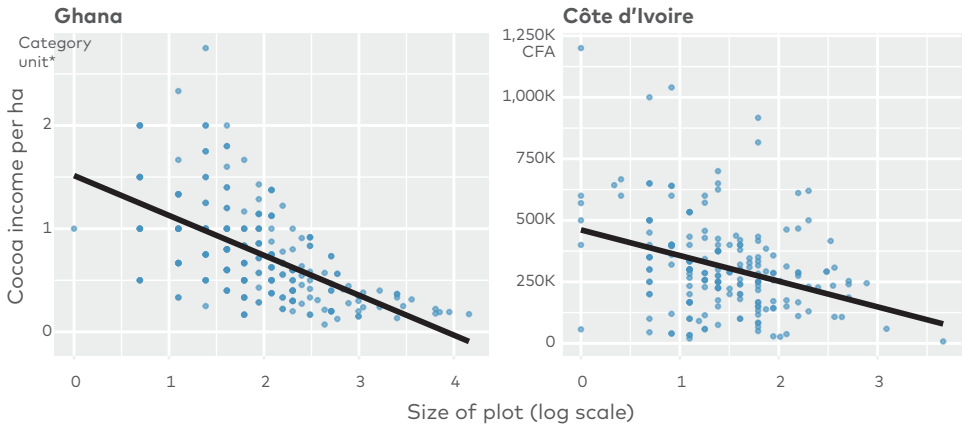
(MODEL 1), we observe that female-headed farms reduce average performance by 21.7 percent in relation to male-headed farms. Loans or access to credit were not found to be relevant factors in relation to gender differences in these farms. It is therefore clear that there must be some other factors likely explaining this difference in performance.

FIGURE 12

Relationship between farm performance (cocoa income per ha) and size of farm

As observed, for both countries there is a clear negative relationship between performance and size, suggesting smaller farms to be more efficient. This is confirmed in all three country models (See Models 1, 2, and 3 in Annex). For instance, a 1% increase in farm size reduces productivity by 0.7% and 0.5% in Ghana and Côte d'Ivoire, respectively.

* Category unit explained in Table 2.



We observe three major trends that may explain the lower farm performance of female heads. First, we find that despite the larger attendance at GAP trainings, the implementation of Good Agricultural Practices by female heads is slightly lower than for males, such as with pruning practices (96.6% females vs 99.3% males), replanting (87.5% vs 92.4%), use of manure (23.9% vs 33.3%), and full shading (3.4% vs 6.3%). Second, we find that female heads engage more in labor hiring practices in relation to males (80.7% vs 70.8% in Ghana; 46.2% vs 23.1% in Côte d'Ivoire). Investing a higher amount of income or finance in labor practices likely reduces the amount of funds left to invest in improved agricultural practices. Third, it is likely that more female farmers engage in more subsistence-oriented practices (i.e., including a larger variety of products besides cocoa), which would also explain the lower efficiency on a per ha basis.

Resident status was found to represent a significant effect on farm productivity in Ghana, while age is a relevant factor in Côte d'Ivoire. Migrant farmers in Ghana likely experience additional hurdles in relation to native farmers and therefore present a negative association to farm productivity (MODEL 1). Specifically, accounting for other variables, an average productivity reduction of 18.1 percent is expected in relation to farmers presenting a native resident status. Finally, the role of farming experience likely plays a role in the younger farming population of Côte d'Ivoire. According to MODEL 2, a 1.1 percent increase in productivity occurs on average for each yearly increase in age.

5.4 Limitations

The quality of the data used depends, to some extent, on the reliability of answers given by the farmers. There are different reasons why responses from smallholders can lack accuracy. In some instances, for example, people can underestimate incomes if they think they will receive more support. As a result, some caution is needed when evaluating absolute metrics in isolation. However, it is expected that farmers will consistently engage in these biased answers, and therefore, as a whole it would not have a relevant impact in the results presented in the model.

The implementation of survey designs tends to target established farmers and overlook marginal farmers. Interventions in the cocoa sector that address behavioral changes to increase productivity necessarily engage with more established farmers, or at least these farmers tend to be prioritized in a context of limited resources. Farmers receiving support or belonging to some types of organizations, such as cooperatives, are likely to be in a better situation than recently established farmers. Our sample, which includes an uncharacteristically high level of GAP training, is less likely to include marginal farmers that are disproportionally engaging in deforestation practices. Although it is a hard balance to strike and numerous logistical difficulties exist in these challenging environments, future surveys should nevertheless attempt to include marginal farmers in their assessments, which would render more granular insights regarding the landscape-level deforestation dynamics of the sector.

The models obtained describe a limited amount of the variability in farm productivity (Adjusted R-squared: 0.49, 0.26, and 0.24 for the three models, respectively) for the following reasons. Firstly, there are other factors explaining productivity that are out of the scope of the study, namely factors describing different climate-related variables or soil conditions. Secondly, the quantitative part of the study has focused strongly on the use of categorical-type answers (e.g., 'yes' or 'no' for fertilization practices). The quantification of many of these variables would likely improve substantially the amount of variability explained. However, our results are sufficient to conclude that there is indeed an important link between GAPs, farmer support, access to credit, and improved performance in cocoa systems.

