

IMPACT STUDY

Evaluating How Root Capital's Client Businesses Impact Smallholder Livelihoods: Oil Palm in Ghana

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EXECUTIVE SUMMARY

Root Capital

Root Capital invests in the growth of agricultural enterprises so they can transform rural communities. These businesses purchase crops such as coffee, cocoa, or grains from smallholder farmers. With growth, they become engines of impact that can raise incomes, create jobs, empower women and young people, sustain peace, and preserve vulnerable ecosystems. We supply these businesses with vital resources: access to capital, trade and technical partners, financial training, and conservation practices. We work in hard-to-serve geographies where others don't. To date, we've distributed \$1.5 billion to improve the lives of 10 million people in farming communities.

The Mastercard Foundation-Root Capital Partnership

Since 2014, Root Capital and the Mastercard Foundation have partnered to bring essential financing and capacity building to agricultural businesses in West Africa. The latest phase of our partnership, *Expanding the Frontier of Agricultural Finance in West Africa*, began in 2016. Under this initiative, we aimed to achieve three main objectives:

1. Accelerate the bankability and growth of more than 100 high-impact, early-stage agricultural businesses with capital needs under \$150,000 and/or business revenues under \$300,000;
2. Pilot an expanded set of advisory services, including leadership development for agribusiness employees; financial literacy training for smallholder farmers; mobile technology and mobile money; and local microfinance institution empowerment programs to better serve the agricultural sector; and
3. Contribute to sector learning by developing a framework for documenting and analyzing the costs and impacts associated with early business growth in the agricultural sector.

Purpose of the Study

Under objective three, as part of our project learning agenda, Root Capital partnered with Participatory Development Associates (PDA)—a research and evaluation firm based in Ghana—to conduct evaluations with two Ghanaian businesses that Root Capital reached with the support of the Mastercard Foundation. These evaluations—conducted with Serendipalm

(an oil palm aggregation and processing firm) and a domestic sorghum aggregator—measure Root Capital’s impact on the businesses, as well as the businesses’ impact on their suppliers, consumers, and communities. These enterprises represent diverse segments of Root Capital’s portfolio and present a unique learning opportunity about Root Capital’s impact.

This impact report focuses on our evaluation conducted with Serendipalm. The evaluation centered on the following research question: **To what extent does affiliation with an agribusiness supported by Root Capital’s lending and advisory services improve the wellbeing of smallholder farmers?** In service of this research question, the study explores:

- The impact of affiliation with Serendipalm on the production, income, and wellbeing of smallholder oil palm farmers;
- The social and economic impact of Serendipalm on its smallholder oil palm suppliers and/or communities, particularly in terms of gender and youth inclusion; and
- The efficacy of Root Capital’s engagement with Serendipalm in supporting business outcomes and smallholder livelihoods.

This report provides insights directly from the business’ supplying producers on whether and how Serendipalm is meeting their needs and affecting their agricultural practices, production, and livelihoods. It also highlights important learnings for Root Capital and the Mastercard Foundation on how our partnership and approach creates value for smallholder farmers in West Africa, with insights on the challenges and enablers of our impact in the region.

Study Approach

Root Capital and PDA co-implemented the evaluation, with each responsible for different aspects to ensure its successful completion. Root Capital staff led client engagement, provided guidance on data collection, and conducted methodological design, data analysis, and report writing. PDA staff assisted in methodological development, managed data collection in the field, conducted data analysis, and co-authored this report.

We began the evaluation shortly after Root Capital’s engagement with the Mastercard Foundation began in 2017, an average six years after the Serendipalm suppliers involved in the study joined the enterprise. We collected two rounds of household survey data—in December 2017 and January 2020—from 100 Serendipalm suppliers and 100 oil palm farmers in the same region who did not supply to Serendipalm. We asked farmers about their demographics, farm characteristics, agricultural practices, oil palm production, income, and overall quality of life, as well as the services they receive from Serendipalm and other buyers. The 2020 survey also included retrospective questions about farmer livelihoods prior to joining

Serendipalm, or ten years prior (for unaffiliated farmers). We matched Serendipalm suppliers to non-suppliers on retrospective characteristics using a statistical matching algorithm to generate a sample of respondents that was statistically comparable prior to the intervention (defined as the treatment group's affiliation with Serendipalm).¹ We used the matched sample to generate quantitative estimates of the business' impact. We also conducted focus groups and interviews with Serendipalm suppliers and staff to obtain a more holistic picture of gender and youth inclusion at the enterprise, key benefits of enterprise suppliership, and Serendipalm's experience as a Root Capital client. This quasi-experimental study design represents one of our most rigorous to date.

Main Findings

We found that farmers affiliated with Serendipalm earned 39% more income from oil palm production in 2020 than did comparable, unaffiliated farmers in the region. Serendipalm suppliers produced and sold more oil palm in the low season than did non-suppliers; they also achieved higher productivity per acre and received higher prices. Serendipalm suppliers also earned greater total household income than did non-suppliers in both 2017 and 2020.

Female study participants reported facing various challenges to their oil palm production related to labor requirements, competing household responsibilities, and food insecurity. As a result, women produced and sold less oil palm than did men, though gender differences were less pronounced among Serendipalm suppliers than farmers who are unaffiliated with Serendipalm. Youth in the region also face difficulties entering the oil palm sector, particularly due to land access. However, Serendipalm provides youth with numerous opportunities to get involved with the enterprise and oil palm farming through internships, job opportunities, and input subsidy programs.

Oil palm farmers affiliated with Serendipalm were more likely to hold farm certifications than were unaffiliated farmers. They also hired more permanent and temporary workers to assist them in oil palm production. In addition, they were also more likely to report receiving a number of key services, including agronomic training, loans, prompt payment, crop weighing, equipment, and inputs for oil palm production. Serendipalm suppliers reported a high degree of satisfaction with the enterprise, indicating that it has helped them increase their agricultural knowledge, production, and incomes.

¹ For the purposes of this report, the term 'non-suppliers' refers to individuals who are not Serendipalm suppliers. These non-suppliers form our study's comparison group. However, it should be noted that these individuals may be suppliers of cooperatives or enterprises that are not affiliated with Root Capital.

INTRODUCTION

The Oil Palm Industry in Ghana

Palm oil currently accounts for more than half of the global import and export trade of vegetable oils.² In Ghana, oil palm represents the fifth largest crop in terms of area planted (after cocoa, maize, cassava, and yam).³ Approximately 60% of Ghana's oil palm is produced by small-scale producers.⁴ While demand for palm oil is on the rise in Ghana, supply lags behind demand. According to the Ministry of Food and Agriculture, the country produces about 243,852 tons of crude palm oil annually. Local demand for the commodity is estimated at 278,852 tons, leaving about 35,000 tons of demand unmet in the local market.⁵ Due to this unmet need, as well as the high proportion of smallholder farmers in the sector, oil palm is considered a strategic pillar for agribusiness development and poverty reduction by the Ghanaian government.⁶

However, underinvestment in the oil palm sector in Ghana, coupled with low yields and prices, has led farmers to substitute oil palm production for other, more economically viable crops.⁷ Those smallholder farmers who persist in the oil palm sector live in poverty and extreme vulnerability, and lack access to finance, inputs, trainings, and reliable markets for their produce—locking them in a vicious cycle that can lead to neglect of good agricultural practices, environmental degradation, and poor yields. Bridging the financing barrier, guaranteeing stable and competitive markets, and infusing environmentally sustainable farming practices in the smallholder palm oil sector could significantly reduce poverty and contribute to the sustainable development agenda in Ghana, while simultaneously increasing oil palm yields.⁸

² George Kojo Yawson, *Overview of the Oil Palm Industry in Ghana* (Kade: CSIR-Oil Palm Research Institute, 2015).

³ BUSAC Fund, "Cheap Vegetable Oils Killing Oil Palm Industry," last accessed December 8, 2020, busac.org/details.php?news=19.

⁴ C. Osei-Amponsah et al, "Processing Practices of Small-Scale Palm Oil Producers in the Kwaebibirem District, Ghana: A Diagnostic Study," *NJAS-Wageningen Journal of Life Sciences* 60, 49-56, 2012.

⁵ K. Ofoso-Budu and D. Sarpong, "Oil Palm Industry Growth in Africa: A Value Chain and Smallholders Study for Ghana" in *Rebuilding West Africa's Food Potential* (Rome: FAO/IFAD, 2013), 349-389.

⁶ Amponsah et al, 2012.

⁷ Ghana Web, "The Sorry State of Oil Palm Growers," last updated January 31, 2014, ghanaweb.com/GhanaHomePage/NewsArchive/The-sorry-state-of-oil-palm-growers-299356; Ministry of Food and Agriculture.

⁸ International Fund for Agricultural Development, *Investing in Rural People in Ghana* (Accra: IFAD, 2015).

Over the past decades, palm oil has become one of the most controversial raw materials in the world, largely due to its association with negative social and environmental impacts—primarily deforestation and degradation of High Conservation Value areas. This environmental risk is most notable in industrial, mono-cropped farm systems that rely on the regular use of agrochemical and mechanized equipment, and are often located on land previously covered by tropical forests. In West Africa, however, oil palm is traditionally cultivated on small lots in agroforestry systems in a manner that preserves local biodiversity and ecosystem services. As a result, promoting optimal agricultural practices and market access among smallholder oil palm farmers represents an ethical business model for expanding oil palm production and reducing rural poverty.

Serendipalm

Serendipalm Company Limited is a palm oil company based in Asuom, Kwaebibirem District of the Eastern Region in Ghana. It is one of four Serendiworld palm oil projects (in Ghana, Kenya, India, and Sri Lanka) owned by Dr. Bronner's Magic Soaps, a US-based natural soap company. Since its founding in 2009, Serendipalm has produced palm oil from certified organic and Fair Trade oil palm fruits supplied by the company's network of smallholder farmers in the communities of Asuom, Abaam, Abodom, and Bomso. Thirty percent of its 557 registered oil palm suppliers are women. As the largest employer in the region, Serendipalm maintains approximately 270 employees, the majority of whom are women.

Serendipalm produces around 500 metric tons of crude palm oil per year. Processing activities include fruit transportation, fruit bunch storage, fruit cleaning, fruit steaming, fruit pressing, oil clarifying, and fiber/nut separation. The crude palm oil is sent to an oil refining company in the Netherlands before it is distributed to buyers. Around 70% of Serendipalm's total output is sold to Dr. Bronner's in the United States, and the rest to buyers in the European Union, including German organic food brand Rapunzel.

As the world's first organic⁹ and Fair Trade¹⁰ certified palm oil project, Serendipalm puts social and environmental sustainability at the center of its activities. In addition to its environmental certifications, the enterprise manages a variety of programs that have positive environmental impacts. Some of the services offered to employees and producers include management or facilitation of reforestation; use or distribution of low-emissions or clean technology; water conservation efforts; and management or facilitation of on-farm crop diversification.

⁹ In accordance with the EU Organic Regulation (EC) No. 834/2007 and the National Organic Program (NOP) of the U.S. Department for Agriculture.

¹⁰ Under IMO's "Fair for Life" program.

Serendipalm also organizes regular trainings for farmers on organic- and Fair Trade-compliant farming, good agricultural practices, and agroforestry production. Farmers are regularly audited to ensure they comply with requirements for organic production and enterprise environmental policies. Other areas of training provided by the enterprise include health, safety, and financial management.

Serendipalm is also committed to ensuring good working conditions for its employees and supporting producers in their work as organic farmers. Serendipalm reports that it pays farmers an organic premium of 10% over the prevailing average local market price. The business also supports the wider communities where it operates; it has funded a number of social initiatives and community development projects using its Fair Trade premiums. These projects have included the construction of water wells and towers, public toilets, a birth clinic, a computer lab, a library, and foot bridges.

Root Capital began financing Serendipalm in 2014, with a \$300,000 working capital loan. Serendipalm currently has an active loan of \$200,000 with Root Capital and is also receiving advisory services on financial planning, analysis, and governance.

Study Objectives

This evaluation seeks to measure:

- The impact of affiliation with Serendipalm on the production, income, and wellbeing of smallholder oil palm farmers;
- The social and economic impact of Serendipalm on its smallholder oil palm suppliers and/or communities, particularly in terms of gender and youth inclusion; and
- The efficacy of Root Capital's engagement with Serendipalm in supporting business outcomes and smallholder livelihoods.

By measuring these outcomes, this study aims to uncover important lessons on the success of Serendipalm's activities in improving farmer livelihoods. It also seeks to test Root Capital's theory of change—that our financial support enables the expansion and resilience of agribusinesses that offer key services in their communities.

METHODOLOGY

This study employed a mixed-methods approach to assess how affiliation with Serendipalm impacts farmer livelihoods and inclusion-related barriers to agricultural productivity over time.

In December 2017, we collected quantitative data from 100 farmers who belonged to Serendipalm—at the start of our partnership with the Mastercard Foundation and six years after surveyed Serendipalm farmers joined the enterprise—as well as a group of 101 comparable farmers who were not suppliers of Serendipalm. We contacted these same farmers with a similar survey in January 2020; in 2020, we reached 80.5% of farmers surveyed in 2017. Surveys contained questions about farmer demographics; household characteristics; health and quality of life; farm and production characteristics; oil palm buyers; oil palm prices; income; services offered by buyers; and aspirations in oil palm production. We also asked respondents about a set of key demographic and production characteristics in the year prior to joining Serendipalm (or ten years prior, for non-supplier respondents), in order to construct recalled baseline data to match treatment farmers to similar comparison farmers.

To identify the impact of affiliation with Serendipalm on individual farmer outcomes in 2017 and 2020, we employed a retrospective comparison group matching technique. We matched treatment and comparison farmers based on our recalled baseline data—a process that theoretically reduces bias in study results. The final, matched sample included 73 unique respondents: 51 treatment respondents and 22 comparison individuals. Respondents were matched with replacement, allowing for a matched sample of 51 treatment respondents and 51 comparison respondents.¹¹ Matching produced treatment and comparison groups that were statistically similar on a variety of characteristics. We used this matched sample to generate quantitative impact estimates on a variety of outcomes related to oil palm production, income, and farmer wellbeing over time.

We also collected qualitative data—through focus groups and individual interviews—allowing us to establish context for our quantitative results in the words of farmers and enterprise staff. While we encountered some challenges in data collection, this study represents one of our most rigorous to date. For a more detailed overview of the study methodology, data collection processes, and limitations of the study, see Technical Appendix Sections 1-3.

¹¹ Throughout this report, all findings, tables, and figures reflect the matched sample of 102 respondents.

FINDINGS

Summary Statistics

Treatment and comparison farmers in our matched sample are similar on many demographic characteristics. Table 1 contains summary statistics on respondent demographics in the matched sample.

Sixty-seven percent of treatment farmers are male, as are 57% of comparison farmers. Treatment farmers were an average 56 years old in 2020; comparison farmers were an average 59 years old. Treatment farmers live in households with an average 6.2 suppliers. Comparison households contain an average 6.8 suppliers.

