FCIP
Farm & Cooperative Investment Program

NEW INSIGHTS ON REACHING LIVING INCOME

BASELINE ANALYSIS FROM FARMER FIELD BOOKS OF COCOA FARMERS IN CÔTE D'IVOIRE

idh the sustainable trade initiative

the sustainable trade initiative

Le Conseil du Café-Cacao

Le Conseil de Régulation, de Stabilisation et de Développement de la Filière Café-Cacao

AGRI LOGIC

Cargill

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RAINFOREST ALLIANCE

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FOREWORDS

IDH initiated the Farm and Cooperative Investment Programme (FCIP) with the government of Cote d'Ivoire (Le Conseil du Café Cacao) in 2017 to improve cooperative investment and farmer prosperity. As part of this programme, 11 companies and financial institutions have been facilitating access to finance and professionalization services to approximately 400 cooperatives and 190,000 farmers.

Understanding the impact of these interventions at farm level requires understanding better the farmers we work with. An important way to reach this is to gather daily data on farmers' economics and activities. Out of the 11 FCIP partners, three companies – Cargill, Barry Callebaut and Beyond Beans (formerly Cocoanect) – entered into a pre-competitive collaboration to gather and publicly share aggregated farmer data from across various cooperatives using the Farmer Field Books (FFB) tool.

The analysis from this report provides important baseline information into farm management and farmer economics including a critical reality check on the complexities involved in enabling farmers to reach a living income. The analysis does not yet provide information on the impact of FCIP financial and professional services or farmer's ability to invest which will be the focus of an aggregated impact report planned for mid-2021.

All partners working in the cocoa sector will have much to gain with this new insight and what it tells us on the bottlenecks but also opportunities to improve farmer professionalism. IDH is committed to continue to bring different partners together under FCIP to deepen our understanding of what is working and not working for farmers as captured in this report.

Jonas MvaMva

IDH Cocoa Program Director

With this baseline report we are pleased to be able to showcase some of the work we have been doing with various partners in the cocoa sector over the past few years. We'd like to take this opportunity to thank all the farmers who have contributed their farm and activity data. We hope that the farm management reports each of them receives every year helps to improve farm management and returns. We are also indebted to the field teams of the partners who have expended significant effort to ensure timely collection and digitisation of information. Our analysis shows that there are bright spots in the cocoa sector of farmers who are outperforming their peers and by doing so demonstrate that under the right conditions achieving profitable cocoa production is possible. Unfortunately, we also see that a large majority of farmers fail to achieve a Living Income and continue to do so even under optimistic pricing scenarios. We were able to put more accurate numbers to labour contributions of households, children and workers to production than to our knowledge were previously available. This, we think highlights some of the challenges the sector is facing, yet also helps to provide a more data-driven perspective on some of the discussions that are on-going in various panels, platforms and other organisations.

Michiel Kuit

Co-founder Agri-Logic

01 Reader's guide

The purpose of this publication is for readers to gain a better understanding of the challenges and opportunities facing cocoa farmers by diving into specific aggregated data analysis on farm management and farmer economics. The report includes the following key sections:

- The **Definitions** section provides clarification on terminology as well as detail on variables measured.
- The **Summary and Recommendation** section provides an overview of the main findings and resulting recommendations. Subsequent sections contain the background analysis on which the findings and recommendations are based.
- The **Introduction** provides the backdrop and context of this analysis as well as details on the methodology used.
- The **Household and Farm Profiles** section outlines a characterisation of farmers in sample used for the analyses in this report.
- The **Farm Management** sections deals with labour use, payment of workers, the gender wage gap, nutrient management and the use of biocides.
- The **Production** section dives deeper into production and productivity figures, where deemed useful we used data segmentation with respect to investment levels, region and farm size
- The **Farm Economics** section shows cost of production, revenue and profit margins. Farming and household characteristics that drive higher profit margins are identified. We determine where farmers stand relative to the poverty line. Different scenarios with increased prices and productivity were used to show what is needed for poverty alleviation, if this were to be achieved based on cocoa income alone.
- The **Environmental Performance** section presents analysis on the Environmental Impact Quotient and carbon emissions.