Finally, the depth of this study was constrained by our time, capacities, and resources. Organizing interviews was challenging, especially in Côte d'Ivoire due to the sensitivity of the topic. It was especially difficult to obtain information on the illegal and informal sectors of the cocoa supply chain. Additionally, human rights are another major concern in this sector, specifically regarding child labor. However, the topic transcends the scope of our study.

6. Discussion

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The results from the models separately address the samples of each country, and, as a result, some caution is needed in making direct comparisons between communities and countries. Nevertheless, behaviors and characteristics we observe in the results from each model can provide insight on the dynamics influencing farmer decision-making and the adoption of sustainable practices. This discussion presents our reflections on these issues, informed by our qualitative assessment of SSIs and the implementation context, literature review, survey results, and stakeholder interviews.

6.1 Effects of demographic factors on sustainable practices

Our findings suggest that younger farmers are more likely to apply learned skills and engage in new practices. The surveyed farmers in Côte d'Ivoire were generally younger and presented a higher proportion of males and migrants compared to the sample in Ghana. Our literature review revealed that cocoa farmers generally represent an aging population, and the youth are not easily motivated to participate in cocoa farming due to prevailing poverty and better opportunities elsewhere.[171] However, younger farmers tend to be more flexible and appreciative of new practices. They may also be more predisposed to taking risks.[172] This is demonstrated by our sample in Ghana where younger farmers undertook more long-term practice changes (e.g., shading, replanting) than older farmers; smallholders who have been working in cocoa production for a long time are more likely to continue methods they are already practicing.[173] Companies and NGOs interviewed confirmed that older farmers tend to rely on well-established cultural norms and be less open to changing their mindset or behaviors.

In our Ghana sample, we observe that the barriers female farmers face exert a negative impact on their production.[174] The number of women in the Côte d'Ivoire sample was too small to derive meaningful insights. In Ghana, however, in addition to experiencing larger hurdles in relation to land ownership, our data indicates that despite attending more trainings and borrowing more money, our sampled women invest in fewer GAPs, hire more labor, and engage in more subsistence activities, in line with the literature.[175] Interestingly, discussions with women in Ghana revealed that acquiring their inputs in stores and raising their own seedlings, whereas many men received access to government support and reported being provided such inputs directly by the government and NGOs – even within the same association.[176] These factors and additional costs (e.g., labor, inputs) demonstrate the disadvantaged position of these women within their

171. Bymolt, R., Laven, A., & Tyszler, M. (2018). *Demystifying the cocoa sector in Ghana and Côte d'Ivoire: Chapter 3: Demographics*. Retrieved March 5, 2020, from https://www.kit.nl/wp-content/uploads/2018/10/Demystifying-cocoa-sector-chapter3-respondents-and-households-demographics.pdf; Löwe, A. (2017); Daniel, A. T., & Alex, A. (2017).
172. Djokoto, J. G., Owusu, V., & Awunyo-Vitor, D. (2016).Adoption of organic agriculture: Evidence from cocoa farming in Ghana, Cogent Food & Agriculture, 2:1.
173. Barrientos, S.W & Asenso Akyere, K. (2012). Mapping sustainable production in Ghanaian cocoa, Report to Cadbury. Institute of Development Studies & University of Ghana; Daniel, A. T., & Alex, A. (2017).
174. Hiscox, M., & Goldstein, R. (2014). Gender Inequality in the Ghanaian Cocoa Sector. Harvard University. At https://www.cocoalife.org/~/media/CocoaLife/News%20Articles%20PDF/Ghana%20Gender%20Assessment%20by%20Harvard%20University.pdf; Barrientos, S.W & Asenso Akyere, K. (2012). Mapping sustainable production in Ghanaian cocoa, Report to Cadbury. Institute of Development Studies & University of Ghana.
175. Ruf, F., & Schroth, G. (Eds.). (2015). Economics and ecology of diversification: the case of tropical tree crops.; Bymolt, R., Laven, A., & Tyszler, M. (2018).
176. Zamasiya, B., Kefasi, N., & Mukamuri, B. (2017). Factors influencing smallholder farmers' behavioural intention towards adaptation to climate change in transitional climatic zones: A case study of Hwedza District in Zimbabwe. *Journal of Environmental Management, 198*, 233–239.

communities. However, their interest in sustainable practices (e.g., attending trainings) suggests that they are likely to implement GAPs provided they receive the necessary support.