Educational attainment for the two groups is similar, though the comparison group has fewer individuals with no education. The most common level of educational attainment among treatment farmers is completion of upper primary school (53%); 6% completed lower primary school, 11% completed junior high school, 10% completed senior high school, 4% completed technical education, and 16% received no education. In the comparison group, 51% of respondents completed upper primary school, 6% completed lower primary only, 6% completed junior high school, none completed senior high school only, 8% completed technical education, and 23% received no education.

Marital status is also similar in the two groups: 72% of treatment farmers were married in 2020, and 4% were single. In the comparison group, 67% of farmers were married in 2020, and none were single. A lower proportion of women (42%) were married relative to men (86%).

Treatment farmers have been producing oil palm for an average of 21 years, whereas comparison farmers have worked in the sector for an average of 24 years. Treatment farmers have been suppliers of their enterprises for an average of eight years. In 2020, 72% of treatment farmers sold all of their oil palm to Serendipalm; 10% sold most of their oil palm to Serendipalm, 2% sold less than half, 4% sold very little, and 12% did not sell any of their oil palm to Serendipalm. The majority of comparison farmers reported that they typically sell their oil palm to local aggregators; some reported selling to cooperatives or other entities.

Table 1: Demographic Characteristics by Treatment Status¹²

	Treatment Group		Comparison Group	
	Observations	Mean	Observations	Mean
Male	51	0.686275	51	1.431373
Age	51	55.64706	51	58.96078
Household Size	51	6.176471	51	6.764706
No Education	51	0.1568627	51	0.2352941
Lower Primary Complete	51	0.0588235	51	0.1176471
Upper Primary Complete	51	0.5294118	51	0.5098039
Junior High Complete	51	0.1176471	51	0.0588235
Senior High Complete	51	0.0980392	51	0
Technical Education Complete	51	0.0392157	51	0.0784314
Single	51	0.0392157	51	0
Married	51	0.7254902	51	0.6666667
Divorced	51	0.0392157	51	0.2352941
Widowed	51	0.1960784	51	0.0980392
Years in Oil Palm	51	20.86275	51	24.15686
Years Supplying Serendipalm	51	8.176471		

Farmer-Level Impacts

We identified several positive associations between suppliership with Serendipalm and farmer-level outcomes. This section describes our findings on farmer income, production, agricultural practices, buyer services, and quality of life. Farmer-level impacts were estimated using Ordinary Least Squares (OLS) regressions of individual outcome variables on Serendipalm suppliership in the matched sample. More information on our regression specifications, as well as regression output tables, is located in Technical Appendix Section 4.

FINDING 1: We found a positive and significant association between oil palm income and Serendipalm suppliership in 2020. We also found a positive and significant association between total household income and suppliership in both periods.

Before presenting our results on income, it is important to note the complexity of income calculation among rural and low-income households. Numerous research institutions, including the World Bank, caution that values reported for income in rural household surveys are likely to

¹² Note that sample sizes reflect the weighted, matched sample of 51 treatment respondents and 51 comparison respondents; these data reflect 73 unique individuals.

be underestimates.¹³ It is difficult for individuals to remember the correct prices and quantities of sales of multiple crops over long periods. Respondents may also purposefully misstate their income so as not to alert neighbors or other community members as to their income level, or to conceal informal employment.¹⁴ Although we made our best attempts to estimate household income—by breaking down responses by income type (i.e., crop income, remittances, etc.) and validating responses through calculations where possible—our measures for income may contain some errors that could bias our results.

We found that Serendipalm suppliers earned 39% more income from oil palm production in 2020 than did comparison farmers—a difference of USD \$275 or GH¢1,605.¹⁵ This result was statistically different from zero at 95% confidence and controlled for oil palm income in the retrospective period, as well as gender, total income, and total household land (both in the retrospective period). Note that these data do not incorporate farm costs, so income values reflect gross, rather than net, income.¹⁶ We did not identify a statistically significant difference in oil palm income between treatment and comparison farmers in 2017. As described in the sections below, these results are likely driven by higher prices and increased uptake of optimal agricultural practices among treatment farmers between 2017 and 2020, which has contributed to increased oil palm production, productivity, and sales among Serendipalm suppliers relative to comparison farmers.

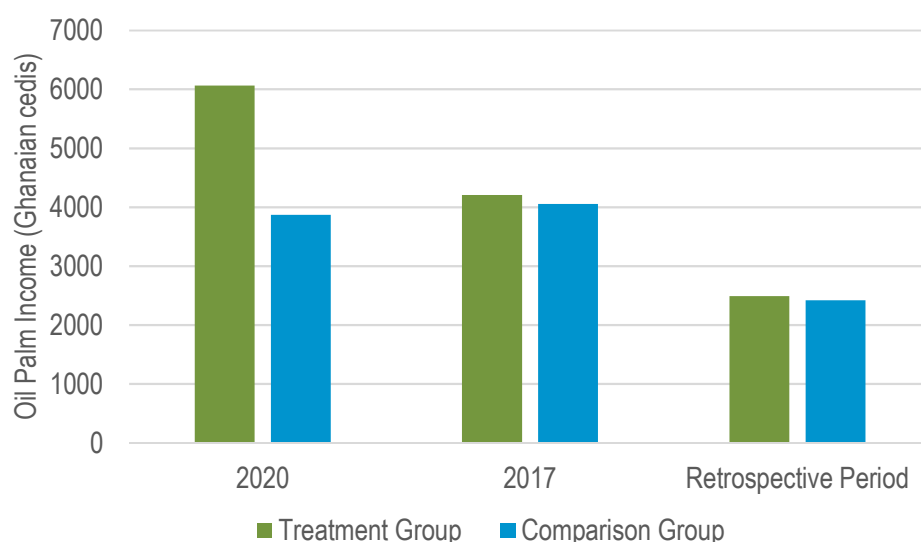
In both periods, we found that men earned over 20% more income from oil palm production than did women, though this effect was driven primarily by gender differences in the comparison group. In focus groups, treatment women more commonly reported that they were satisfied with the income they generate from oil palm than did comparison women.

¹³ World Bank Group, “Measuring Poverty,” in *Introduction to Poverty Analysis* (Washington, DC: World Bank Group, 2005).

¹⁴ Ibid.

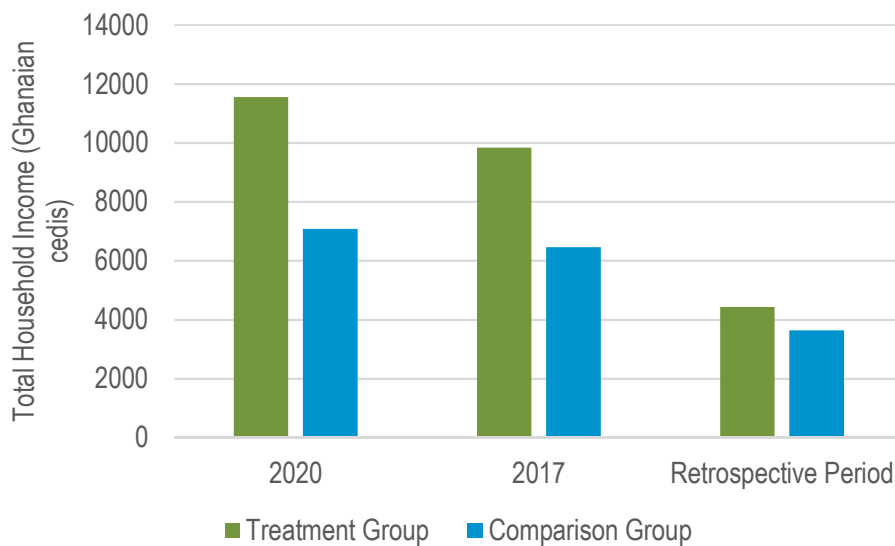
¹⁵ As of December 2020, 1 Ghanaian cedi is equal to 0.17 US dollars.

¹⁶ Costs for oil palm production with mature trees typically emanate from fertilizer, pesticides, and labor costs. Treatment farmers are less likely to purchase chemical fertilizers for their farms than comparison farmers due to their organic certifications, but organic practices require greater labor to implement. As a result, it is unclear whether treatment or comparison farmers might see higher farm costs for oil palm production. Lifianthi and Husin, “Productivity and Income Performance Comparison of Smallholder Oil Palm Plantation at Dry Land and Wet Land of South Sumatra Indonesia,” *APCBEE Procedia* 3 (2012).

Figure 1: Oil Palm Income by Treatment Status

We also identified positive and statistically significant associations between Serendipalm suppliership and total household income in both periods. As per Figure 2, treatment farmers earned 41% more total household income than did comparison farmers in 2020 (about USD \$545 or GH¢3,180), and 50% more income in 2017. Both findings were statistically different from zero at 95% confidence. Though men reported greater household income than did women in both periods in the treatment and comparison groups, the difference was not statistically significant.

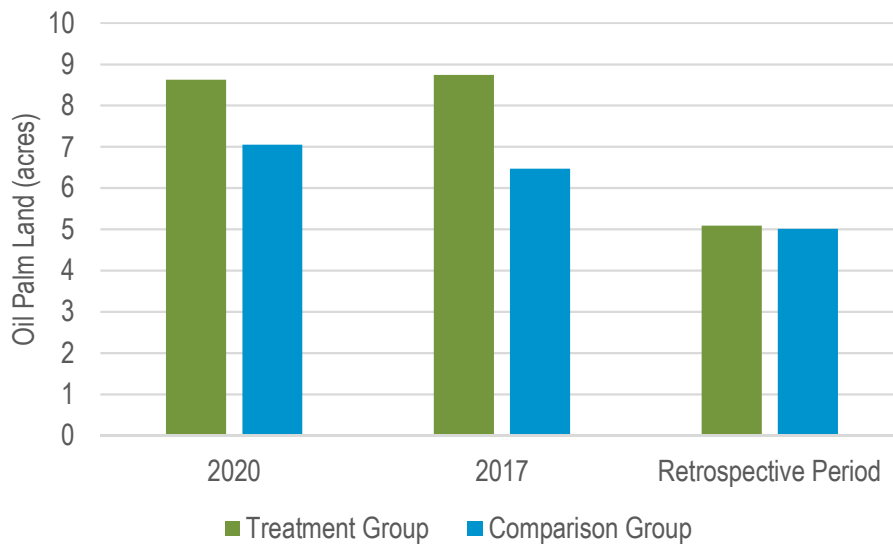
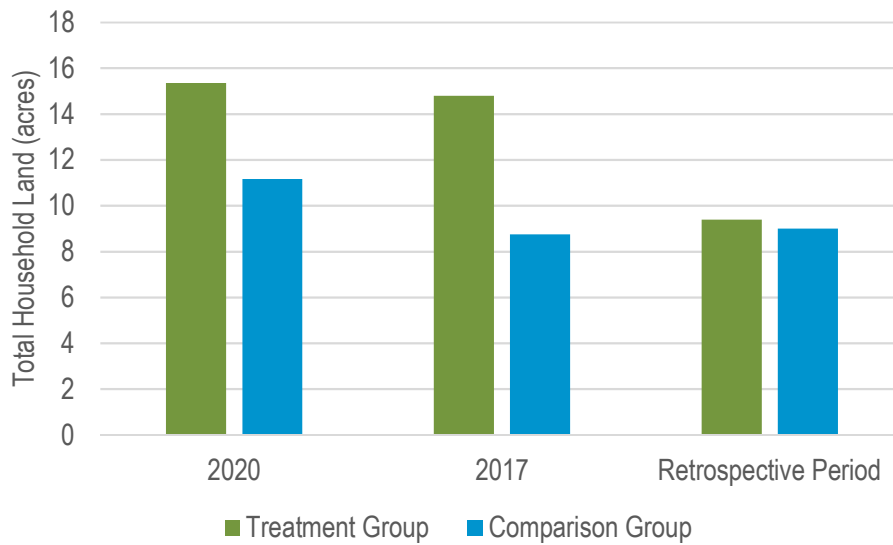
This result may not reflect the true magnitude of the difference in total income between treatment and comparison individuals; as is visible in Figure 2, treatment and comparison farmers could not be perfectly matched on household income in the retrospective period. As a result, differences in household income prior to the intervention may be influencing our results. However, there is a theoretical basis for this positive finding on household income. Data from Root Capital's loan due diligence processes indicate that Serendipalm offers its producers a program to encourage income diversification; the enterprise trains and provides inputs for farmers to produce cocoa, mangoes, avocados, citrus, timber trees, cassava, and bananas alongside oil palm, in order to improve soil quality and provide additional outlets for income. Data collected for this study support this notion; Serendipalm farmers earned significantly more income from non-oil palm crop production (including cocoa, a leading cash crop) than did comparison farmers. Serendipalm may be successfully facilitating the uptake of alternative income generation activities among its suppliers, accounting for their higher total income relative to comparison individuals.

Figure 2: Total Household Income by Treatment Status

FINDING 2: We identified a positive effect of suppliership on land size and oil palm trees that diminishes over time.

We found that Serendipalm suppliers held 32% more oil palm acres than non-suppliers in 2017 (statistically different from zero at 95% confidence); however, we did not identify a statistically significant effect of Serendipalm suppliership on oil palm land size in 2020, though the effect size is similar. As per Figure 3, it appears that comparison farmers acquired more oil palm land between 2017 and 2020, while treatment farmers largely maintained their acreage over the same period. We identified similar trends in our data on oil palm trees and total household land (Figure 4).

While we found no statistically significant difference by gender on oil palm farm size, male farmers held 24% more total land than women in 2020, and 47% more total land than women in 2017.

Figure 3: Oil Palm Land by Treatment Status**Figure 4: Total Household Land by Treatment Status**

Box 1: Oil Palm Land Expansion

Deforestation and natural ecosystem conversion are key concerns in global oil palm production. The large-scale conversion of tropical forests for oil palm production, particularly in Malaysia and Indonesia, has led to the destruction of plant and animal habitats and protected areas—resulting in a significant loss of local biodiversity and global atmospheric carbon sequestration potential.¹⁷ Forest clearing can also contribute to air pollution, soil erosion, and climate change.¹⁸ Though Serendipalm holds organic and Fair Trade certifications and is committed to sourcing oil palm from producers using sustainable environmental practices, we sought to further verify that farmers in the study were not contributing to deforestation or encroachment into protected, or High Conservation Value, areas. While all natural areas possess inherent conservation value, High Conservation Value areas house outstanding biological, ecological, social, or cultural assets considered critically important or unique at the natural, regional, or global level.

In 2020, we asked farmers whether they had expanded their land dedicated to oil palm since they began working with Serendipalm (or within the past 10 years, for comparison farmers). Fifty percent of treatment farmers and 33% of comparison farmers indicated that they had expanded their oil palm farms during this period. Of these, 52% of treatment farmers and 58% of comparison farmers reported converting land that they already owned, but had dedicated to another crop, to oil palm production. Four percent of treatment farmers reported purchasing and converting a natural area for oil palm production. According to data from the World Database of Protected Areas, deforestation has occurred within and around both treatment and comparison farmer communities in the past decade, but there is little indication of encroachment into adjacent protected areas or forest preserves by study farmers. An analysis of GPS data associated with our surveys demonstrated that the majority of treatment farmers were not located within a zone of influence, or within five kilometers, of protected forest areas in the region.¹⁹ A greater percentage of comparison farmers were located within five kilometers of these protected areas, but again, we found little indication of encroachment. Comparison farms, however, were closer to a developed community that contains multiple palm oil mills.