DEFINITIONS

The results presented in this report are the totals for the **period 1 March 2018 to 28 February 2019**. This means they include one mid-crop and one main crop.

Monetary values are in West African CFA francs (XOF) unless stated otherwise. The currency is pegged to the Euro at 1 EUR = 655.957 XOF.

Prices for dried cocoa beans, other crops and inputs were taken as reported by farmers. The following minimum farm gate prices were in effect during the analysis period:

- Mid crop 1 April '18 to 30 September '18: 700 XOF/kg
- Main crop 1 October '18 to 31 March '19: 750 XOF/kg

Results in this report can be expressed Per Farm and/or Per Hectare.

- **Per Farm** means the total value (e.g. labour hours, yield, income) reported by the farmer for his/her entire cocoa area, which may consist of multiple separate plots.
- **Per Hectare** values are obtained by dividing the Per Farm value by the total cocoa area in hectares.

We define the farm economic terms Revenue, Costs and Profit as follows:

- **Revenue** is the gross income from the sale of cocoa and (in some cases) other crops.
- **Costs** include labour costs (wages), input costs (e.g. pesticides, fertiliser, seedlings), equipment rental costs, transport and fuel costs. The value of household labour is not included as a direct cost.
- **Profit** is defined as Revenue minus Total Costs; taxes, interest and amortisation of assets are not taken into account.

Cocoa Production and Yield:

- **Production** refers to the total amount of dry beans produced *per farm*.
- **Yield** refers to the amount of dry beans produced per hectare. These variables are recorded by the farmer when selling the beans. We purposely do not ask the farmer who the beans were sold to in order to limit under-reporting when farmers side-sell.

When we refer to a **significant difference** this is always calculated at a 95% confidence level, unless indicated otherwise.

Farm management activities: with the FFB, farmers keep track of their daily farm management activities. Some of them take place before the harvest and impact production and yield, other activities depend on the level of cocoa pods to be harvested and processed and do not impact yield levels as such. Where necessary we distinguish between these two activity categories.

Pre-harvest activities are: Fertilising, Spraying biocides (referred to as 'spraying'), Collecting diseased cocoa pods, Weeding, Pruning cocoa trees (referred to as 'pruning'), Pruning shade trees, Mulching, (Re)planting cocoa trees (referred to as 'planting') and Attending any form of training (referred to as 'training')

(Post-) Harvest activities are: Harvesting cocoa pods, Breaking cocoa pods, Fermenting cocoa beans, Drying cocoa beans and Selling cocoa beans

The terms **biocides** and **pesticides** are used interchangeably and both include insecticides, fungicides and herbicides.

In FFB data collection we disaggregate the time spent on farming activities by gender & age group and household & hired labour. Note that:

- Household labour includes work by all people who usually live in the compound/household, as well labour by caretakers.
- All labour that is not done by members of the household or caretakers is registered as hired labour. Communal labour is also part of this category, because despite the fact that farmers do not typically pay wages for this form of labour, there may be costs in the form of provision of food for a large group of people.
- Gender-specific labour data is collected for adults (above 16 years) for both household and hired labour.
- Child work is all labour that is executed by boys and girls younger than 16 years. This age-specific data is only collected for labour from household members. With the data at hand it is not possible to make a clear distinction between Child Work and Child Labour as defined by the International Labour Organisation.

02 Summary and recommendations

SUMMARY

In 2017, The Sustainable Trade Initiative (IDH) and Le Conseil du Café-Cacao launched the Farm & Co-op Investment Program (FCIP) with the goal of developing sustainable business models for medium- and long-term financial solutions. To enable prototyping of finance mechanisms for cocoa farmers and co-ops, the program has set up the Cocoa Challenge Fund (CCF). Several cocoa trading companies receive CCF co-funding for the implementation projects that support the professionalization of cocoa farmers in Côte d'Ivoire.

Within the CCF framework, Barry Callebaut, Cargill and Beyond Beans implement the Farmer Field Book (FFB). The FFB is a data collection and analysis program that enables companies to keep track of their farmers' daily activities, investments, production and sales. FFB implementation at one of the partnering companies is in part funded by the Rainforest Alliance.