Migrants have less or no access to land titles, which can contribute to deforestation. In our Ghana sample, we observed that native famers show higher rates of productivity than migrant farmers. This is likely linked to land tenure, which may be why we do not observe the same in Côte d'Ivoire. In Côte d'Ivoire, it is impossible for migrants to own land.[177] Instead, according to a public institution in Côte d'Ivoire we interviewed, deforesting the land in Fôrets Classées (protected areas) may be a way to "claim" it. More farmers in our sample in Côte d'Ivoire reported primary forest as the previous land use compared to our respondents in Ghana.

6.2 Finance and knowledge as precursors to behavioral change

Both farmers with access to credit and farmers who borrow present overall higher productivity (income per hectare). Most farmers cannot afford to invest in new practices or the inputs that are needed for improving their farm productivity.[178] However, even when they attend more trainings to afford improving their cocoa practices (e.g., shade, replanting, pruning) or obtaining higher quality or quantities of inputs (e.g., fertilizers, equipment), some farmers will require financial assistance more than others.[179] While our data only provides conclusive evidence for our Ghana sample, it is likely that the situation in Côte d'Ivoire is similar.[180] Our sample from Ghana demonstrates that farmers with higher income tend to invest more in their farms, or that farmers with less resources (e.g., female or migrant farmers) are less likely to implement GAPs, even when attending more trainings. Farmers with access to credit can also diversify their income, which alleviates the seasonality aspect of cocoa farming and the periods of time after replanting.

Informal lending plays a critical role for farmers in the short-term but cannot substitute formalized financial services. Cocoa farmers' access to loans via the banking system and formal credit institutions is very limited, and group self-lending is an alternative with limited coverage and capacities.[181] Financial institutions still perceive engaging with cocoa farmers as an activity that involves too many financial risks. As stakeholders from all boards mentioned, very few cocoa producers can meet the legal (e.g., having an ID) and financial (e.g., asset collateral) requirements to obtain individual loans. And when they do, generally the interest rates and conditions are not favorable. As a result, cocoa farmers surveyed in Ghana indicated that they participate in group borrowing schemes such as village or association lending groups. In Côte d'Ivoire, some companies have indicated that their strategy is to support the capacity of cooperatives to acquire loans or provide loans directly. The cooperatives can then provide advance payments in consideration of future harvests.

Training and the use of farm inputs has a clear effect on optimizing cocoa yields. Farmers with more attendance to GAP trainings have a higher rate of adoption of those practices and therefore higher yield and reduced cocoa losses.

177. Fountain, A., & Huetz-Adams, F. (2015).
178. Oomes, N. et al. (2016b).
179. Barrientos, S.W & Asenso Akyere, K. (2012). Mapping sustainable production in Ghanaian cocoa, Report to Cadbury. Institute of Development Studies & University of Ghana.
180. Meless Siméon, A., Djibli Vincent, D., & Guédé Bayard, B. (2019). Cocoa Farming and Difficulties in Adopting the Innovations of Intensive Agriculture in Boguedia (Côte d'Ivoire). *American Journal of Agriculture and Forestry, 7*(5), 177.
181. Balineau, G., Bernath, S. & Pahuatini, V. (2017). Cocoa farmers' agricultural practices and livelihoods in Côte d'Ivoire. Insights from cocoa farmers and community baseline surveys conducted by Barry Callebaut between 2013 and 2015. Technical Reports, No. 24. AFD, Paris.

This is particularly the case for yields that are constrained by soil nutrient content, which increases the risk of crop loss due to pest and diseases. Companies are aware that farm inputs are costly for farmers, especially good quality inputs for sustainable farm practices, and often providing inputs as part of SSI implementation.

The entry threshold – or amount of time, complexity, and financial efforts needed for sustainable farm practices – influence the adoption rates. Easily implemented and cost-efficient GAPs show high adoption rates. Those practices can be performed with simple mechanical tools and lead to fast visible results on the farm. We confirm this by showing that the adoption rates of weeding and pruning are almost 100 percent in Ghana and Côte d'Ivoire. Furthermore, GAP trainings have had their limitations when they promote the adoption of practices which are more complex to apply and less tangible in terms of benefits. Farmers are likely to abandon new practices if the benefits are not tangible or if the farmers did not adopt the GAPs properly.

Some company stakeholders raised concerns that farmers may become dependent on inputs being provided to them, becoming unsustainable in the long-term. However, this concern may be linked to the suspension of government campaigns to provide high yield seedlings as international cocoa prices remain low due to oversupply of cocoa, particularly in Côte d'Ivoire. This may have driven farmers to place more reliance on companies and other sources of support. Furthermore, this illustrates the paradox of focusing smallholder support on the improvement of their yields, as it can generate negative spillovers for the cocoa price and thus for farmers themselves.