¹⁷ World Wildlife Fund, “Palm Oil: Overview,” last accessed December 8, 2020, [worldwildlife.org/industries/palm-oil](https://www.worldwildlife.org/industries/palm-oil).

¹⁸ Ibid.

¹⁹ We collected GPS data on the location at which each household survey was conducted. Interviews typically took place at respondent homes; however, we collected information on the distance from the interview location to respondent farms, and mapped coordinates based on these distance data.

FINDING 3: We found that Serendipalm suppliers produced more oil palm in the low season than did non-suppliers, largely due to higher productivity per acre.

We found that treatment farmers produced 32% more kilos of oil palm during a typical month in the high season in 2020 relative to comparison farmers, though this difference was not statistically significant due to a high degree of variation in our data on oil palm production. We also found that treatment farmers produced 107% more kilos during a typical month in the low season than did comparison farmers (statistically different from zero at 99% confidence). Correspondingly, while we found no statistically significant difference in sales during the high season, we found that treatment farmers sold 113% more kilos of oil palm than did comparison farmers during a typical month in the low season (statistically different from zero at 99% confidence).

This result appears to be driven largely by increased productivity among treatment farmers during the low season; as per Figure 8, we found that treatment farmers produced 93% more kilos on a single acre in 2020 than did comparison farmers during a typical month in the low season (statistically significant at 99% confidence).²⁰ In accordance with our findings on production, we found no statistically significant difference by treatment status on productivity per acre in the high season. The low season for oil palm coincides with the annual dry season; as such, optimal agricultural practices that assist in water retention—such as the application of crop residues—are especially important for low season oil palm yields. Treatment farmers appear to apply such practices with greater frequency than comparison farmers, perhaps because they are more likely to receive technical assistance focused on improving oil palm yields—a service provided by Serendipalm. We discuss this potential explanation further in Finding 5.

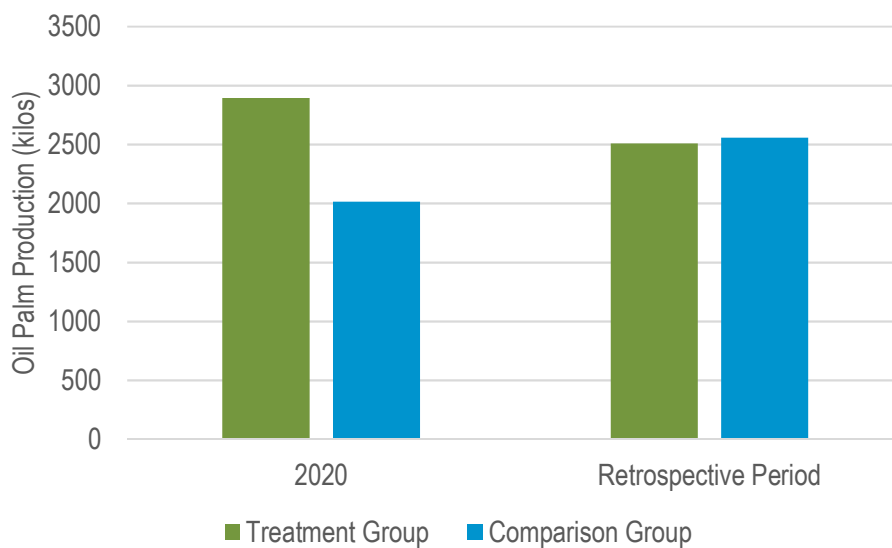
We also found that male farmers produced significantly more kilos than did female farmers in both the high and low seasons. We found that men produced 51% more kilos per acre than did women in the high season, and 36% more in the low season, though differences were more pronounced between men and women in the comparison group. This is likely due to differences in agricultural practices between men and women; our qualitative data suggest that women may often lack the time to attend trainings or apply new practices due to their responsibilities at home and on the farm.

²⁰ Per Figure 8, productivity in the low season declined for treatment and comparison farmers between the retrospective period and 2020 (though low season productivity in 2020 was significantly higher among treatment farmers than comparison farmers). It may be that any production increases over this period did not fully offset increases to oil palm land size that occurred over the same time period.

Box 2: Oil Palm Seasonality

Oil palm production occurs year-round, with the peak production season corresponding with the period of highest rainfall.²¹ During the peak season, palms produce enough fruit for harvest every two to three weeks. During the low season, production dips such that oil palm fruit is harvested every three to four weeks. In Ghana, the peak season typically lasts from February to May and the lean season from September to December.²²

Figure 5: High Season Production by Treatment Status



²¹ GSOPP, "Background Information," *last accessed November 13, 2020*, s1.q4cdn.com/789791377/files/doc_downloads/SDG/case-studies/2019/01/GSOPP-Background-Information_2019_Compress.pdf.

²² Kaysara Khatun et al, "From Agroforestry to Agroindustry: Smallholder Access to Benefits from Oil Palm in Ghana and the Implications for Sustainability Certification," *Frontiers in Sustainable Food Systems*, March 20, 2020.

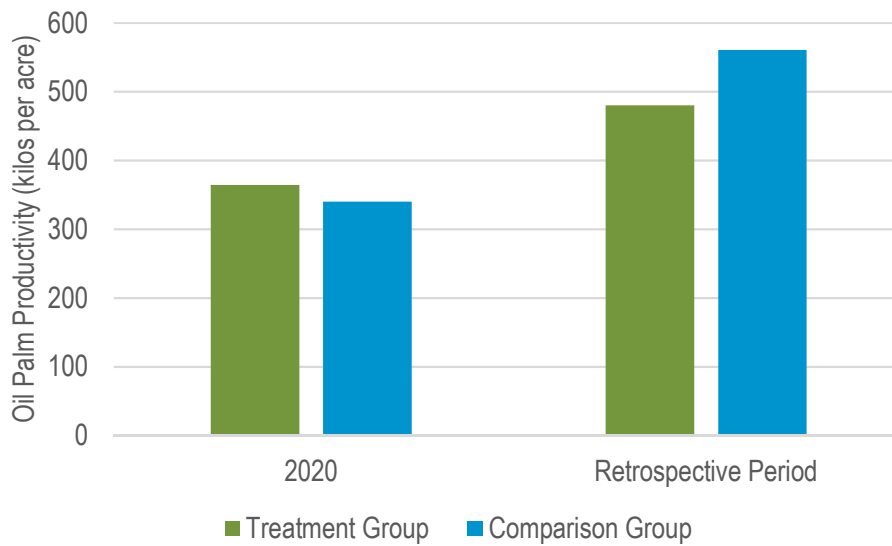
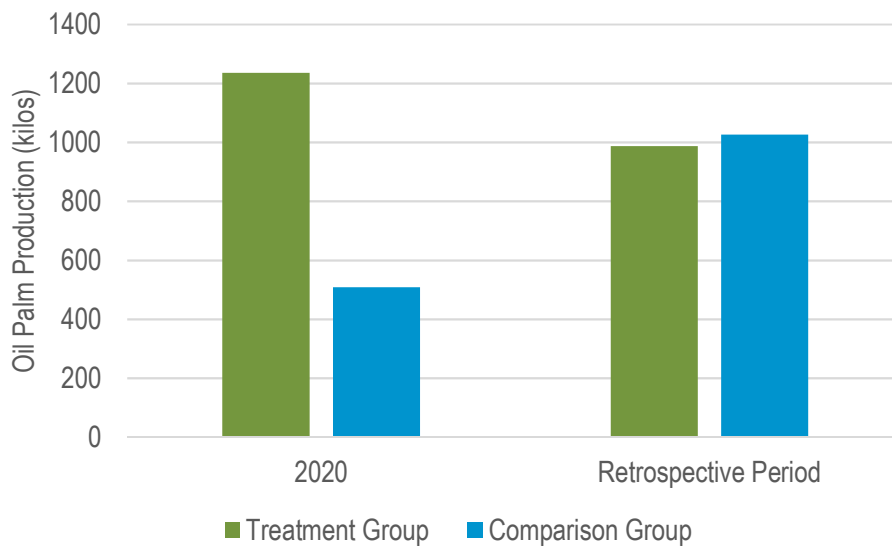
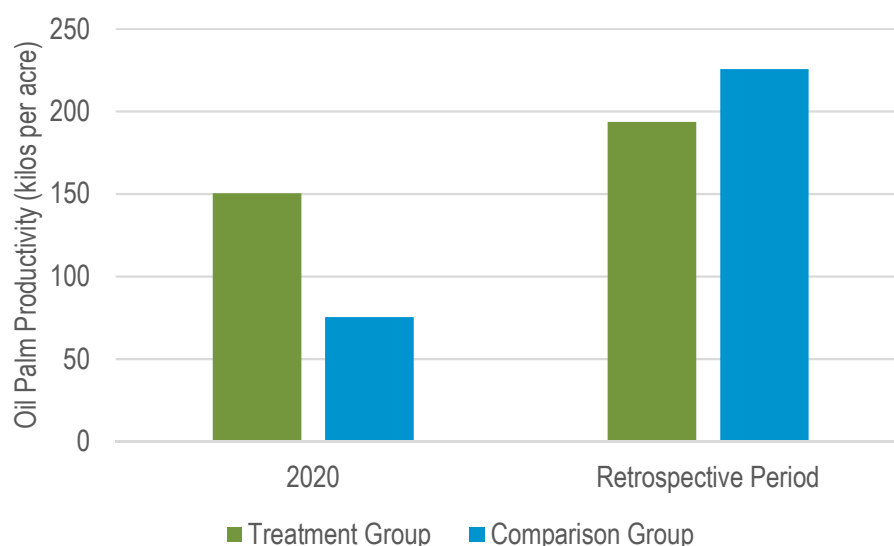
Figure 6: High Season Productivity by Treatment Status**Figure 7: Low Season Production by Treatment Status**

Figure 8: Low Season Productivity by Treatment Status

FINDING 4: Serendipalm farmers earned a higher price for their oil palm than did comparison farmers in 2017 and 2020.

The majority of treatment farmers sold oil palm only to Serendipalm; in 2020, 17% sold to Serendipalm and other local aggregators, as did 19% in 2017. Serendipalm farmers earned higher prices for oil palm from Serendipalm than from other buyers in both the high and low seasons. In 2020, the average price paid by Serendipalm in both the high and low seasons also exceeded the average prices received by comparison farmers, by 24% and 11%, respectively. In 2017, we asked only about average price across high and low seasons and found that treatment farmers received a price that was 9% higher, on average, than that received by non-suppliers (statistically different from zero at 95% confidence).

We also noted that men earned higher prices than women across the sample. In 2020, during both the high and low seasons, men earned a price that was 11% higher than that earned by women, from both Serendipalm and other sources. Qualitative data suggest that this difference may arise because women are less likely to negotiate with non-Serendipalm buyers over price. There may also be quality differences in the products that men and women deliver to Serendipalm and other buyers. Ideally, oil palm should be delivered for processing within two days of harvest. Women may deliver their oil palm to their buyers less often than men due to time constraints—because of their more significant household responsibilities, for example—at the expense of product quality and perhaps price.

Box 3: Side-Selling

In this study, 17-19% of suppliers sold crops to other buyers instead of, or addition to, Serendipalm—a practice called “side-selling.” Side-selling occurs when farmers engaged in formal or informal purchase agreements with a cooperative or other enterprise sell to alternative buyers. Farmers generally side-sell due to a lack of liquidity. Farmers face a cash crunch during the harvest season: they incur most of their production costs during the harvest months, yet they have little savings remaining from the previous production season. If a local intermediary offers a higher price upon delivery than their enterprise, farmers may opt for immediate cash over the higher future price provided by the enterprise. To this end, 24% of farmers reported that they receive only partial payment for their crop upon delivery to Serendipalm. Transportation costs, loyalty to the enterprise, and product quality can also influence side-selling behaviors. Serendipalm employees noted that their processing capacity limits the amount of oil palm they can purchase from each producer; as a result, some Serendipalm suppliers side-sell when they produce more than Serendipalm is able to purchase. That being said, side-selling rates identified in this study were much lower than those identified in other studies of Root Capital clients, which have ranged from 14-53%. It may be that Serendipalm’s higher prices in both the high and low seasons disincentivize side-selling among suppliers.

FINDING 5: Serendipalm suppliers were more likely to apply optimal agricultural practices than non-suppliers; they were also more likely to hold farm certifications.

On-Farm Practices

We asked farmers about their use of numerous agricultural practices on their oil palm farms. As illustrated in Figures 9 and 10, the use of optimal agricultural practices was high across the sample, with more than 50% of suppliers and non-suppliers employing the majority of listed practices in both periods. In 2020, we found that Serendipalm suppliers were more likely to use weeded circles, prune, apply crop residue, and harvest regularly than non-suppliers; we found no statistically significant difference on fertilizer application or the use of drainage systems in 2020. Importantly, pruning and crop residue application are key practices to increase yields during the dry, low season.

We found few statistically significant differences in practice application by treatment status in 2017. For some practices, including use of weeded circles, the difference between 2020 and 2017 is driven by increased uptake of the practice by treatment farmers. For others, including application of crop residue and intercropping, the difference is driven by declining use of the practice by comparison farmers over time.

We found that, in 2020, men were more likely than women to prune, apply fertilizer, and harvest their oil palm regularly. In 2017, men were more likely than women to use weeded circles, apply fertilizer, and harvest regularly. Once again, these differences are explained largely by differences in the comparison group—treatment women applied practices at similar, albeit slightly lesser, rates as did treatment men.

Oil palm farmers in the region have access to many sources of technical assistance, which accounts for the high uptake of agricultural practices across our sample. The Ghanaian government has prioritized tree crop productivity in recent agricultural extension programming, and many large oil palm aggregators offer technical assistance to producers. However, given the observed differences in practice application (and productivity), it appears that Serendipalm’s technical assistance program may be more effective in encouraging uptake of key practices related to water conservation and oil palm productivity relative to alternative training sources, especially over time. Treatment respondents reported in focus groups that Serendipalm’s trainings—which cover intercropping, circle weeding, crop residue application, pruning, organic standards, and refuse management—are one of the most useful services offered by the enterprise. Serendipalm offers centralized trainings, individual on-farm visits, and soil and carbon analysis for producers. Serendipalm also offers an incentive program for farmers to maintain their supply during the lean season, providing farming equipment to those who sell oil palm to the enterprise a minimum of five times during that period each year.