Each partner tracks between 200 to 400 farmers. Data is collected and digitized with a high frequency of two to four times per month to minimize recall bias and accuracy. Data quality is further strengthened by giving farmers a stake in providing accurate information. To this end, each farmer in the programme receives a detailed personal farm management report that also allows farmers to compare their own performance to that of their colleagues. This makes the approach labour intensive and therefore the programme is applied to a sample of farmers.

This report provides a baseline overview of 687 cocoa farmers in Côte d'Ivoire from 12 regions and cooperatives. The partners selected the farmers for the purpose of gaining insights in the farm level situation in general and more specifically the impact of CCF funded interventions which will be captured in an endline report planned in June 2021. At the time of writing this report CCF interventions were not yet allocated to farmers, but a preliminary selection of cooperatives and farmers was done such that approximately half the sample receives CCF interventions and the other half does not.

In the end-line report that is scheduled for publication in 2021 we will apply a difference-in-difference analysis to determine the effect of CCF interventions. These interventions are not identical between partners, but several revolve around access to finance, both in the form of cash credits and input credits. Other interventions provide specifically targeted training sessions on better farm and financial management. Some of the cooperatives have gone through a professionalisation programme, that seeks to make them better suppliers of support to their farmer members. In the end-line report we expect to end up with several sub-sets of farmers who receive specific interventions and those that do not, which we will use to attempt to isolate effects on farm management and farmers' incomes of specific CFF interventions and the CCF programme as a whole.

Cocoa producing households appear to be larger than the number that is currently used in Living Income calculations. These may therefore be under-estimating poverty. Cocoa producing households in the sample tend to be large with an average of 8.9 people. This is significantly higher than the typically used nuclear-family size of six persons that is prescribed in the calculation of a living income in the country. Using the definition of a six-person household results in over-estimating the share of farmers who earn a living income. Rather than using the nuclear-family, we argue that it would be more appropriate to use the number of people dependent on the farm for their living. This number averages 11.3 people in our nation-wide sample and would see a still smaller share of farmers currently earning a living income with and for their dependants.

We find that children are involved in cocoa production on 48% of the farms, contributing on average 3h45 per week. The average age of farmers is 47 years and they have been active for 24 years in cocoa. Despite cocoa being the core business of most farmers in the sample, we find that labour use averages 11 hours per week per ha, but with strong regional variations. 68% of labour is used for harvesting and processing activities. Our records indicate that 17% of the labour effort is contributed by women in the household. We do not know what share of child work is in the form of child labour as defined by the ILO, but it is likely that some of it is, especially when children are involved with activities that may pose greater risk of injury such as harvesting and pod breaking.

Very few farmers apply sufficient nutrients. On the macro-nutrients of nitrogen, phosphorus and potassium nearly all farmers remove more nutrients from their soil than they put back in. This is likely to limit production and endangers soil fertility in the mid to long-term. Moreover, this situation could also be a potential driver for deforestation as farmers on depleted soils may be tempted to move into more fertile virgin lands currently under forest cover.

Yields are low in comparison to more productive, albeit smaller, origins such as Vietnam where yields average 800 kg/ha1. Half of the farmers produce between 200 and 600 kg dry beans per ha, the average yield was 519 kg/ha and production per farm came in just over 2,000 kg. Supply of cocoa is highly skewed, the 20% largest producers supply 47% of cocoa. We found the highest yield levels in the south-west of the country.

Just 22% of farmers meet or exceed the CocoaAction target yield of 700 kg/ha. These farmers tend to invest significantly more labour time in pre-harvest farm management activities, have smaller farms and regrettably also see greater involvement of children in farming. Aiming to raise yields, as many programmes do, may come with unintended side-effects. Continued and diligent monitoring and remediation of child labour remains imperative.

Larger farms tend to be less profitable per ha, as yields tend to be lower on larger farms. Input use, fertiliser and pesticides, show a positive correlation with profit. Farm level revenues from cocoa averaged 1.52 million XOF, which after deduction of costs results in an average profit of 1.29 million XOF per farm. Hired labour is by far the largest item of expenditure, with biocides and fertiliser accounting from most of the remaining costs. As with yield, also here strong regional variations exist.