6.3 Tenure issues as both a source of tension and a barrier to conservation

The role of land titles has different implications for farmers' assets, stability, and readiness to adopt GAPs in Ghana and Côte d'Ivoire. The communities we surveyed in Côte d'Ivoire presented not only larger average income and farm size, but also higher cocoa productivity. Our results suggest that the farming communities in Côte d'Ivoire present better productivity performance in relation to Ghana, despite presenting a lower ownership of the land. In Ghana, farms become smaller as they are passed through generations because of the prevailing inheritance system which leads to low productivity and lack of interest in investing in the farm.[182] It is also likely that the lower use of fertilizers and lower level of professionalism in Ghana partly explain the difference in productivity.[183] Indeed, farmers we sampled in Ghana wish to invest comparatively more in farming inputs such as fertilizers that they currently lack than the farmers in Côte d'Ivoire.

In both Ghana and Côte d'Ivoire, lack of tenure security and right to ownership of trees in cocoa farms may explain the reluctance to invest in agroforestry. Historically, farmers have opted for full-sun cocoa farms that mature faster and present options for faster returns on investment instead of agroforestry systems.[184] However, providing optimal shade pays off in the longer term.

182. Steijn, C. P. A. (2016). Towards sustainable cocoa production: a mixed method assessment of the influence of local governance modes on the farm level impact of private cocoa certification standards in Ghana

183. Kongor, J. E., De Steur, H., Van de Walle, D., Gellynck, X., Afoakwa, E. O., Boeckx, P., et al. (2018). Constraints for future cocoa production in Ghana. *Agroforestry Systems, 92*(5), 1373–1385.

184. Tondoh, J. E., Kouamé, F. N., Martinez Guéi, A., Sey, B., Wowo Koné, A., & Gnessougou, N. (2015). Ecological changes induced by full-sun cocoa farming in Côte d'Ivoire. Global Ecology and Conservation, 3, 575–595. http://www.sciencedirect.com/science/article/pii/S2351989415000219;
Ruf, F. O. (2011)

Planting non-cocoa trees in the cocoa farm can provide sustainable yields, improving farm resilience and sequestering carbon.[185] In Ghana, for example, farmers have had no incentive to invest in non-cocoa trees on their cocoa farms because of the prevailing land and tree systems under which the land ownership may be vested in an individual. Yet only the state retains ownership over non-cocoa trees. has the right of ownership over non-cocoa trees.[186]

Our research supports previous studies that land and tree tenure reforms should carefully consider the roles of customary and formal tenure regimes.[187] These include considerations for the fairness and equity of farmers and the maintenance of their informal rights as well as the authority of traditional leaders to avoid disputes.[188] At the same time, strengthening formal rights to trees may have significant environmental sustainability benefits, such as a greater adoption of shading practices.[189]

6.4 Sustainability as requiring a system-wide overhaul rather than solely an increase in productivity

Our survey data hints that, in the absence of larger scale solutions, the relationship between cocoa farming and deforestation may continue to be a troublesome one. Most farmers in Ghana (80.2%) and Côte d'Ivoire (69.8%) disclose farm expansion as their top investment priority. This clearly highlights the need and urgency to engage with cocoa communities in farm rehabilitation and replanting as a strategy to improve productivity and income instead of expanding into forestlands. For smallholders to transition to such climate and forest-friendly practices, they not only require finance and inputs (e.g., planting materials, fertilizers) but also the knowledge of modern agricultural techniques and farm management skills. This calls for collaborative actions by public and private actors to provide smallholders with integrated support.[190]

Drastic efforts are needed to address root causes of land degradation and deforestation, such as the CSSVD, poverty, and climate change. The persistence of the CSSVD remains an issue despite efforts from the governments of Ghana and Côte d'Ivoire to eradicate the disease.[191] Performed management practices are argued to be inefficient due to lagging detection of the disease, non-persistence of the management practices, insufficient financial support for farmers when replanting is needed, land tenure issues, and lack of alignment of replanting recommendations.[192] These issues also keep productivity low for farmers without expensive inputs trapping them in a cycle of poverty. Increasing the price of cocoa and/or issuing premium payments are also important tools towards improving the livelihoods of farmers; however, increasing the amount farmers are paid for cocoa requires strong institutions, a supportive enabling

185. Gockowski, J., & Sonwa, D. (2011).
186. Roth, M., Adarkwah Antwi, Y., & O'Sullivan, R. (2017). Land and Natural Resource Governance and Tenure for Enabling Sustainable Cocoa Cultivation in Ghana. 60.
187. Hirons, M., McDermott, C., Asare, R., Morel, A., Robinson, E., Mason, J., Boyd, E., Malhi, Y., & Norris, K. (2018).; Asaaga, F. A. et al. (2020).; Asaaga, F. A., & Hirons, M. A. (2019).
188. Roth, M. et al. (2017).
189. Hirons, M., McDermott, C., Asare, R., Morel, A., Robinson, E., Mason, J., Boyd, E., Malhi, Y., & Norris, K. (2018). Illegality and inequity in Ghana's cocoa-forest landscape: How formalization can undermine farmers control and benefits from trees on their farms. *Land Use Policy, 76*: 405-413
190. Kroeger, A., Koenig, S., Thomson, A., Streck, C. with contributions from Weiner, P.W., & Bakhtary, H. (2017). *Forest- and Climate-Smart Cocoa in Côte d'Ivoire and Ghana, Aligning Stakeholders to Support Smallholders in Deforestation-Free Cocoa*.
191. Ameyaw G.A., Dzahini-Obiatey H.K., Domfeh O. (2014). Perspectives on cocoa swollen shoot virus disease (CSSVD) management in Ghana. *Crop Protection*.
192. Owusu GK. The cocoa swollen shoot virus problem in Ghana. In: Plumb RT, Thresh JM, editors. Plant Virus Epidemiology. Oxford: Blackwell Scientific Publications; 1983. pp. 73-83.; Thresh JM, Owusu GK, Ollennu LAA. Cocoa swollen shoot virus: An archetypal crowd disease. Journal of Plant Diseases and Protection. 1988;95:428-446.