Figure 9: Use of Agricultural Practices by Treatment Status, 2020

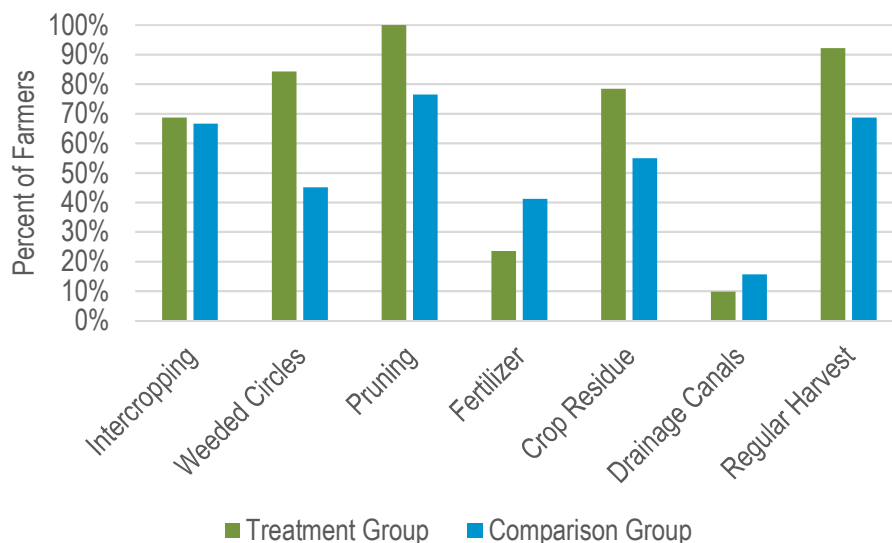
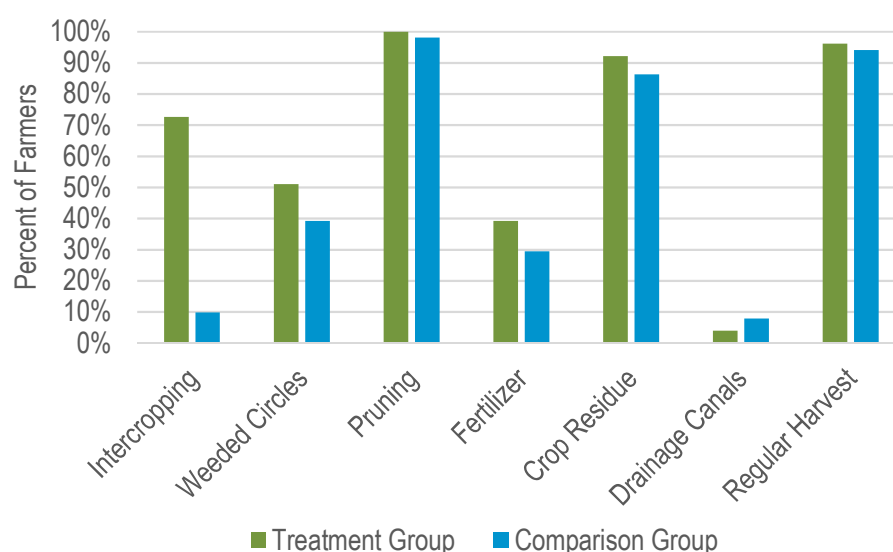


Figure 10: Use of Agricultural Practices by Treatment Status, 2017**Box 4: Surveyed Agricultural Practices**

We asked farmers about their use of agricultural practices designed to conserve soil and water, maximize agricultural yield, and improve oil palm crop quality. These practices and their definitions are listed below.

Soil Conservation Practices

- **Crop residue application:** the practice of applying crop residues—plant material from pruning or crop harvest—to oil palm plots to provide soil coverage, helping to prevent soil erosion and increase water retention.²³
- **Mulch:** a protective layer of organic material spread on top of soil that reduces soil erosion, maintains soil moisture, and suppresses weed growth.²⁴

Water Conservation Practices

- **Drainage:** ditches, swales, or other earthworks used to slow the flow of water, reduce erosion and soil loss, and reduce and drain standing water in low-lying areas.

²³ US Department of Agriculture, “Conservation Practices that Save: Crop Residue Management,” last accessed November 13, 2020, nrcs.usda.gov/wps/portal/nrcs/detailfull/national/energy/conservation/?cid=nrcs143_023637.

²⁴ Natural Resources Conservation Service, “Mulching,” last accessed March 12, 2020, nrcs.usda.gov/wps/portal/nrcs/detail/ny/home/?cid=nrcs143_023585.

Productivity and Pest Control

- **Circle weeding:** the process of removing vegetation and weeds in a circular formation around an oil palm trunk to improve ease of harvest, ensure the efficient application of fertilizers, and improve crop yield and quality.²⁵
- **Intercropping:** the practice of growing two or more crops in close proximity to make efficient use of light, water, and nutrients; decrease pest density; and increase yields.²⁶
- **Fertilizer:** organic or inorganic compounds that supplement nutrients needed for crop growth. Fertilizers can improve soil fertility, but their long-term effects on soil health depend on organic status.²⁷
- **Pruning:** the removal of branches and old or dead stems from oil palm trees to increase production, reduce pest and disease problems, and facilitate spraying and harvest.²⁸
- **Regular harvesting:** the practice of collecting mature oil palm fruit frequently to prevent incomplete crop recovery.

Certification

We found striking differences between the groups related to certification status, which we explored in our 2020 survey. We found that treatment farmers were 57% more likely to report holding a farm certification relative to comparison farmers. This finding was statistically different from zero at 99% confidence and controlled for certification status in the retrospective period. Certified suppliers predominantly reported that they hold organic and Fair Trade certifications. We found no difference on certification status by gender.

Farmers noted in focus groups that, as Serendipalm suppliers, they are required to practice organic farming under Serendipalm's organic certification. However, as per Figure 11, not all Serendipalm farmers appear to know that they are certified through the enterprise's certification—a trend that we have observed in other studies of our clients. Additionally, some

²⁵ International Sustainability and Carbon Certification, "Circle Weeding," last accessed November 13, 2020, iscc-system.org/wp-content/uploads/2018/09/Circle-Weeding.pdf.

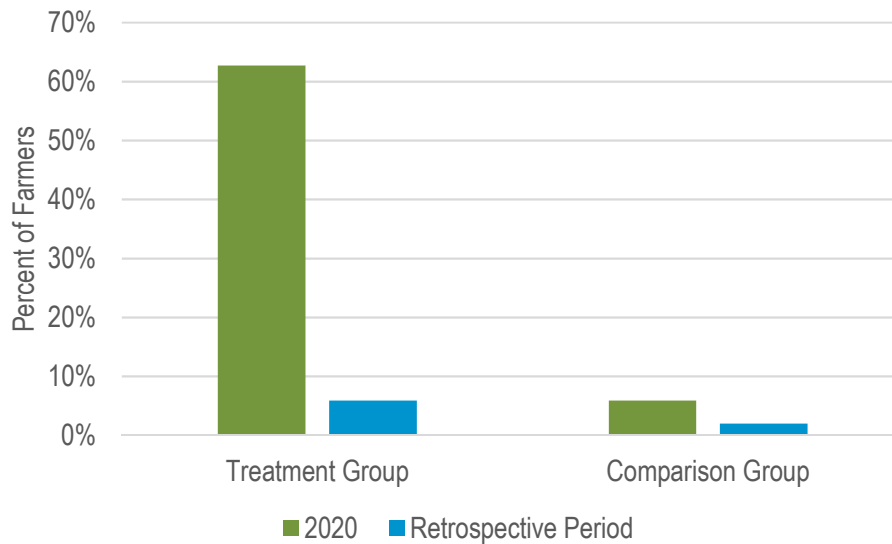
²⁶ Sustainable Agriculture Research and Education, "Guidelines for Intercropping," last accessed November 13, 2020, sare.org/publications/crop-rotation-on-organic-farms/guidelines-for-intercropping/.

²⁷ Root Capital, *Improving Rural Livelihoods: A Study of Four Guatemalan Coffee Cooperatives* (Cambridge: Root Capital, 2014).

²⁸ Janny G. M. Vox, Barbara J. Ritchie, and Julie Flood, *Discovery Learning about Cocoa* (Washington, DC: World Cocoa Foundation, 2003).

noted that organic farming requires a level of effort and time that, in their experience, does not always match the yields they produce. Further research is necessary to determine potential pathways by which Serendipalm could assist farmers in adapting more easily to organic production methods. Serendipalm should also ensure that farmers are aware of the benefits conferred to them through their organic certification.

Figure 11: Certification by Treatment Status



Box 5: Certification

Agricultural enterprises will often pursue certifications indicating that suppliers employ organic, Fair Trade, or other sustainable practices. These certifications can be useful in attracting buyers that operate in a market for sustainable products, as well as higher prices. Businesses may transfer these price premiums directly to farmers when they buy their produce; they also may hold price premiums in a “premium fund,” which is then used to purchase inputs or provide services to farmers.

Studies from organizations such as the Committee on Sustainability Assessment and Rainforest Alliance have found that certified farmers are more likely to employ soil and water conservation practices on their farms. Certified farmers also see both higher incomes from price premiums and higher productivity attributable to their certifications.²⁹ In our study, we found that certified individuals obtained a higher price for their oil palm than did individuals without certifications; individuals who reported certifications earned a price that was 15.6% higher in the high season and 11.2% higher in the low season than uncertified individuals.

FINDING 6: Suppliers hired more labor to work on their oil palm farms than did non-suppliers.

Household and Hired Labor

Though smallholder farmers rely primarily on family suppliers to produce crops, they may hire permanent or temporary workers to assist with farm activities. We asked our study participants about their household and hired labor allocations in our 2020 survey. We found no difference in the number of household suppliers who worked on the family oil palm farm by treatment status. However, we found that treatment farmers hired 0.15 more full-time workers, on average, than did comparison farmers during their most recent production season (statistically different from zero at 90% confidence). In total, this amounts to seven full-time workers hired by treatment farmers in the most recent season, and one full-time worker hired by comparison farmers. Treatment farmers also hired an average 3.043 more temporary workers than did non-suppliers (statistically different from zero at 95% confidence), amounting to 298 total temporary workers hired by treatment farmers and 66 temporary workers hired by comparison farmers in the last season. While further study is necessary to understand the tasks for which treatment

²⁹ Dianna Newsom and Jeffrey C. Milder, *2018 Rainforest Alliance Impacts Report* (New York: Rainforest Alliance, 2018); Committee on Sustainable Agriculture, *The COSA Measuring Sustainability Report: Coffee and Cocoa in 12 Countries*, (Philadelphia; COSA, 2013).

³⁰ Root Capital, *Improving Rural Livelihoods*, 2014.

³¹ Vox et al, 2003.

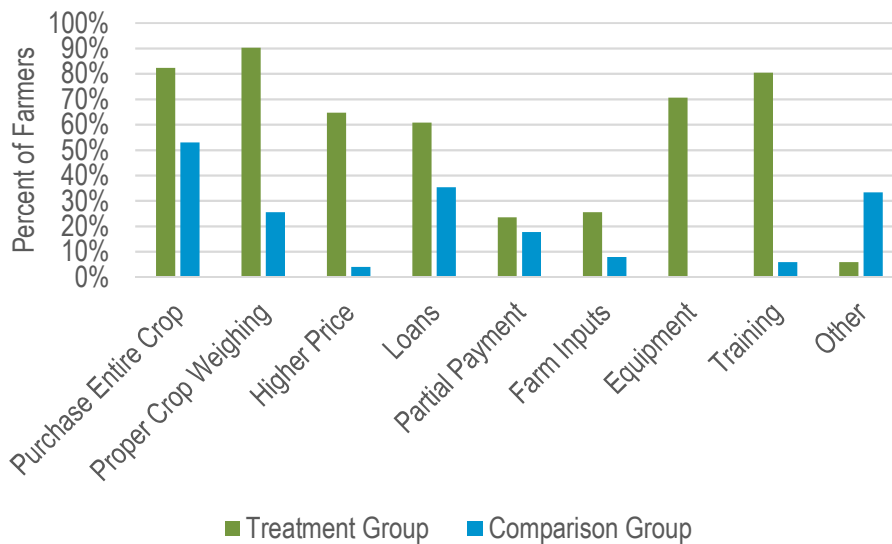
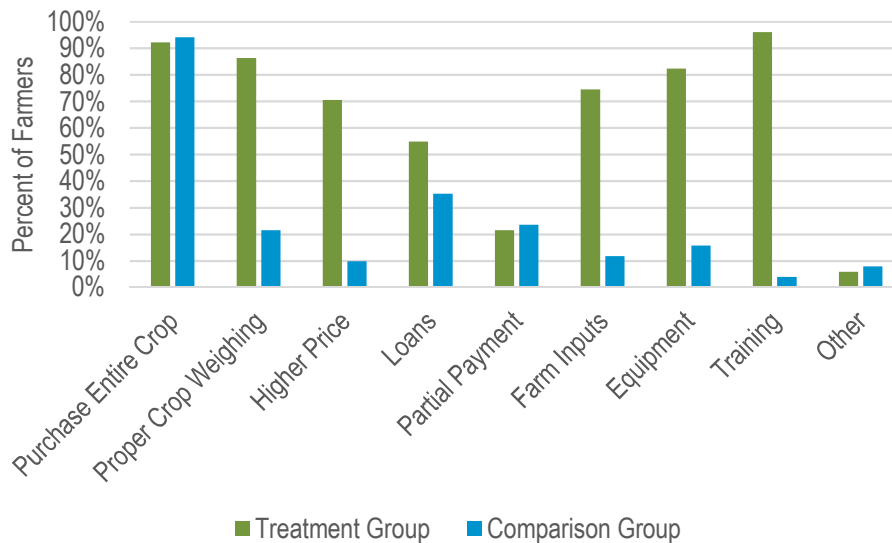
farmers require additional labor, it is possible that they contract more workers to manage their greater production/harvest needs during the low season or to manage the labor-intensive farm practices required by their certifications. To the extent that Serendipalm contributes to greater production, certification standards, and subsequent labor demand, it may be that affiliation with this enterprise is a driver of temporary and full-time job creation in the region.

While we found positive associations between gender and hired labor (women hired more full-time and temporary workers than men), these differences were not statistically significant. Focus group participants in both the treatment and comparison groups indicated that while men take on the majority of labor on their oil palm farms, women working alone typically hire labor to complete more physically demanding on-farm tasks, including pruning and harvesting.

FINDING 7: Serendipalm offers suppliers numerous valued services that other buyers do not.

Buyer Services: Serendipalm vs. the Local Market

We asked treatment farmers about the services offered to them by Serendipalm in 2017 and 2020; we also asked comparison farmers about the services they receive from their primary buyers. Per Figures 12 and 13, a majority of treatment suppliers indicated that Serendipalm offers entire crop purchase, proper crop weighing, higher prices than the local market, loans, equipment, and training. Serendipalm farmers reported receiving these services with greater frequency than comparison farmers in both periods. In 2020, 90% of Serendipalm farmers reported that their buyer (Serendipalm) properly weighs their crop, compared to just 25% of comparison farmers. Serendipalm farmers were more than 50 percentage points more likely to report receiving higher prices, 70 percentage points more likely to report receiving time-saving equipment, and 75 percentage points more likely to report receiving training on oil palm farming than comparison farmers. Serendipalm farmers were also 25 percentage points more likely to report receiving loans from their oil palm buyer. These differences in service provision appear to have become more pronounced over time.