We find that families where women are involved in farm management decision-making tend be more profitable. All else being equal, farms where the woman or the man and woman together make farm management decisions have 20% higher yields

With these profit figures, 36% of farmers earn enough to exceed the international poverty line of 1.9 USD per person per day, while 12% earn a living income. The average gap to the Living Income is 3,378 USD per family. In the latter calculation we look at the total family income, including income from non-cocoa sources.

In the 2018/19 season, paying out the Living Income Differential, all else being equal, would have resulted in 52% of farmers earning more than the international poverty line and 21% of farmers earning a living income. At the time of writing the Living Income Differential was under discussion. We modelled its effects on the assumption that the 400 USD/Mt dry beans would be paid out to farmers in its entirety. The gap to the Living Income under this assumption comes in at a still significant 3,001 USD per family.

Modelling the effect of the Fairtrade Living Income price, which exceeds the 2018/19 market price and the Living Income Differential gives slightly better numbers: 63% above the international poverty line and 28% earning a living income. In this calculation we assumed a farmer would be able to sell all his or her cocoa as Fairtrade, which is unlikely. But even then, poverty remains wide-spread.

We find that pricing strategies can help, but price alone is not going to solve the pervasive incidence of poverty. An often ignored aspect in the price debate, seems to be how non-market based pricing is going to affect farmers' incentives to produce. An artificially high price is meaningless if supply outstrips demand and there are no buyers for excess supply beyond what the market consumes.

In the 2018/19 season, to lift 80% of our sample above the far less ambitious international poverty line of 1.9 USD/day yields would have to reach 734 kg/ha. Under all scenarios that we ran this falls far short of meeting industry commitments to enable farmers to earn a living income by 2030.

The only realistic way to have all farmers above the living income by 2030 that we can see at this point is to select farmers much more carefully and only source from the top 20% to 30% of largest producers. But doing so risks cutting off the poorest and most vulnerable farmers from international supply chains, which is unlikely to be the intended effect of any industry commitment.

SUMMARY AND
RECOMMENDATIONS

RECOMMENDATIONS

Project treatment and control group:

- At the time of reporting, an overview of FFB farmers participating in the CCF programme was unavailable for two of the three partners who started their projects recently. We were therefore not able to split the analysis by treatment. This is not overly problematic. We expect details of which farmer is part of CCF and which is part of the control group to become available over the coming months. In the 2020/21 season CCF programme report we can then analyse farmers' performance by their CCF status for that season and the previous ones.

Data quality and delivery:

- In addition to the FFB data collection exercise, an additional survey was planned to collect data on variables such as financial access, loans and diversification. Implementation of this was delayed and we received too little data (30% of farmers) for it to be included in this report. We assume that data collection for this is still on-going. If and when we receive the additional survey data for the 2018/19 season, we can still include it in next season's report.
- The data for the year 2018 was collected retroactively for one partner because they were not involved from the beginning of the project.

Farm management:

- While the regression model does not identify the use of nitrogen as a significant factor for explaining yield, we think this under-estimates its potential effect. We have too few farmers in the sample who apply nitrogen at a level that approaches what is removed during harvest. We do see that farmers remove vastly more nitrogen from their fields than they apply and we are fairly certain this is one of the key limiting factors to raising yields. Cocoa farmers in places like Brazil and Vietnam apply significantly higher nitrogen levels and generally a more balanced N, P and K mix that is much closer to what is removed during the harvest and in some regions achieve average yields of over 1,000 kg/ha.
- We recommend all companies in the CCF programme to seek collaboration with the on-going CocoaSoils programme if they haven't done so already. The companies could make their FFB platform available to CocoaSoils for testing of their enhanced fertiliser recommendations under farm conditions. The benefit for CocoaSoils would be that there is no additional cost for data collection, while companies and farmers can see first-hand how the recommendations are panning out.
- As part of their training programmes we recommend the partners to train farmers on how to estimate yield by conducting flower and pod counts on randomly selected trees on the farm. Data in this report shows how much N, P and K is removed during the harvest, which in combination with expected yield provides a means to estimate how much N, P and K needs to be applied to meet tree nutrition demands. In the absence of more sophisticated soil analysis, this can serve as a reasonable proxy on which to build a nutrient management strategy.