environment, and appropriate policies to avoid unintended outcomes, such as incentivizing the expansion of cocoa.

Achieving a sustainable and resilient cocoa sector requires substantially more research and investment. There remains no routinely reliable method to predict the onset of the rainy season or intra-seasonal variability, or for improving weather forecasts for smallholders.[193] Rather than developing local adaptation strategies, an approach for climate change adaptation in West Africa at the regional level may be better suited to address the different degrees of vulnerability along the cocoa belt.[194] Furthermore, additional investments in climate-smart cocoa varieties will be necessary. Genetic variation and adaptive responses of certain cocoa germplasm are as important as investments in the final stages of breeding to develop cocoa seeds that yield high in non-optimal environments.[195] Gene-editing has also shown great promise.[196]

A comprehensive investment compact is necessary to overcome structural poverty and create sustainable cocoa livelihoods. Implementing GAPs and zero-deforestation agriculture is costly, and smallholders are too vulnerable to take the risk of changed practices lacking the ability to make longer-term investments. Governments and companies cannot expect that sustainability commitments can be achieved as long as the farmers benefit so little from value creation in the global value chain. A fair and increased farm gate price, together with a comprehensive investment package that would share the burden among public and private actors and address the problem at scale, would be needed to bring the sector on a path towards long-term sustainability.

193. Rhodes, E. R., Jalloh, A., & Diouf, A. (n.d.). Review of research and policies for climate change adaptation in the agriculture sector in West Africa. 52.
194. Schroth, G., Läderach, P., Martinez-Valle, A. I., & Bunn, C. (2017). From site-level to regional adaptation planning for tropical commodities: cocoa in West Africa. *Mitigation and Adaptation Strategies for Global Change, 22*(6), 903–927.
195. Lahive, F., Hadley, P., & Daymond, A. J. (2019). The physiological responses of cacao to the environment and the implications for climate change resilience. A review. Agronomy for sustainable development, 39(1), 5.
196. Farrell, A. D., Rhiney, K., Eitzinger, A., & Umaharan, P. (2018). Climate adaptation in a minor crop species: is the cocoa breeding network prepared for climate change? *Agroecology and Sustainable Food Systems, 42*(7), 812–833. Penn State. "Cocoa CRISPR: Gene editing shows promise for improving the 'chocolate tree'." ScienceDaily. ScienceDaily, 10 May 2018. https://www.sciencedaily.com/releases/2018/05/180510101245.htm.

7. Lessons for SSIs

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A shift towards practices that are both sustainable and economically feasible demands long-term commitment and investment. Activities range from costly, high labor- and resource-intensive practices, with long-term return (e.g., replanting), to medium labor and resource-intensive practices, with shorter-term return (e.g., weeding, pruning). These considerations of costs, benefits, and efforts – as well as farmer support which would make these activities more accessible or attractive – can lead farmers to adopt some GAPs but not others.

The better a company understands the factors that motivate and influence smallholder decision-making, the greater the likelihood that interventions will be effective. Cocoa SSIs are successful if they formulate and provide incentives that support smallholders' capacities to implement and overcome barriers to the adoption of sustainable (zero-deforestation) agricultural practices, which ultimately support forest conservation (e.g., reducing pressure on forests as a result of intensification). There are several benefits to the adoption of sustainable practices that will generate a positive feedback for farmers' livelihoods and help scale and consolidate the SSIs' impact. However, individual company SSIs cannot address structural barriers, which have to be addressed in cooperation with governments in the context of joint private-public partnerships.

Furthermore, SSIs are only successful if they create long-term support incentives, at least until farmers are capable of making their own investments. Overcoming the different challenges faced by farmers requires a sustained and comprehensive effort. There is no one-size-fits-all solution, and SSI programs need to be context and location specific. Our analysis illustrates that there are important differences – farm-level and structural – between farmers in the factors that influence their decisions to adopt sustainable practices. Programs require a comprehensive and adaptable strategy that can be tailored to address barriers of some farmers and opportunities for others. Furthermore, some farmers may require different degrees of support.