Figure 12: Buyer Services by Treatment Status, 2020**Figure 13: Buyer Services by Treatment Status, 2017**

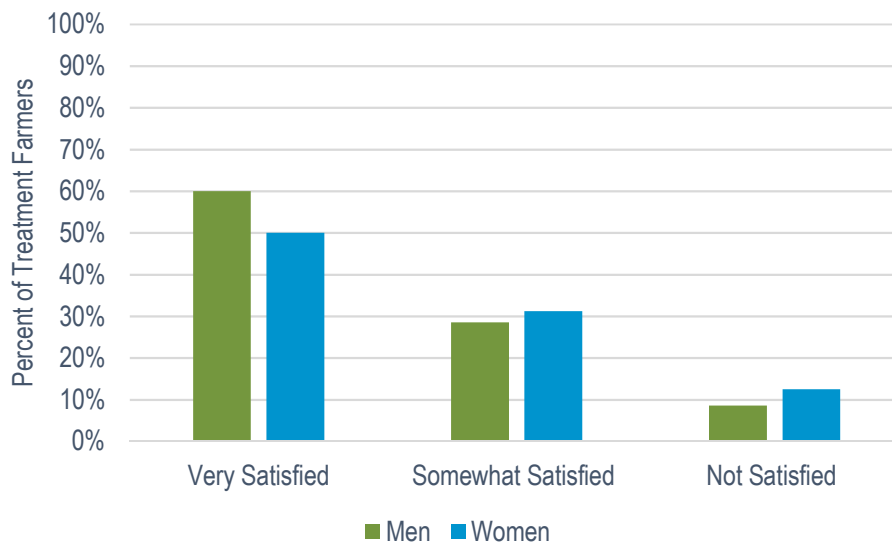
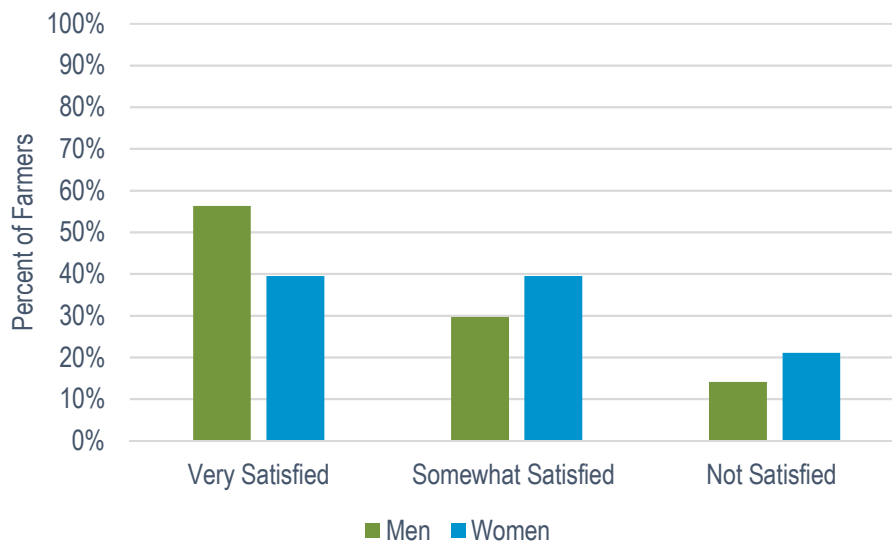
Serendipalm employees confirmed that the enterprise offers these services and provided more detail as to the scope of Serendipalm's community programming. In addition to agronomic assistance, training on financial management, and loans, Serendipalm provides farmers with training on Fair Trade topics, including anti-discrimination, democracy, empowerment, and community development. Serendipalm also provides employees with female empowerment and gender inclusion trainings, meals, health screenings, health insurance, and flexibility to pursue educational opportunities alongside work. Serendipalm uses its Fair Trade premiums,

meanwhile, to deliver a variety of community services. The enterprise offers 10-14 scholarships to local university students each year; it has also built bridges, solar panels, and other infrastructure, and is in process of constructing a school in the community.

Our quantitative data indicate that these services have meaningful implications for farmer production and wellbeing. In 2020, 100% of treatment respondents and just 17% of comparison respondents reported that the services they received from their agribusinesses helped them increase their production. Ninety-two percent of treatment farmers reported that the services they received allowed them to save time, compared to 25% of comparison farmers. Ninety-two percent of treatment farmers also reported that the services they received helped them reduce stress, compared to 47% of comparison farmers. These findings indicate that Serendipalm provides services that can not only increase agricultural production and productivity, but also contribute to farmer and community wellbeing.

Benefits of Serendipalm Suppliership

We asked Serendipalm suppliers about the key benefits they derive from their engagement with the enterprise, as well as their overall satisfaction with Serendipalm. In 2020, over 50% of treatment farmers reported that they are very satisfied with Serendipalm; 29% reported that they are somewhat satisfied and less than 4% reported that they are not satisfied. In focus groups, many Serendipalm suppliers confirmed these positive perceptions of the enterprise, commenting that they appreciate the prices, crop transport, and training services they receive from Serendipalm. Per Figures 14 and 15, levels of satisfaction were slightly lower among women than men in 2020, but women's satisfaction with Serendipalm appears to have increased over time, while men's has remained fairly constant.

Figure 14: Satisfaction with Serendipalm by Gender (2020)**Figure 15: Satisfaction with Serendipalm by Gender (2017)**

Satisfaction with Serendipalm is driven by a variety of factors. When asked to name the primary benefits of supplying to Serendipalm, female producers reported higher prices, prompt payment, and other factors as primary benefits in 2020; technical assistance was also a top benefit to female producers in 2017. Male producers reported prompt payment, technical assistance, and higher prices as key benefits in 2020 and 2017.

Figure 16: Primary Benefit of Supplying to Serendipalm by Gender (2020)

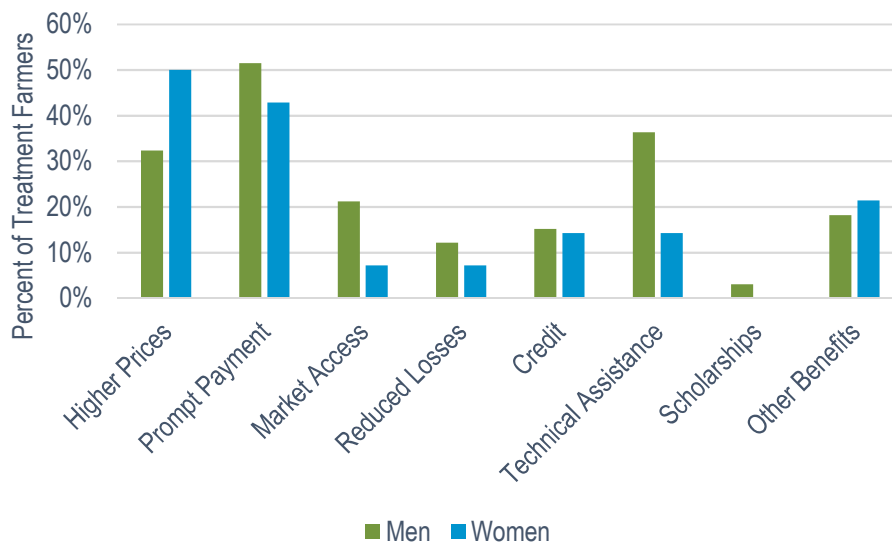
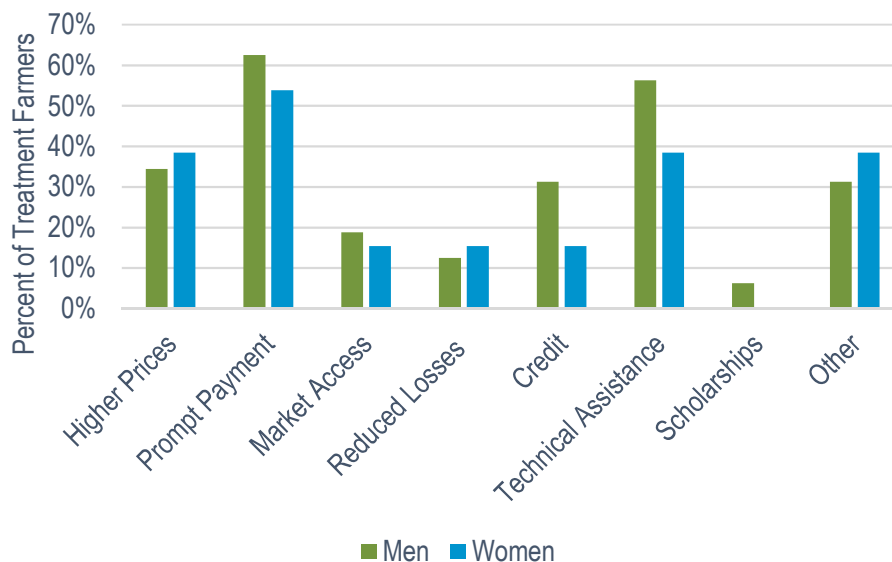


Figure 17: Primary Benefit of Supplying to Serendipalm by Gender (2017)



Suppliers also provided numerous suggestions for Serendipalm. As per Figures 18 and 19, Serendipalm suppliers were interested in a variety of additional or improved services. Men, more so than women, reported in 2020 that they would like to receive higher prices and more prompt payment. Some farmers also reported that they would like to receive short-term credit. In focus groups, participants noted that Serendipalm could provide some promised services with greater consistency, including timely crop transport and road maintenance.

Figure 18: Ideal Enterprise Services by Gender (2020)

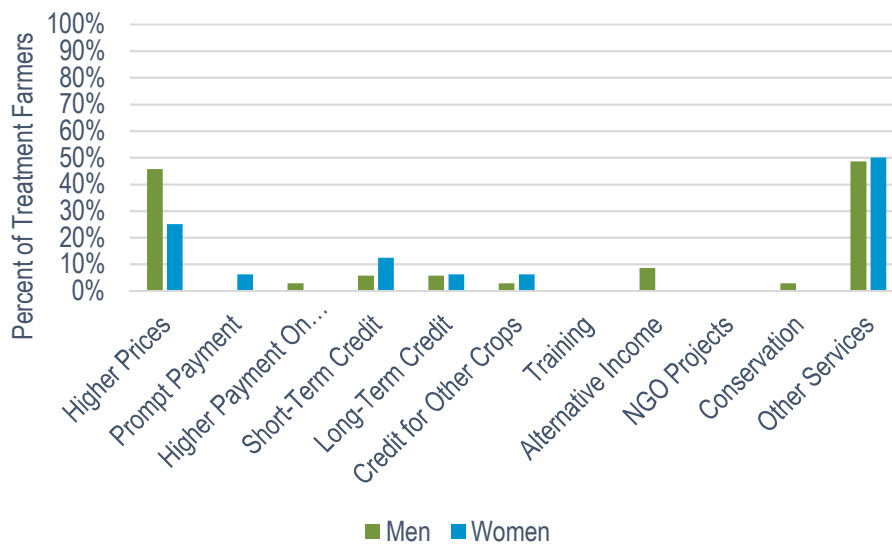
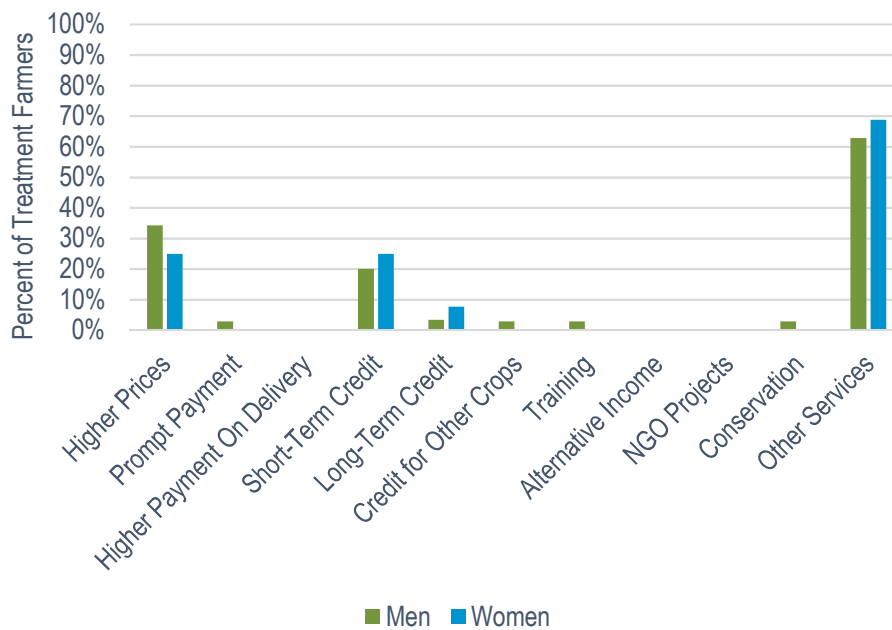


Figure 19: Ideal Enterprise Services by Gender (2017)

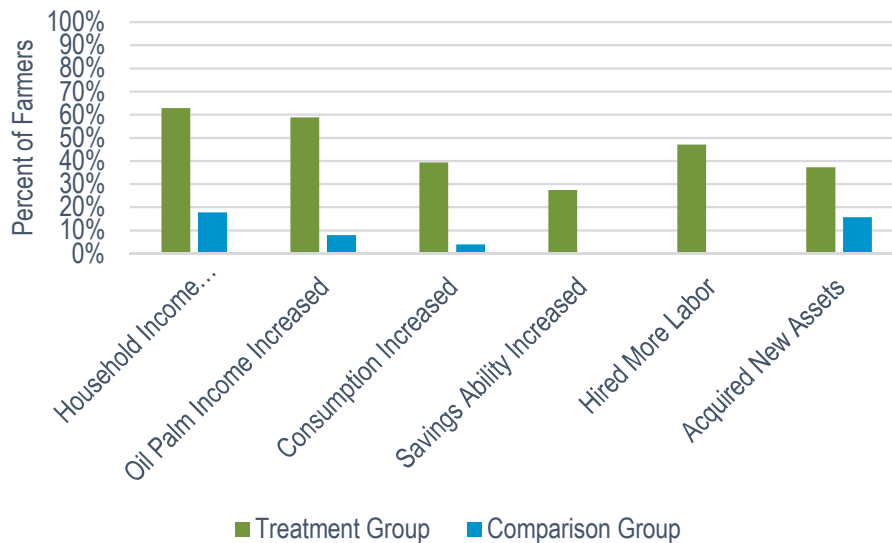


FINDING 8: We found that suppliership with Serendipalm is associated with a variety of positive outcomes on farmer wellbeing, including increased savings, consumption, and acquisition of assets.

Savings and Consumption

We asked farmers whether they have experienced a variety of improved financial outcomes since joining Serendipalm (or since working with their oil palm buyer, for comparison farmers). As per Figure 20, treatment farmers were significantly more likely than comparison farmers to report that since they started working with their oil palm buyer, their total household income, portion of household income derived from oil palm, consumption, savings ability, hired labor, and asset base have increased.