Cocoa price effects:

- Sixty five percent of FFB farmers are below the absolute poverty line. At current farm gate prices, it will be very challenging to lift farmers out of extreme poverty on cocoa income alone. Increasing the floor price to 2,600 USD/Mt as proposed by the governments of Côte d'Ivoire and Ghana, would change the share of farmers living under poverty line from 65% to 52%. The Fairtrade Living Income Reference Price (3,467 USD/Mt) would further decrease this share to 32%, but to our knowledge this price is not being used. Against this background it seems unrealistic to expect to be able to lift a significant share of farmers above the poverty line on cocoa income alone. We recommend focusing on a combination of yield improvement, in which improved nutrient management will play an important role, as well as diversification of income. While doing so, we recommend supporting women's involvement in household farm management decision making as well as continued monitoring and remediation of child labour since we find significantly more child work on higher yielding farms. Even under a scenario of higher prices and yields, a share of farmers would continue to live in abject poverty. Ideally, such farmers would move out of cocoa all together and into other sectors of the economy.

Environment:

- The pesticide footprint, as measured by the EIQ Field Use Rating has gone up, compared to the previous season. It could be lowered by providing advice on less toxic pesticide options to the top 5% farmers with the highest EIQ Field Use Ratings.
- The carbon emissions from cocoa production, excluding those from deforestation, are limited at 34 kg/Mt.