While the effective implementation of sustainable practices requires effort from everyone, we propose the following recommendations to leverage the existing efforts of SSIs and accelerate their implementation:

- **Provide resources to young farmers, who may be more open to new practices.** In particular, SSIs can support young farmers in the adoption of practices that require more long-term support and investment, setting the stage for future cocoa production.
- **Strengthen support programs for female farmers.** Although there are some initiatives focusing on women that are working well, our research indicates that, overall, women do not receive the same proportion of support as men. Additionally, our research suggests that the quality of support they currently receive is lower. Support for more cooperatives that target women would likely improve this situation.
- **Improve livelihoods by paying farmers a fair farm gate price or premium payments for cocoa.** However, a price increase should be accompanied by forest protection and law enforcement. Lifting farmers out of poverty can also have positive feedback effects on their decisions to adopt new practices. Furthermore, ensuring farmers have access to credit can ease their financial burden and in some cases the pressures, to decide between household needs or farm inputs.

LESSONS FOR SSIs

- **Provide financial management training to farmers.** GAPs are complex, and it can be challenging to account for all the costs incurred in their adoption. Generally, practices that have a low entry threshold are adopted first, while more complex measures require more training, planning, and investment. Financial literacy can support farmers in their decision-making while prioritizing the sustainable use of limited resources.
- **Help farmers meet pre-conditions for adopting GAPs.** Farmers must be aware of the existing GAPs, which evolve over the years, and need to understand the benefits and costs of each of these practices. Demonstrative plots and farmer networks provide opportunities to share this knowledge. Importantly, the success of these practices depends on proper application and adherence, so farmers should be trained in the field and have access to technical assistance or coaching during implementation. Farmers require funds for the adoption and maintenance of GAPs.
- **The design of support packages for farmers can be tailored to their needs.** This allows the provision of support (e.g., access to inputs) to be more efficient and cost-effective. Care should be taken to ensure that farmers are receiving the appropriate balance of inputs for their plot (e.g., to address nutrient requirements, or control pests and diseases). Support and application of inputs should also be monitored and regularly re-evaluated.
- **SSIs should attempt to track the proportion of shade trees in the cocoa farms they support.** There is a higher productivity performance for farmers producing in cocoa production systems with shade. However, the extent of shade trees on farms is generally unknown or roughly estimated. Although the optimal level varies, this knowledge would help understand the effort needed to support farmers to adopt a shade production system. Securing rights to trees for farmers is also central to increasing shading practices.
- **Tenure reforms should ensure the inclusion and equality of farmers.** Tenure is complex, and there are tradeoffs to customary and formal arrangements. Many farmers benefit from informal ownership and may need assistance in navigating through formal processes; yet legal rights (e.g., to trees) can also provide farmers with security and the incentives to invest in their land. SSIs may serve as a middle ground for developing pathways to balance the benefits from both.
- **Invest in the broader cocoa sector.** Funds could be earmarked for research and innovation to ensure the long-term sustainability of the sector. In addition to support directly for farmers to rehabilitate and restore forests, investment is needed to tackle the persistent problems and other underlying pressures in the sector like CSSVD and climate change. Finance from the private sector could be leveraged in partnership with finance from the public sector.
- **Programs should be established at scale and combined with adaptation programs.** In particular, targeted efforts could be made to capture marginalized farmers, which could help mitigate some of the potential tradeoffs and disparities that may occur as the sector formalizes. For these farmers, diversification and alternative livelihoods programs may also be an option.

Annexes

Annex 1: Survey for smallholder farmers

1. Name of the Enumerator
2. Region
3. District
4. Town
5. Location
6. Name of farmer (official name on ID card)
7. Gender
8. Age
9. Resident Type
10. From where did you or your father move here?
11. What is your highest educational level?
12. Is cocoa farming the main occupation?
13. What other occupations do you have?
14. What is the average household income (cocoa plus other sources)?
15. What household income is from cocoa?
16. How many plot(s) do you own?
17. How many to do you run/manage yourself?
18. Do you have ownership right to land?
19. Are the plots documented (tenure documentation)?
20. If yes, which authority registered the land(s)?
21. How long has the farm been under your management?
22. How was the land used before you acquired it?
23. What type shading system is used on the farms?
24. What is the total size of all your plots combined (acres)?
25. What arrangement do you have with the land owner?
26. How old are the cocoa trees?
27. How much of your farm did you lose to the disease?
28. Do you intend to plant more cocoa trees in the future?
29. What other crops do you produce?
30. Are there timber trees in your farm?
31. Why do you produce cocoa?
32. Do you hire labor to manage your farm?
33. What types of work do these laborers do on the farm?
34. Do you make profit at the end of the season?
35. Have you made any changes to your activities in the last year to increase profit?
36. If yes, what have you done in the last three years?
37. If yes, what have you done in the last five years?
38. Are you a member of any producer associations (e.g., cooperatives) or unions?