Figure 20: Financial Benefits by Treatment Status (2020)

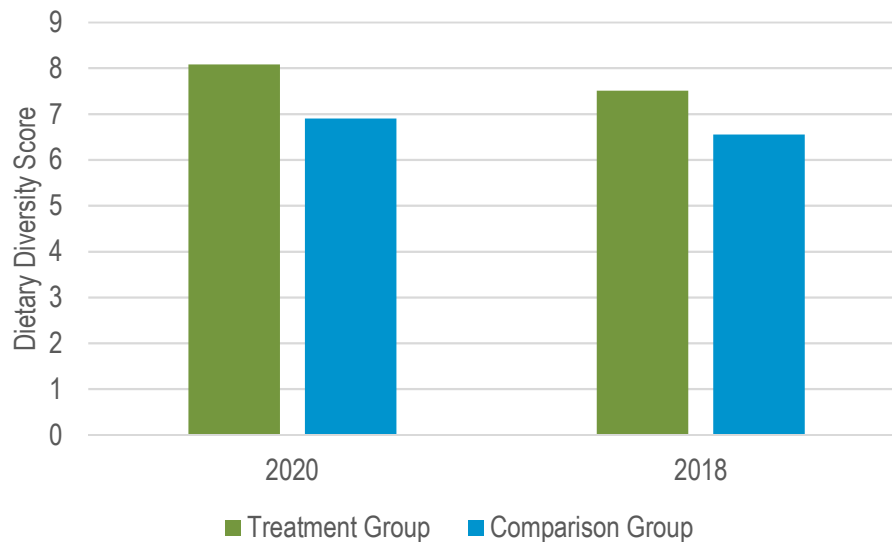


Food Security

While we found no difference by treatment status on insufficient food access in either study period, we found that suppliers reported consuming a more diverse diet than non-suppliers in both 2017 and 2020. Figure 21 provides data on Household Dietary Diversity Scores (HDDS; a 0-12 ranking of dietary diversity, with 12 representing the highest level of dietary diversity on the scale) for treatment and comparison respondents in 2017 and 2020. Suppliers saw an HDDS that was 14% higher than that of non-suppliers in 2020 (statistically different from zero at 95% confidence). In 2017, suppliers' HDDS was 15% greater than non-suppliers' (statistically different from zero at 99% confidence).

In both periods, however, we found that women were more likely than men to experience hunger—measured by at least one month in the past year in which they did not have enough food. Women also experienced poorer dietary diversity in both periods.

Figure 21: Dietary Diversity by Suppliership Status



Aspirations

We asked farmers to report whether they would still like to be farming oil palm in five years' time. While we found no statistically significant difference on this metric between treatment and comparison farmers, over 90% of farmers in our sample reported that they would like to continue farming oil palm into the future. While many individuals in focus groups noted that oil palm provides a good living, some noted that oil palm is one of the only industries in the region and that they participate in the sector because they feel they have no other option.

We found more variation on whether farmers would prefer their children to farm oil palm. While we again found no statistically significant difference between treatment and comparison farmers on this metric, just 50% of farmers in our sample reported that they would like their children to farm oil palm.

Summary of Farmer-Level Impacts by Gender

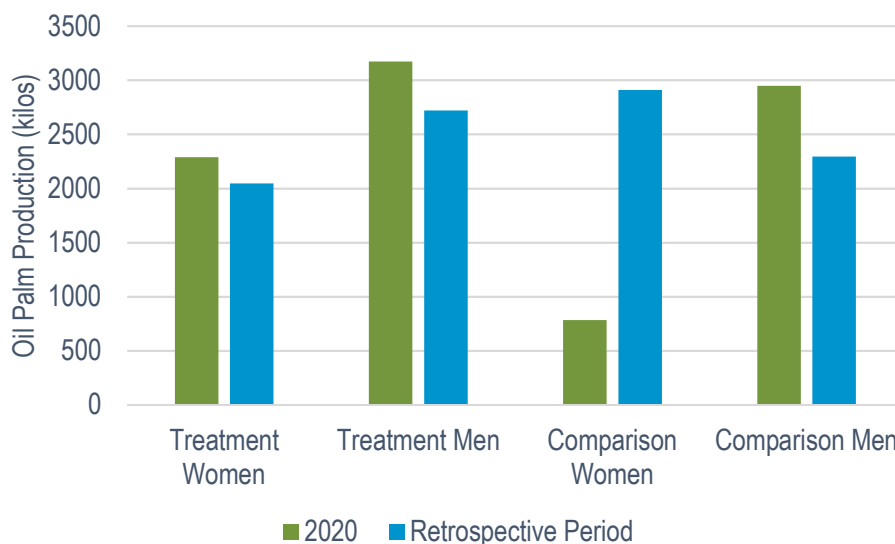
A key objective of this study was to examine the impacts of Serendipalm suppliership by gender and understand the barriers and opportunities faced by women in oil palm-producing communities. While we mentioned many of these findings above, this section offers additional context drawn from focus groups and interviews with enterprise suppliers and staff. Overall, we

identified several barriers that inhibit the full participation of women farmers—who represent a significant minority in the sector—in the oil palm value chain in Ghana.

FINDING 9: Women face various challenges to their oil palm production, though gender differences are less pronounced in the treatment group than in the comparison group.

As indicated in our quantitative results, women earned less income from oil palm than men; they also earned lower prices, produced less oil palm, and achieved lower productivity on their farms. As exemplified by Figure 22, women in the treatment group performed more on par with men in terms of production, productivity, price, and income than did women in the comparison group. In fact, over half of the women in the comparison group reported that they produced no oil palm in 2020 because they had recently replanted their oil palm farms—these young trees had yet to begin producing fruit. Regardless, these trends hold when excluding those who were not able to produce oil palm in 2020, with comparison women lagging behind other groups on key outcomes—perhaps due to their lower application of good agricultural practices. Overall, gender differences were present in both the treatment and comparison groups.³²

Figure 22: High Season Production by Treatment Status and Gender



³² Our matched sample contained 35 male Serendipalm suppliers, 16 female Serendipalm suppliers, 29 male comparison group suppliers, and 22 female comparison group suppliers. Our study was not powered to measure the statistical significance of differences among these small groups, and these small sample sizes could create bias in our comparisons of gender by treatment status.

These differences may relate to women's roles in the oil palm sector. Focus groups indicated that men primarily take on tasks such as pruning and oil palm harvest; women typically collect fallen fresh fruit bunches and transport them for sale. It is unclear whether women do not participate in a broader array of farming activities due to the danger associated with these activities, their physical requirements, knowledge of best practices, or other factors. Regardless, women who work without the help of their husbands hire labor to assist with these tasks. As a result, the costs of oil palm farming are much higher for single women and women may choose to go without important services, like pruning, when they cannot afford them—at the expense of their productivity.

Furthermore, time poverty appears to play a significant role in women's lesser productivity and income. Our qualitative data suggest that women often lack time (due to their childcare, housework, and on-farm responsibilities) to harvest their crops regularly and implement optimal agricultural practices, both of which affect their agricultural productivity. Our quantitative data also indicated that women experienced greater food insecurity and poorer nutrition than did men in our sample. While it is unclear from our qualitative data why this phenomenon is occurring, it could be that women's on-farm productivity is further impacted by hunger and malnutrition.

FINDING 10: Despite these challenges, women reported a high degree of satisfaction with Serendipalm's services.

Women in focus groups reported a high degree of satisfaction with the services they receive from Serendipalm. Participants noted that Serendipalm's prices, agronomic trainings, financial assistance, and payment structure have helped to increase their production capacity. They also noted that Serendipalm provides maternity leave to women who work for the enterprise and that the enterprise is in process of creating a day care center for the children of employees and suppliers. It is clear that Serendipalm adds value to the community through its prices and services; however, the enterprise should conduct further research and planning to address the gender-related barriers noted in this report.

Box 6: Root Capital's Women in Agriculture Initiative (WAI)

In 2012, Root Capital launched our Women in Agriculture Initiative (WAI) to recognize and promote gender-equitable practices among our client enterprises. Through the WAI, Root Capital strengthens gender equity in agricultural businesses and the agricultural sector more broadly. We accomplish this through gender-inclusive lending and advisory services, the creation of women-designed products and services, and by generating and sharing evidence to close gender gaps in agriculture. More specifically, we:

- Seek out and invest in businesses committed to inclusion of women;
- Build women's financial and agricultural knowledge so they can thrive, personally and professionally;
- Encourage and support women-led design of new products and services that benefit the whole community; and
- Demonstrate a model for investing in women to help catalyze gender-smart changes in policy and practice.³³

Summary of Farmer-Level Impacts on Young People

Another key objective of this study was to examine the impacts of Serendipalm suppliership by youth status and understand the barriers and opportunities faced by young people in oil palm-producing communities. Unfortunately, we only encountered eight individuals who would be 35 or under at the time of our 2020 survey when recruiting study participants, and the majority of these individuals did not belong to Serendipalm. Just one of these individuals was ultimately included in our matched sample; the other youth respondents did not farm oil palm in the retrospective period or were significantly different from any potential matches.

As a result, we were not able to disaggregate our full quantitative findings by youth status, as we intended. However, findings drawn from focus groups and interviews with enterprise suppliers and staff shed light on the challenges faced by youth in oil palm production, which could account for the lack of young people encountered by our survey team.

Focus group respondents indicated that a key challenge faced by youth in the Ghanaian oil palm sector involves land tenure. Land is prohibitively expensive in the area; thus, many young people acquire land through family inheritance, and those without such inheritance struggle to enter the sector. However, those whose families work in oil palm often compete with many

³³ Root Capital, *Women in Agriculture Initiative: Business Plan 2019-2021* (Cambridge, MA: Root Capital, 2019).

siblings for a single land inheritance; as a result, younger siblings are often unable to secure family land for farming. Additionally, while young people's agility provides them a clear advantage in undertaking the physically demanding aspects of oil palm farming over older producers, their inexperience presents a barrier. Older producers noted that younger producers often lack knowledge related to oil palm farming that hampers their agricultural productivity.

It is important to note that the quantitative data available to us indicated that not all youth suffer from challenges to land access and productivity. As per Table 2, the eight young people we surveyed were performing more strongly in 2020 on oil palm income, total income, oil palm farm size, total farm size, production in the high and low seasons, price in the high and low seasons, and food sufficiency than the average individual in our matched sample. Again, these individuals are primarily comparison respondents, and most were not included in the impact analyses presented in previous sections (either because they did not farm oil palm in the retrospective period or because they were significantly different from all potential matches in our sample). However, these data indicate that some youth in the region are able to perform at a high level in the oil palm sector, though it is unclear from our research what characteristics allow them to do so.

Table 2: Key Production Characteristics Among Youth Farmers, 2020

	Youth		Full Matched Sample (Youth and non-Youth)	
	Observations	Mean	Observations	Mean
Oil Palm Income (GH¢)	8	9,025	99	4,094
Household Income (GH¢)	8	15,863	101	9,292
Oil Palm Farm Size (acres)	8	10	102	7.8
Total Farm Size (acres)	8	15.7	102	13.3
High Season Production (kilos)	8	9,338	102	2,455
Low Season Production (kilos)	8	5,400	101	781.4851
High Season Price (GH¢)	6	0.45	83	0.43
Low Season Price (GH¢)	6	0.50	83	0.49
Farming Certification	8	0	102	0.343
Full-Time Workers	8	0	102	0.078
Temporary Workers	8	3.6	102	4.4
Sufficient Food?	8	0.5	102	0.3
Farm Oil Palm in Five Years?	8	0.88	102	0.93

In our focus groups and interviews, we learned that Serendipalm has devoted resources to encouraging youth to get involved in the oil palm sector. Serendipalm has employed young suppliers of the community at the enterprise as technical assistance staff and interns. Youth hired by Serendipalm help deliver on-farm services to farmers, such as dynamic agroforestry installation and weeding support. Serendipalm also provided oil palm seedlings to young people on credit, as well as trainings for young people on farm management. Despite these efforts, the low proportion of younger farmers in Serendipalm's suppliership base indicates that more effort is needed to attract younger farmers to oil palm.

Box 7: Root Capital's Next Generation Jobs Strategy

"Jobs for the Next Generation" is a key focus of Root Capital's strategy to build both the bankability and resilience of agricultural businesses and rural communities around the world. To date, we have placed nearly 50 young people in first-time roles within agricultural enterprises through our Talent Partnerships Program, awarded 18 Resilience Grants for clients to implement youth-positive development strategies, and provided HR management training to help our clients integrate over 60 young people successfully into their businesses.

Looking ahead, we will build upon this experience—much of it undertaken in partnership with the Mastercard Foundation—to formalize our global strategy for next-gen jobs. In the next five years, we will enhance employment pathways for youth into agricultural enterprises, promote opportunity for career advancement and fulfilling work, and catalyze innovative career paths for youth in agriculture. In so doing, we hope to demonstrate to youth that viable and attractive opportunities in agriculture exist as an alternative to urban migration. Our youth programming will include a focus on technology and digitization, succession planning that integrates the next generation, and scale-up of our Talent Partnerships Program, among others. Through continued engagement with valued partners such as the Mastercard Foundation, we will refine our approach to accelerating youth inclusion in agricultural businesses, paving the way for a future engagement strategy that centers agricultural businesses in approaches to increase meaningful employment for young people in rural communities.

Business-Level Impacts

As mentioned in previous sections, the main focus of this study is the farmer-level impact of affiliation with Serendipalm. However, we also collected information on Serendipalm's interactions with Root Capital, as well as employee perceptions of Root Capital's services and impact. This section details our findings related to these data.

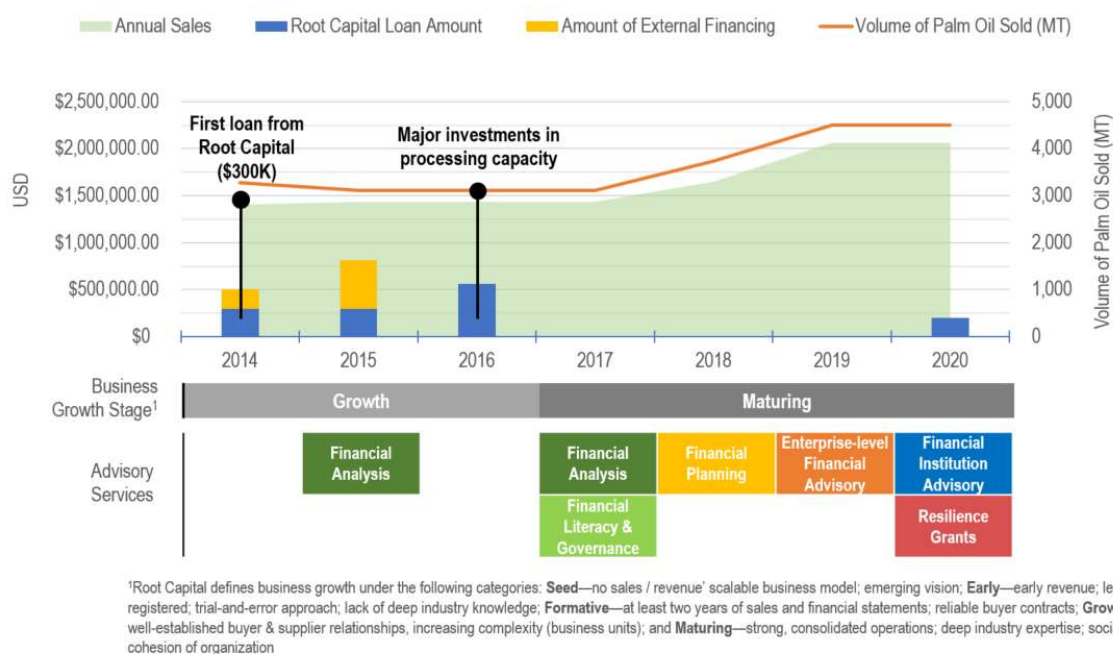
FINDING 11: According to enterprise employees, Root Capital financing and training has enabled Serendipalm to meet its business goals.