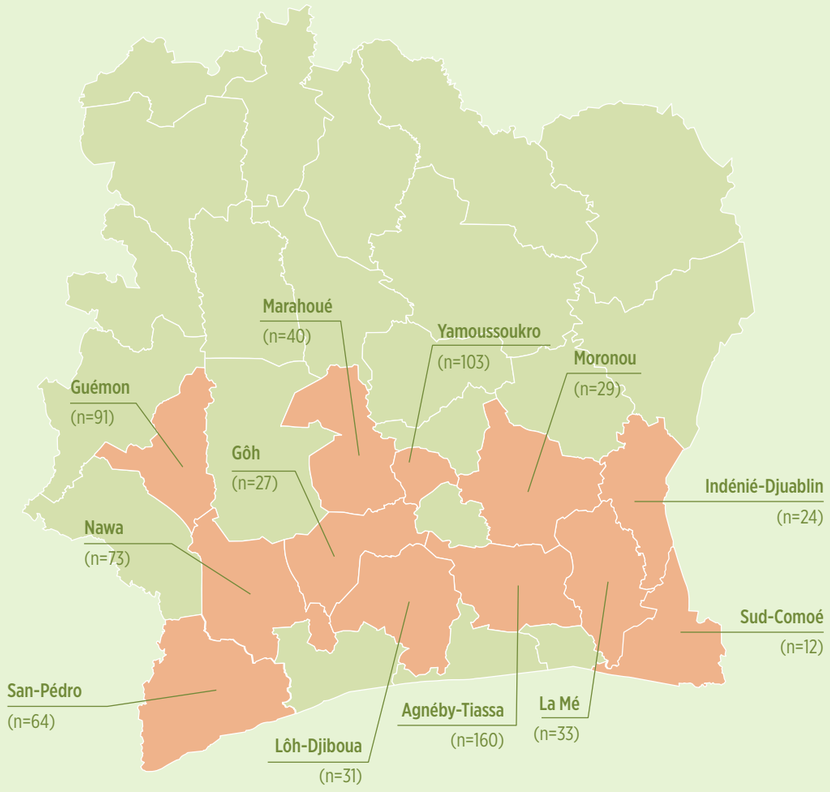
03 Introduction

- In 2017, The Sustainable Trade Initiative (IDH) launched the Farm & Co-op Investment Program with the goal of developing sustainable business models for medium- and long-term financial solutions. To enable prototyping of finance mechanisms for cocoa farmers and co-ops, the program has set up the Cocoa Challenge Fund (CCF). Several cocoa trading companies receive CCF co-funding for the implementation projects that support the professionalization of cocoa farmers in Côte d'Ivoire. FFB implementation at one of the partnering companies is in part funded by the Rainforest Alliance.
- Within the CCF framework, Barry Callebaut, Cargill and ETG Group implement the Farmer Field Book (FFB). The FFB is a data collection and analysis program that enables companies to keep track of their farmers' daily activities, investments, yield and sales.
- This report is based on the data collected through the FFB program and provides a descriptive (baseline) overview of cocoa farmers in Côte d'Ivoire from various regions and cooperatives. Barry Callebaut, Cargill and ETG Group selected the farmers for the purpose of gaining insights in the farm level situation in general and more specifically the impact of CCF funded interventions.
- In two of three supply chains the CCF interventions started recently and at the time of writing the allocation of interventions to cooperatives to which farmers belong was not known. A second CCF level report is foreseen in 2020/21 by which time treatment and control groups will be included to perform a "difference-in-difference" analysis to identify programme effects.
- This report is part of a series of four types of reports, based on FFB-data:
  - Individual Farm Management Reports with detailed performance results for each participating famer;
  - Detailed Farmer Group Reports, allowing farmers to compare their performance to that of their peers;
  - A Company Report, containing in-depth statistical analysis on supply chain level, specific to each company; and
  - **Cocoa Challenge Fund report** (this report) in which data from all the fund's grantees that keep FFBs is consolidated.
- Agri-Logic used data from 687 cocoa farmers about their farming activities, investments and returns that was of sufficient quality to be included in statistical analysis for this report.
- The report covers the 2018-2019 analysis period, which runs from 1 March 2018 to 28 February 2019.
- For part of the farmers, data was collected at a daily basis, whereas data from other farmers relies on recall of the last season. The latter farmers started real time data collection in January 2019.

Sample size and geographical spread

- The analyses presented in this report are based on the data of 687 cocoa farmers.
- Farmer data was collected in twelve administrative regions in the southern half of Côte d'Ivoire.
- The numbers on the map indicate the number of farmers in the sample per region.
- The farmers in the sample collectively have 4,126 ha of land under management, of which 2,885 ha is planted with cocoa.
- The cocoa area in the sample is planted with 4.04 million cocoa trees.

Figure 1 Geographical Distribution of Farmers in the Sample



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The Farmer Field Book is a data collection method combined with data analysis software.

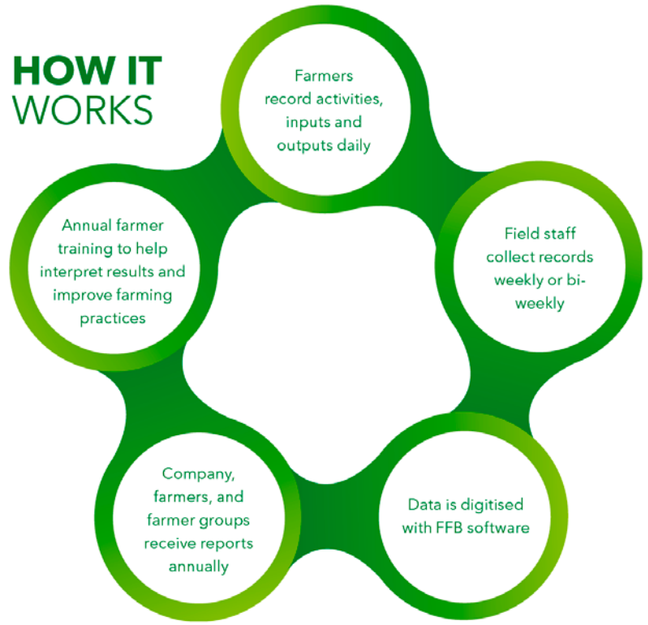
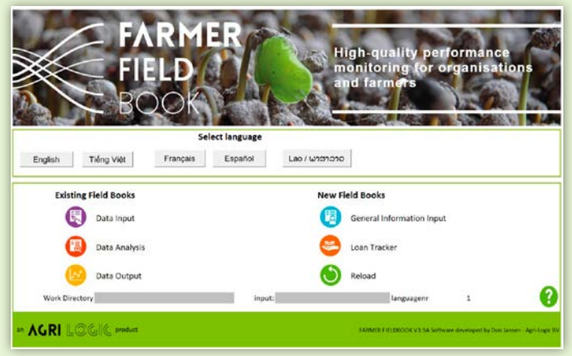