39. If no, why not?
40. Why did you join the cooperatives?
41. Did get the benefits you expected?
42. If yes, which benefits did you get?
43. How do you apply the knowledge/benefits in your farm?
44. For how many years has cocoa been cultivated on this land?
45. Do you keep farm records?
46. What kind of records do you keep?
47. How do you think records keeping improves farm activities?
48. What natural resource are on/near your plots
49. How do you protect these resources?
50. What type of farming materials do you have?
51. Are all the materials owned or borrowed?
52. For how long have you been using these tools?
53. Do you use fertilizers?
54. If yes, what type?
55. What made you decide to start using fertilizer?
56. How often do you apply manure/compost?
57. How often do you apply pesticide?
58. How often do you apply fungicide?
59. How long have you been using these inputs?
60. Where do you get your seedlings from?
61. Who pays for the seedlings?
62. Why do you decide to get your seedlings from this place?
63. Where do you get fertilizers, pesticides, and fungicides from?
64. Who pays for them?
65. Why do you decide to get your inputs from that place?
66. Do you weed your cocoa farm?
67. If yes, how often do you weed?
68. If yes, how often do you weed?
69. When do you start weeding?
70. Why do you decide weed at this time?
71. If no, why not?
72. Do you prune your cocoa farm?
73. If yes, when did you start pruning?
74. If yes, when did you start pruning?
75. Why do you decide to prune your farm?
76. If no, why don't you prune your farm?
77. Do you use Personal Protective Equipment (PPEs)?
78. What specific PPEs do you use?
79. How you do think these equipment protect you?
80. How many bags of cocoa beans do you get from your farm?
81. How many bags of cocoa beans do you get from your farm?
82. If yield > 1 MT, how many bags?

83. How has your productivity been over the last year?
84. Why do you think production has changed over last year?
85. How has your productivity been over the last 3 years?
86. Why do you think production has changed over last 3 years?
87. How has your productivity been over the last 5 years?
88. Why do you think production has changed over last 5 years?
89. What could be the reasons for the change in productivity?
90. How does your production compare to your neighbors?
91. Have you changed your production practices in the past?
92. If yes, how and why?
93. Where do you sell your beans?
94. To whom do you sell your beans?
95. Why do you sell your beans to these people?
96. Is it easy to find a buyer?
97. Do you take your beans to market or its picked up by the buyer?
98. Do you have a long-term agreement with your buyer(s)?
99. Do you always sell to the same buyer/middlemen or many different ones?
100. Do you always sell to the same buyer/middlemen or many different ones?
101. Do you have a buyer choice or is the market effectively controlled by one or a few buyers?
102. If you have buyer choice, how do they decide who to sell to?
103. If controlled by one or a few buyers, who are the buyers?
104. How do you decide who to sell your beans?
105. How much do you get for a bag of cocoa beans?
106. Who decides this price?
107. Has the price increased in the past years?
108. Has the price increased in the past 3 years?
109. Has the price increased in the past 5 years?
110. Is there any room for negotiating the price?
111. How are you paid (e.g., in cash or credit)?
112. How did you get access to Mobile money or Ezwich?
113. Are you paid immediately upon sale or at a later date?
114. If paid at later date, how long does it take to receive your money?
115. Do you make profit at the end of the season?
116. Do you get support from your cooperative/farmer organization?
117. What support?
118. If input, what type of input?
119. If Technical, what technical support do you receive?
120. Do you get support from any company(ies)?
121. Do you get support from any NGO(s)?
122. If yes, which NGO(s)?
123. What support do you receive from NGO(s)?
124. If input, what type of input?
125. If technical, what technical support do you receive?
126. Do you get support from government agencies?

127. If yes, which agencies?
128. What support do you receive from government agencies?
129. Are these supports conditional on meeting any requirements?
130. What are these requirements?
131. What are these requirements?
132. Do you receive any support (e.g., training) from your buyer(s) to comply with these requirements?
133. Do they request any documentation from you?
134. When did you start receiving this support?
135. How have your activities/practices changed, if at all, since you began receiving this support?
136. Do you plan to invest in the farm?
137. If yes, why do you want to invest in your farm?
138. Where do you intend to get the funds to invest in your farms?
139. If yes, what specific do you want to invest in?
140. If no, why not (what is holding you back)?
141. Where do you get money to invest in your farm?
142. Do you feel like it is easy or difficult to get money?
143. Which sources is easiest to get funds from?
144. Which sources is hardest to get funds from?
145. Has your access to finance and inputs improved since joining a cooperative?
146. Do you receive any other technical, financial, to support investments?
147. If yes, what kind of support?
148. From whom do you receive the support?
149. Do you have access to credit?
150. Do you borrow money often?
151. Where do you borrow money from?
152. Why do you borrow money?
153. Do you have access to crop insurance or other insurances?
154. Do you receive information about market and prices of cocoa beans?
155. Where do you get this information from?
156. Do you receive information about prices of farm inputs?
157. What would you like to do to improve your farm?
158. Have you attended any GAP trainings in the past year?
159. If yes, did you change any of your farm activities/practices after attending the training?
160. Have you attended any GAP trainings in the past 3 years?
161. If yes, did you change any of your farm activities/practices after attending the training?
162. Have you attended any GAP trainings in the past 5 years?
163. If yes, did you change any of your farm activities/practices after attending the training?
164. How did you change your farm activities/practices?
165. Why did you change your farm activities/practices?
166. Have you seen any changes in the farm productivity after changing your activities/practices?