Root Capital has provided Serendipalm with a variety of services since 2014, when we approved a \$300,000 loan to Serendipalm for general working capital. Since then, we closed loans with Serendipalm in 2015 (\$300K), 2016 (\$560K)—for a line of credit and a term loan which was extended through 2020—and 2020 (\$200K).

Alongside our lending, we began providing Serendipalm with advisory services in 2015. As of the publication of this report, our advisory team has spent 48 days training Serendipalm employees on financial analysis, financial literacy and governance, financial planning, and financial product design for rural businesses. In 2020, in response to the COVID-19 crisis, Root Capital awarded Serendipalm a \$13,000 Resilience Grant, which Serendipalm used to form a credit union for employees and producers facing greater credit needs due to the pandemic.

Serendipalm's sales have grown steadily over our engagement; as per Figure 23, revenues have grown from \$1.4M in 2014 to \$2.1M in 2019. Its suppliership base has held steady at approximately 500 suppliers across our engagement period.

Figure 23: Serendipalm's Engagement with Root Capital



Enterprise interviews indicated that these services have been instrumental to Serendipalm's growth and community impact. Employees reported that Root Capital financing has allowed the enterprise to finance new processing equipment that allows it to purchase more oil palm from

its suppliers. This change has directly benefited Serendipalm's suppliers, who are able to sell larger volumes of their crop to the enterprise for higher prices than those offered on the local market. Larger volumes also increase the value of Fair Trade premiums that Serendipalm receives from its buyers, which increases its capacity to conduct community development projects.

Employees also emphasized the benefits they have received from Root Capital's advisory services. They noted that Root Capital trainings have empowered Serendipalm's accounts team with important information on management and financial stewardship. These services set Root Capital apart from other lenders in the region. They feel that Root Capital is an "ethical lender," committed to supporting Serendipalm through the challenges it faces and building its capacity to address these challenges.

Serendipalm sees great room for improvement in its farmers' yields, and employees see Root Capital as a key partner in increasing supplier productivity through training and capital for on-farm loans.

"There have been other companies approaching us...we look at the benefits we get from [Root Capital] and other support services beyond the money they give to us and we think it is not worth moving to other companies."

– Member of the Serendipalm leadership team

FINDING 12: Enterprise staff requested lower interest rates and more training from Root Capital.

Serendipalm employees noted that they would like to see Root Capital offer a lower interest rate. Employees also mentioned that it would be useful to provide more trainings designed to support women and youth. They noted that it would be particularly helpful to host an event to provide community youth with vocational training, which could help connect farm families with sources of alternative income during the low season.

CONCLUSION

This study reveals promising findings about the impacts of Serendipalm on farmer livelihoods in the Ghanaian oil palm sector. We found that Serendipalm suppliers had higher oil palm production, productivity, sales, and income than comparison farmers. Serendipalm suppliers also received higher prices for their product and were more likely to engage in a variety of optimal agricultural practices and maintain farm certifications. While women lagged behind men on many key outcomes, gender differences were less pronounced in the treatment group than in the comparison group.

Farmers affiliated with Serendipalm reported in focus groups that this affiliation has had numerous positive impacts on their incomes and quality of life. Most focus group participants expressed enthusiasm about the trainings offered by Serendipalm, noting that they feel trainings have led to improvements in their agricultural practices and productivity. Farmers reported that the services they receive from Serendipalm help them save time. Our data also indicated that Serendipalm is providing suppliers with opportunities to develop capacity for alternative income generation, allowing producers to diversify their incomes.

Serendipalm employees, meanwhile, noted that their partnership with Root Capital has helped them develop stronger relationships with their suppliers. Root Capital loans have enabled the enterprise to acquire key processing equipment, allowing them to purchase greater volumes from suppliers. Our advisory services have also provided helpful training on financial planning and analysis.

At the same time, this study exposed numerous areas for further attention and research. Though Serendipalm requires producers to comply with organic standards in their production, some farmers reported that these requirements do not always translate to greater yields. Further exploration is necessary to clarify whether S to improve yields and/or the amount of time they invest in organic production, to ensure compliance with organic standards alongside farmer productivity.

It is also evident that women face barriers that impede their full participation in oil palm production and that very few youth work in the sector. Serendipalm might consider specific initiatives to assist female producers in acquiring land and improving farm yields. The enterprise may also find success in programs that encourage more homemaking among male suppliers, to allow women more time to devote to their farm responsibilities. Though the enterprise reported a number of programs to encourage youth involvement in oil palm farming, youth engagement appears to remain very low. Serendipalm may benefit from a review of its

youth inclusion strategy, to the extent that youth engagement is a key focus of the enterprise. One employee noted that it would be useful for Root Capital to provide the enterprise with more training on women and youth inclusion, which could help to facilitate these strategies.

Overall, this study largely validates the key premise of Root Capital's model—that agricultural enterprises can generate positive outcomes for rural communities with the right investment and targeted training. We hope to deepen our relationship with Serendipalm in the years to come, as the enterprise confronts the challenges and opportunities that affect its business and the lives of its suppliers.

TECHNICAL APPENDIX

Section 1: Quantitative Approach

To identify the impact of affiliation with Serendipalm on individual farmer outcomes—such as oil palm farm size, production, and income—we employed a retrospective comparison group matching technique. This quasi-experimental approach allowed us to match unaffiliated farmers (the comparison group) to Serendipalm farmers (the treatment group) based on their characteristics prior to the intervention. We used the matched sample of farmers to measure the association between suppliership with Serendipalm and our outcomes of interest.

Data Collection Strategy

In December 2017, we collected household survey data from 100 Serendipalm suppliers and 101 non-member oil palm farmers working in nearby communities. In the case of unaffiliated farmers, we interviewed the household member primarily responsible for oil palm production. Surveys contained questions about farmer demographics, household characteristics, health and quality of life, farm and production characteristics, oil palm buyers, prices farmers receive for the sale of their oil palm, income, services offered by buyers, and aspirations in oil palm production.

Treatment participants were selected randomly from Serendipalm's member database; randomization was stratified by farmer community, and we oversampled women in the hope of conducting stratified analyses by gender. Comparison farmers were selected from a set of communities that were demographically similar to treatment communities; all comparison farmers responded to screening questions to determine whether they farmed oil palm for sale, whether they owned less than 21 acres of oil palm, and that they did not supply oil palm to Serendipalm. In 2017, we substituted four replacements for treatment participants who were not available for interview; all replacements were of the same sex.

In January 2020, we followed up with these farmers with a similar survey, reaching 83 treatment respondents and 78 comparison respondents (an attrition rate of 19.5%). In 2020, we also asked respondents about a set of key demographic and production characteristics in the year prior to joining Serendipalm (or ten years prior, for non-member respondents), in order to construct baseline data to match treatment farmers to similar comparison farmers. In both periods, data collection was overseen in the field by Participatory Development Associates, Ltd., as well as Ibrahim Ouattara, a Root Capital consultant.

Analytical Approach

Accurate impact estimation relies on the assumption that the comparison group represents the outcomes of farmers in the treatment group had they not joined Serendipalm. We attempt to justify this assumption by choosing comparison farmers who were statistically similar to treatment farmers prior to intervention—for our purposes, prior to the point at which treatment group farmers joined Serendipalm. Under such an assumption, the only difference between the treatment and comparison groups is the intervention; as a result, any difference in eventual outcomes between the two groups can be attributed to the intervention.

Rigorous impact evaluations typically rely on randomization to fulfill this assumption. Individuals are randomly assigned a treatment or control status, which should result in two statistically indistinct groups, one of which receives the intervention. Outcome measures are then collected after a certain intervention period has elapsed. However, the nature of Root Capital's business model is such that randomization is not a sensible methodological tool to employ for the purpose of impact evaluation. We devote significant resources to the process of vetting clients for loan approval. Moreover, contacting farmers before and after intervention is costly. Finally, we have limited access to client suppliers before we begin lending to a given enterprise, let alone before suppliers decide to join these enterprises.

Therefore, for this study, we employed a *retrospective comparison group methodology* to assess impacts on Serendipalm suppliers. We collected data from farmers at two points in time (after treatment farmers had been working with Serendipalm for a number of years). We also asked farmers to recall information about their farm characteristics and oil palm production prior to intervention (for treatment respondents, in the year prior to joining Serendipalm, and for comparison respondents, ten years prior). These retrospective characteristics—which included oil palm farm size, income, production and sales, agricultural practices, and certification status—are predictive of enterprise suppliership. We also collected data on current-time oil palm income, our primary outcome of interest. We dropped any study participant who was not farming oil palm in the retrospective period. We then matched treatment and comparison respondents on these characteristics, dropping participants with no close matches, and used the matched sample to conduct regression analyses and generate impact estimates.

This quasi-experimental research design allowed us to generate plausibly causal estimates of Serendipalm suppliership in a cost-effective manner. It produced treatment and comparison samples that were largely comparable on recalled retrospective data. Where possible, we also incorporated retrospective data as controls in our regression models. Although we undertook the best approach to determining causality given budget and logistical constraints, there may still be some differences between our treatment and comparison groups, which can cause bias in our estimates.

Section 2: Matching Methodology

We matched treatment and comparison respondents using propensity score matching. This process matches treatment individuals to comparison individuals using propensity scores, a measure that reflects the likelihood of treatment group suppliership given observed baseline characteristics.³⁴ Comparison respondents who are not selected as matches—as well as treatment respondents for whom a suitable match is not available—are dropped from the sample.

We imposed a caliper, or a maximum acceptable level of difference between a treatment individual and their selected comparison respondent, to avoid poor quality matches; the caliper was set at 0.2 standard deviations of the distance function. As indicated in the report, we matched on oil palm income, oil palm production in the high and low seasons, and oil palm farm size in the retrospective period. We also considered gender, marital status, total household land, total income, oil palm trees, application of pruning and fertilizer, use of regular harvests, and oil palm sales in the high and low seasons (all in the retrospective period) when assessing balance.

Comparison respondents were matched with replacement, meaning that a single comparison respondent could be matched with multiple treatment farmers with whom they were sufficiently similar. The final matched sample included 102 respondents: 51 treatment respondents and 51 comparison individuals, representing 51 unique treatment respondents and 22 unique comparison respondents. Table 3 details the number of participants and proportion of women in the matched sample, relative to the total number of Serendipalm suppliers.

Table 3: Matched Sample Size vs. Producer Population

	Sample Size (% women)	Total Number of Producer Suppliers (% women)
Treatment Group	51 (43%)	805 (25%)
Comparison Group	51 (31%)	N/A

Table 4 demonstrates the results of matching, and illustrates the differences in balance (the level of similarity between treatment and comparison groups) between the raw and matched samples. The standardized differences (ideally zero) decreased in absolute value on most variables in the matched sample relative to the raw. In the matched sample, standardized

³⁴ Peter C. Austin, “An Introduction to Propensity Score Methods for Reducing the Effects of Confounding in Observational Studies,” *Multivariate Behavioral Research* 46(3), May 2011, 399-424. www.ncbi.nlm.nih.gov/pmc/articles/PMC3144483/.

differences in oil palm income, high and low season production, oil palm farm size, oil palm trees, and high and low season sales were very low (<0.05). We also achieved acceptable balance on total household land and pruning in the retrospective period. Variance ratios (ideally 1) improved in the matched sample relative to the raw on marital status, harvest regularity, and low season sales.

Table 4: Balance on Matching Covariates

	Standardized Differences		Variance Ratio	
	Raw	Matched	Raw	Matched
Past Oil Palm Income	-0.0319946	0.0251632	1.182448	1.589516
Past Household Income	-0.0263912	0.192619	1.381242	3.224504
Past Oil Palm Farm Size	.0339617	.0273047	1.39263	1.663797
Past Oil Palm Trees	-.0140779	-.029021	1.222198	1.462186
Past Farm Size	-.028992	.0601389	1.2492	1.542396
Past High Season Production	-.0259559	-.0264651	2.651216	3.96964
Past High Season Sales	.0364724	-.0191597	3.55199	5.047616
Past Low Season Production	.035679	-.0478516	1.909216	2.061982
Past Low Season Sales	.1535038	-.0447099	2.500463	2.156857
Past Pruning	.1637653	.0900134	2.202353	1.469388
Past Fertilizer Application	.1266843	.2892957	.8906787	.8222222
Past Harvest Regularity	.236837	.1656006	2.875294	1.918367
Gender	-.0947867	-.242738	.9298824	.8777429
Marital Status	.2331479	.126891	.8362484	.8961938

Quantitative Methodological Challenges

We encountered difficulties throughout data collection and analysis that could influence our results. Nearly 20% of our 2017 survey respondents were not available for participation in our 2020 study—these missing respondents had passed away, moved from the study communities, or declined to participate. The PDA team successfully conducted some surveys via phone for several participants who had relocated, but some were unreachable via their telephones or community connections. As a result, the sample that was available for matching and the final matched sample are relatively small, which could create inaccuracies in our impact estimates.

Though the retrospective comparison group design lends more confidence to our results than a simple comparison group design or pre-post analysis, this methodology is not without drawbacks. The validity of our results rests on the assumption that we have included all covariates that could influence both treatment status (joining Serendipalm) and our key

outcomes of interest (oil palm income) in our matching and regression models. It is likely that a variable exists for which we have not accounted, which could bias our impact estimates.

A limitation specific to the *retrospective* nature of our study design, meanwhile, is the difficulty of accurately recalling retrospective data. Treatment farmers belonged to Serendipalm for an average of eight years when we collected retrospective data in 2020 (50% of farmers had been suppliers 6.5 years or less). It is likely that some farmers incorrectly estimated crucial information, such as income or oil palm production in the year prior to joining Serendipalm. In some instances, respondents simply could not recall information. As they could not be matched without that data, these respondents were dropped from the analysis, limiting our final sample size.

We also had to select a common timeframe for retrospective questions asked of comparison farmers, potentially creating misalignment in the response timelines of treatment and comparison participants. Based on the average suppliership tenure among Serendipalm farmers, we asked comparison farmers to report retrospective data from ten years prior. It is likely that, in some cases, treatment farmers and their comparison matches did not report retrospective data from the same year.

Finally, though this model improves the overall balance of our treatment and comparison samples on retrospective characteristics relative to our raw data, we still observe poor balance on many variables in the matched sample. Our model saw high standardized differences on household income, fertilizer application, harvest regularity, gender, and marital status between the raw and matched samples, and suboptimal variance ratios on the majority of variables. These imbalances could indicate systemic differences between the treatment and comparison samples that may bias results. However, given that the model succeeded in matching on key covariates related to oil palm production—including oil palm land, sales, and income—we have greater confidence in the results relative to what we would have achieved using a simple comparison group methodology.

Section 3: Qualitative Approach

To complement our quantitative data, we conducted focus groups with farmer-suppliers and interviews with enterprise staff. These conversations allowed us to collect detailed narratives on key outcomes of interest—particularly gendered or youth-related trends in oil palm production or individual outcomes. They also provided an opportunity for Root Capital to solicit direct feedback about the enterprise and our own services in a neutral environment. Finally, they helped us develop a stronger understanding of the social and economic context in which this clients and its suppliers operate.