Figure 2 Data collection form or mobile app

Figure 3 Interface snapshot



Farmers' individual performance and group reports

Each FFB farmer receives an individual farmer performance report, or Profit & Loss statement, annually. This report can contain, for example:

- Labour hours spent on different farming activities, both household and hired labour
- Costs: money spent on labour, on material such as fertilisers, on equipment rental and maintenance, and investments in and depreciation of assets
- Income from the selling of different crops
- Profit or loss (income minus costs)
- All variables expressed in total and per hectare to allow comparison to peers

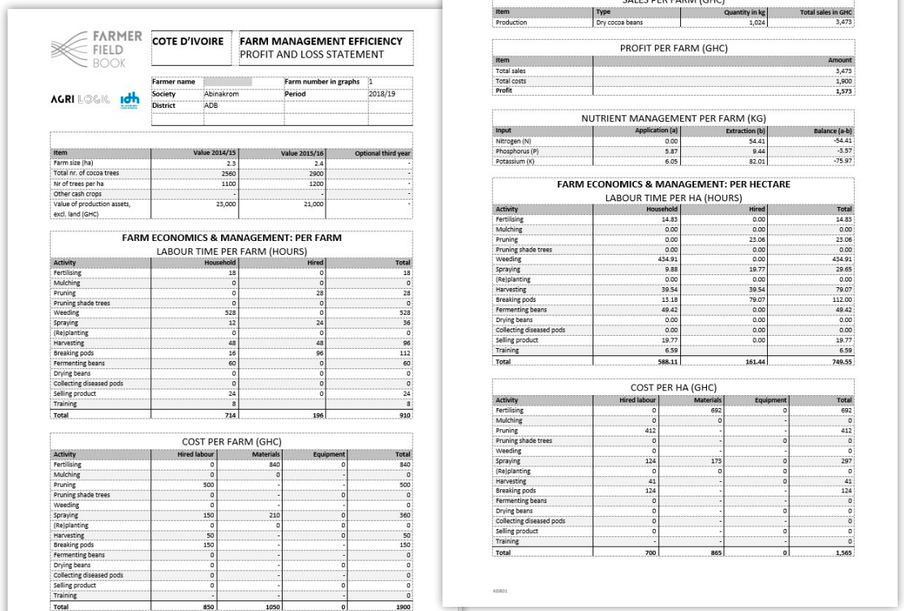
→ **Farmers gain insight in their investments & earnings**

→ **Farmers can adjust their investments & increase income**

Farmer groups of 10 to 25 farmers also receive a Group Report:

- These contain graphical representations of the relation between various farming activities and yield or income.
- Each farmer has a unique number, allowing them to identify themselves in the graphs and compare their performance with others.
- These reports serve as a basis for discussion between farmers during a workshop, allowing them to learn from each other.
- Learning is done through discussion:
  - Why are farmers on the same horizontal line investing differently but getting the same yield or revenue?
  - Why are farmers on the same vertical line investing similar amounts (of money, labour, etc) but getting different yields?

Figure 4 Individual farmer report



FARMER FIELD BOOK | COTE D'IVOIRE | FARM MANAGEMENT EFFICIENCY PROFIT AND LOSS STATEMENT

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Farmer name		Farm number in graphs	1
Society	Abinakrom	Period	2018/19
District	ADB		

Item	Value 2014/15	Value 2015/16	Optional third year
Farm size (ha)	2.3	2.4	-
Total nr. of cocoa trees	2560	2900	-
Nr of trees per ha	1100	1200	-
Other cash crops	-	-	-
Value of production assets, excl. land (GHC)	23,000	21,000	-

FARM ECONOMICS & MANAGEMENT: PER FARM
LABOUR TIME PER FARM (HOURS)