167. Do you think there is less forest in your community now than before?
168. How do you think the climate change is affecting production?
169. Are you worried about the change in the weather pattern?
170. What specifically are you worried about?
171. What are your mitigation plans towards the weather?
172. What are your main production limitations?
173. Do you feel any changes in local climate in the past 3 to 5 years?
174. If yes, have these changes affected your farms?
175. If yes, how have they affected your farm?

Annex 2: Models for survey data

Model 1: Ghana

Original set of variables to be considered (24): Location, Gender, Age, Resident status, Education, Ownership, Size of farm, Age of trees, Pruning, Replanting, Shading, Diseases, Manure/Compost, Inorganic fertilizer, Labor, GAP training, Government support, Tenure documentation, NGO support (technical), NGO support (input), NGO support (financial), Borrowing, Credit access, and Crop insurance.
Dependent variable: Cocoa income per hectare
Method: Stepwise linear regression (AIC criterion)
Final model selection (9 variables)
Formula: log(Cocoa income per hectare) ~ Gender + Resident + Tenure_docs + log(Size) + Age_trees + Shading + Comp + NGO_inp + Gov

	Dependent variable:
	log(inc_ha)
Gender1	-0.197***
	(0.069)
Resident2	-0.167**
	(0.068)
Tenure_docs1	0.245***
	(0.069)
log(Size)	-0.716***
	(0.049)
Age_trees	0.101***
	(0.025)
Shading2	0.225
	(0.159)
Shading3	-0.010
	(0.150)
Shading4	0.069
	(0.150)
Comp1	0.123*
	(0.070)
NGO_inp1	0.143**
	(0.072)
Gov1	0.149*
	(0.084)
Constant	0.291
	(0.187)
Observations	231
R2	0.516
Adjusted R2	0.492
Residual Std. Error	0.477 (df = 219)
F Statistic	21.235*** (df = 11; 219)

Note: *p<0.1; **p<0.05; ***p<0.01

Model 2: Côte d'Ivoire (all farms)

Original set of variables to be considered (19): Location, Gender, Age, Resident status, Education, Ownership, Size of farm, Age of trees, Pruning, Replanting, Shading, Diseases, Manure/Compost, Inorganic fertilizer, Labor, GAP training, Input support from coop, Technical support from coop, and Borrowing.
Dependent variable: Cocoa income per ha.
Method: Stepwise linear regression (AIC criterion)
Final model selection (6 variables):
Formula = log(Cocoa income per ha) ~ Age + Resident + log(Size) + Replanting + Manure_Compost + Inorganic + Gap_yr

	Dependent variable:
	log(inc_ha)
Age	0.011***
	(0.004)
Resident1	0.241
	(0.483)
Resident2	0.568
	(0.473)
Resident3	0.756
	(0.476)
log(Size)	-0.470***
	(0.085)
Replanting	0.546**
	(0.266)
Manure_Compost1	0.219
	(0.148)
Inorganic1	0.613***
	(0.156)
Gap_yr1	0.287**
	(0.114)
Constant	10.886***
	(0.590)
Observations	196
R2	0.298
Adjusted R2	0.264
Residual Std. Error	0.656 (df = 186)
F Statistic	8.780*** (df = 9; 186)

Note: *p<0.1; **p<0.05; ***p<0.01

Model 3: Côte d'Ivoire (subset of coop farms)

Original set of variables to be considered (18): Location, Gender, Age, Resident status, Education, Ownership, Size of farm, Age of trees, Pruning, Replanting, Shading, Diseases, Manure/Compost, Inorganic fertilizer, Labor, GAP training, Coop support, and Borrowing.
Dependent variable: Cocoa income per ha.
Method: Stepwise linear regression (AIC criterion)
Final model selection (6 variables):
Formula = log(Cocoa income per ha) ~ log(Size) + Replanting + Shading + Gap_yr + Coop + Inorganic

	Dependent variable:
	log(inc_ha)
log(Size)	-0.414***
	(0.099)
Replanting	0.438*
	(0.254)
Shading2	-0.099
	(0.227)
Shading3	-0.358**
	(0.178)
Shading4	-0.398**
	(0.167)
Gap_yr1	0.450***
	(0.118)
Coop1	-0.386***
	(0.132)
Inorganic1	0.337
	(0.248)
Constant	12.733***
	(0.411)
Observations	97
R2	0.304
Adjusted R2	0.241
Residual Std. Error	0.514 (df = 88)
F Statistic	4.805*** (df = 8; 88)

Note: *p<0.1; **p<0.05; ***p<0.01