Data Collection Strategy

Focus Groups

Focus groups were primarily intended to collect data on men's, women's, and youth's experiences as oil palm producers and Serendipalm suppliers; understand barriers to women's and youth agricultural productivity and enterprise participation; and identify methods through which Serendipalm or suppliers themselves could better support female and youth producers. They included discussion questions on individuals' motivation for becoming oil palm farmers and enterprise suppliers; changes over time to oil palm production and income; services and benefits derived from enterprise affiliation; vulnerabilities and future aspirations; and gender and youth dynamics in their households, businesses, and communities.

Focus groups were disaggregated by gender; a focus group was conducted with women and with men belonging to Serendipalm, as well as with a set of male and female comparison farmers. We also conducted a focus group comprised of youth treatment farmers. Focus groups contained 3-10 suppliers each and were carried out by PDA staff. Participants were selected randomly for focus group discussions; however, in some cases, when randomly selected participants did not present themselves for the discussions, the consultant replaced them with non-randomly selected farmers of the appropriate gender.

Enterprise Interviews

We conducted enterprise-level interviews to collect data on Serendipalm's financial status, successes, and challenges; services provided to farmers; and goals. Enterprise interviews also included questions about the features of the oil palm market in which Serendipalm operates, as well as their experiences with, and suggestions for, Root Capital.

Qualitative Methodological Challenges

Focus groups provide a cost-effective method of obtaining qualitative data from a large number of participants. However, focus groups do not always allow respondents to provide detailed responses, as facilitators are tasked with hearing from multiple people in a limited timeframe. Additionally, the presence of others can bias individual responses. To limit this kind of bias, we separated focus groups by gender. Facilitators were also instructed to limit the exposure of the focus group to non-participant observation or input.

Ethical Considerations

The study underwent a rigorous independent ethical review process to ensure the entire process and approaches used met acceptable ethical standards. This included participants' voluntary participation, protection of participants' identity, and mitigation of both researcher and

respondent biases. The ethical review process was conducted by Participatory Development Associates' (PDA) Ethical Review Committee, which is an independent body of experienced academics and applied researchers in Ghana and the United Kingdom.

In addition, the study followed Root Capital's client-centric approach, which prioritizes learning and benefits for agribusinesses and its member farmers. This approach includes the following features: voluntary participation of the client; close collaboration with the client to draft survey instruments such that questions serve client learning needs and ultimately help the client better serve its farmer suppliers; the use of pseudonyms when the client prefers to not be publically mentioned; and, upon completion of the study, presentation of the results to the client before any external publication.³⁵

Section 4: Regression Results

Table 4: Regression Results on Land Size, Certification, and Labor

VARIABLES	(1) 2020 Oil Palm Land	(2) 2017 Oil Palm Land	(3) 2020 Oil Palm Trees	(4) 2017 Oil Palm Trees	(5) 2020 Total Land	(6) 2017 Total Land	(7) 2020 Farm Cert.	(8) 2020 HH Labor	(9) 2020 Full-Time Workers	(10) 2020 Temp Workers
Member	0.915 (0.932)	2.046** (0.906)	59.27 (56.13)	124.3** (54.30)	2.793** (1.128)	5.43*** (1.37)	-0.6*** (0.07)	0.0855 (0.319)	0.152* (0.0852)	3.043** (1.513)
Oil Palm Farm Size (R)	0.650* (0.330)	0.139 (0.203)								
Female	-1.030 (0.827)	-0.873 (0.911)	-64.93 (49.56)	-64.90 (54.46)	-3.79*** (1.049)	-4.03*** (1.38)	0.0446 (0.08)	-0.407 (0.321)	0.181 (0.116)	0.220 (1.757)
Total Income (R)	0.00051 (0.0003)	0.00011 (0.0002)	0.0295* (0.0172)	0.0031 (0.008)	0.0008* (0.0004)	0.0001 (0.0002)	2.22e-05*** (7.50e-06)	5.89e-05 (5.02e-05)	-2.66e-05 (1.84e-05)	-0.0003 (0.0002)
Total Land (R)	0.207* (0.122)	0.0614 (0.0741)	11.01 (6.899)	4.447 (4.225)	0.821*** (0.127)	0.0679 (0.086)	0.0085 (0.01)	-0.0100 (0.0343)	0.0160 (0.0135)	0.0262 (0.0698)
Oil Palm Trees (R)			0.817** (0.314)	0.219 (0.187)						
Farm Certification (R)							0.5*** (0.15)			
Oil Palm Income (R)									3.38e-05 (2.27e-05)	0.00026 (0.0002)
Comparison Mean	7.04902	6.470588	427.3725	389.0196	11.16667	8.74902	0.058824	1.843137	0.019608	3

³⁵ A full description of Root Capital's client-centric approach can be found at https://rootcapital.org/wp-content/uploads/2018/02/2015-june_client_centric_approach_final.pdf

Observations	102	102	102	102	102	102	102	102	102
R-squared	0.454	0.120	0.481	0.132	0.623	0.236	0.471	0.046	0.154
Robust standard errors in parentheses									
*** p<0.01, ** p<0.05, * p<0.1									
All regressions are OLS, employ robust standard errors, and include a frequency weight used to construct the matched sample. "Member" is a dummy variable indicating treatment status; "Female" is a dummy variable indicating whether the respondent was female. (R) indicates the retrospective time period.									

Table 5: Regression Results on Agricultural Practices, 2020

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	2020 Intercropping	2020 Weeded Circles	2020 Pruning	2020 Fertilizer	2020 Crop Residue	2020 Drainage	2020 Regular Harvest
Member	-0.0214 (0.0753)	-0.282*** (0.0797)	-0.231*** (0.0545)	0.0997 (0.0614)	-0.256*** (0.0783)	0.0504 (0.0570)	-0.211*** (0.0679)
Intercropping (R)	0.622*** (0.0856)						
Female	-0.156* (0.0795)	0.00125 (0.0785)	0.148** (0.0649)	0.0890* (0.0515)	-0.0512 (0.0843)	-0.0895 (0.0632)	0.247*** (0.0804)
Total Income (R)	2.33e-06 (6.58e-06)	-1.26e-05* (6.95e-06)	1.25e-05* (6.51e-06)	-6.46e-06 (5.39e-06)	-2.34e-05** (1.07e-05)	2.00e-05*** (6.51e-06)	-2.45e-06 (7.43e-06)
Total Land (R)	-0.0157*** (0.00544)	0.00671 (0.00651)	-0.00769* (0.00441)	-0.00952** (0.00475)	-0.00122 (0.00654)	-0.0138** (0.00627)	-0.00791* (0.00418)
Weeded Circles (R)		0.524*** (0.0931)					
Pruning (R)			0.301** (0.140)				
Fertilizer (R)				0.700*** (0.0868)			
Crop Residue (R)					0.428*** (0.0975)		
Drainage System (R)						0.323 (0.400)	
Regular Harvest (R)							0.260 (0.256)
Comparison Mean	0.666667	0.45098	0.764706	0.411765	0.54902	0.156863	0.686275
Observations	102	102	102	102	102	102	102
R-squared	0.400	0.480	0.269	0.651	0.284	0.131	0.256
Robust standard errors in parentheses							
*** p<0.01, ** p<0.05, * p<0.1							
All regressions are OLS, employ robust standard errors, and include a frequency weight used to construct the matched sample. "Member" is a dummy variable indicating treatment status; "Female" is a dummy variable indicating whether the respondent was female. (R) indicates the retrospective time period.							

Table 6: Regression Results on Agricultural Practices, 2017

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	2017 Intercropping	2017 Weeded Circles	2017 Pruning	2017 Fertilizer	2017 Crop Residue	2017 Drainage	2017 Regular Harvest
Member	-0.600*** (0.0760)	-0.0513 (0.101)	-0.0162 (0.0164)	-0.116 (0.0903)	-0.0589 (0.0702)	0.0764** (0.0342)	0.00173 (0.0401)
Intercropping (R)	0.149* (0.0774)						
Female	0.0823 (0.0781)	0.189* (0.0995)	0.0204 (0.0207)	0.167* (0.0935)	-0.0472 (0.0780)	-0.0882** (0.0391)	0.143** (0.0614)
Total Income (R)	-2.56e-05*** (8.49e-06)	-3.02e-05** (1.36e-05)	-2.28e-07 (7.85e-07)	1.75e-06 (1.21e-05)	3.09e-06 (5.21e-06)	-1.57e-05** (7.34e-06)	-2.06e-06 (5.54e-06)
Total Land (R)	0.0140* (0.00714)	0.00115 (0.00836)	-0.00138 (0.00141)	-0.00660 (0.00798)	-0.00483 (0.00331)	0.00773** (0.00358)	0.00222 (0.00398)
Weeded Circles (R)		0.104 (0.102)					
Pruning (R)			-0.0166 (0.0187)				
Fertilizer (R)				0.286*** (0.0974)			
Crop Residue (R)					-0.0770 (0.0662)		
Drainage System (R)						0.970*** (0.0316)	
Regular Harvest (R)							-0.0946* (0.0484)
Comparison Mean	0.098039	0.392157	0.980392	0.294118	0.862745	0.078431	0.941176
Observations	102	102	102	102	102	102	102
R-squared	0.487	0.125	0.032	0.155	0.036	0.468	0.101
Robust standard errors in parentheses							
*** p<0.01, ** p<0.05, * p<0.1							
All regressions are OLS, employ robust standard errors, and include a frequency weight used to construct the matched sample. "Member" is a dummy variable indicating treatment status; "Female" is a dummy variable indicating whether the respondent was female. (R) indicates the retrospective time period.							

Table 7: Regression Results on Production, Productivity, and Sales

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	2020 High Season Production	2020 High Season Productivity	2020 Low Season Production	2020 Low Season Productivity	2020 High Season Sales	2020 Low Season Sales	2017 Sales
Member	642.1 (419.4)	-2.276 (73.44)	545.5*** (153.4)	70.94*** (17.36)	375.2 (450.2)	565.6*** (182.2)	-1,379* (772.3)
High Season Production (R)	0.555***						

	(0.179)						
Female	-1.405***	-222.2***	-283.3*	-47.80***	-1,759***	-393.4**	-958.4
	(435.7)	(66.42)	(166.4)	(17.93)	(475.3)	(192.5)	(727.6)
Total Income (R)	0.109	-0.00621	-0.00181	0.000668	0.107	0.0842	-0.116
	(0.0753)	(0.00593)	(0.0174)	(0.00196)	(0.0727)	(0.0524)	(0.0744)
Total Land (R)	34.43	-4.087	15.96**	-0.420	38.61	30.93**	346.3***
	(26.95)	(4.630)	(7.236)	(1.098)	(28.23)	(12.82)	(95.33)
High Season Productivity (R)		-0.0882					
		(0.143)					
Low Season Production (R)			0.202**				
			(0.0814)				
Low Season Productivity (R)				0.0435			
				(0.0519)			
High Season Sales (R)					0.595***		-0.250
					(0.189)		(0.267)
Low Season Sales (R)						0.450**	0.108
						(0.213)	(0.442)
Comparison Mean	2014.706	340.1541	508.2353	75.44858	1965.686	498.4314	2298.472
Observations	102	102	101	101	95	97	68
R-squared	0.395	0.111	0.223	0.233	0.404	0.448	0.482
Robust standard errors in parentheses							
*** p<0.01, ** p<0.05, * p<0.1							
All regressions are OLS, employ robust standard errors, and include a frequency weight used to construct the matched sample. "Member" is a dummy variable indicating treatment status; "Female" is a dummy variable indicating whether the respondent was female. (R) indicates the retrospective time period.							

Table 8: Regression Results on Price and Income

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	2020 High Season Price	2020 Low Season Price	2017 Price	2020 Oil Palm Income	2017 Oil Palm Income	2020 Household Income	2017 Household Income
Member	0.0915***	0.0508***	0.0397**	1,605**	191.8	3,526**	3,250***
	(0.0183)	(0.0192)	(0.0149)	(665.2)	(518.9)	(1,379)	(1,080)
High Season Price (R)	-0.0684		-0.0119				
	(0.0605)		(0.139)				
High Season Price (R)		0.0440	-0.0768				
		(0.0487)	(0.0557)				
Female	-0.0480*	-0.0554*	0.0419**	-2,260***	-904.0*	-1,603	-378.4
	(0.0278)	(0.0305)	(0.0161)	(680.8)	(507.5)	(1,259)	(1,090)
Total Income (R)	-2.53e-06*	-2.83e-06*		-0.270	-0.212*	0.720***	0.0678
	(1.34e-06)	(1.53e-06)		(0.166)	(0.108)	(0.165)	(0.136)
Total Land (R)	0.000144	0.00211*	1.92e-06	116.4*	-34.01	284.7**	57.24

	(0.000990)	(0.00123)	(2.88e-06)	(61.43)	(37.24)	(123.4)	(85.50)
Total Oil Palm Income (R)			-0.00254**	0.807***	0.550***		
			(0.000996)	(0.208)	(0.179)		
Comparison Mean	.3861765	.4641176	.4638889	3265.5	4054.098	7080.157	6461.314
Observations	79	79	66	99	102	101	102
R-squared	0.323	0.173	0.226	0.329	0.117	0.329	0.103
Robust standard errors in parentheses							
*** p<0.01, ** p<0.05, * p<0.1							
All regressions are OLS, employ robust standard errors, and include a frequency weight used to construct the matched sample. "Member" is a dummy variable indicating treatment status; "Female" is a dummy variable indicating whether the respondent was female. (R) indicates the retrospective time period.							

Table 9: Regression Results on Hunger, Dietary Diversity, and Aspirations

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	2020 Hunger	2017 Hunger	2020 HDDS	2017 HDDS	2020 Aspirations for Children	2020 Self-Aspirations
Member	0.0919 (0.0944)	0.0633 (0.0954)	0.967** (0.386)	1.001*** (0.351)	0.00977 (0.0980)	-0.0159 (0.0513)
Female	0.293*** (0.0920)	0.00161 (0.100)	-0.869** (0.370)	0.735** (0.357)	-0.00242 (0.109)	-0.00835 (0.0543)
Total Income (R)	-3.87e-06 (1.05e-05)	1.62e-05 (1.16e-05)	0.000112*** (4.12e-05)	5.32e-05 (4.13e-05)	2.34e-05* (1.27e-05)	-2.08e-06 (3.83e-06)
Total Land (R)	0.0112 (0.00733)	0.00598 (0.00751)	0.0449 (0.0371)	0.00995 (0.0244)	-0.0232*** (0.00748)	-0.00772** (0.00311)
Comparison Mean	0.372549	0.411765	6.901961	6.54902	0.509804	0.921569
Observations	102	102	102	102	102	102
R-squared	0.095	0.039	0.223	0.120	0.088	0.045
Robust standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1						
All regressions are OLS, employ robust standard errors, and include a frequency weight used to construct the matched sample. "Member" is a dummy variable indicating treatment status; "Female" is a dummy variable indicating whether the respondent was female. (R) indicates the retrospective time period.						