Activity	Household	Hired	Total
Fertilising	18	0	18
Mulching	0	0	0
Pruning	0	28	28
Pruning shade trees	0	0	0
Weeding	528	0	528
Spraying	12	24	36
(Re)planting	0	0	0
Harvesting	48	48	96
Breaking pods	16	96	112
Fermenting beans	60	0	60
Drying beans	0	0	0
Collecting diseased pods	0	0	0
Selling product	24	0	24
Training	8	-	8
Total	714	196	910

COST PER FARM (GHC)

Activity	Hired labour	Materials	Equipment	Total
Fertilising	0	840	0	840
Mulching	0	-	-	0
Pruning	500	-	-	500
Pruning shade trees	0	-	0	0
Weeding	0	-	-	0
Spraying	150	210	0	360
(Re)planting	0	0	0	0
Harvesting	50	-	0	50
Breaking pods	150	-	-	150
Fermenting beans	0	-	-	0
Drying beans	0	-	0	0
Collecting diseased pods	0	-	-	0
Selling product	0	-	0	0
Training	-	-	-	0
Total	850	1050	0	1900

SALES PER FARM (GHC)

Item	Type	Quantity in kg	Total sales in GHC
Production	Dry cocoa beans	1,024	3,473

PROFIT PER FARM (GHC)

Item	Amount
Total sales	3,473
Total costs	1,900
Profit	**1,573**

NUTRIENT MANAGEMENT PER FARM (KG)

Input	Application (a)	Extraction (b)	Balance (a-b)
Nitrogen (N)	0.00	54.41	-54.41
Phosphorus (P)	5.87	9.44	-3.57
Potassium (K)	6.05	82.01	-75.97

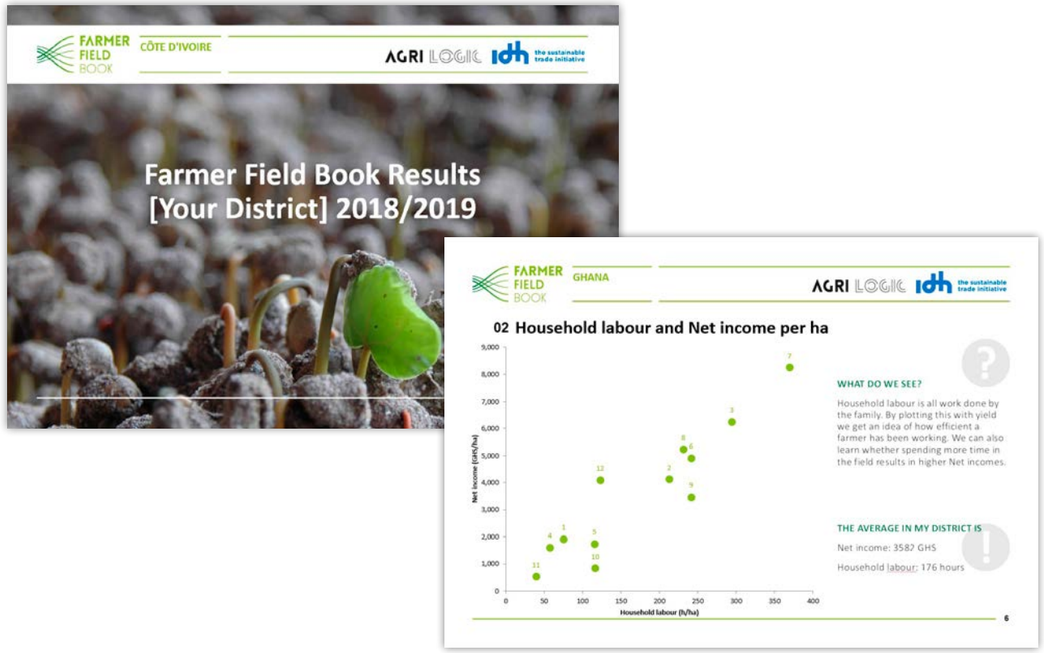
FARM ECONOMICS & MANAGEMENT: PER HECTARE
LABOUR TIME PER HA (HOURS)

Activity	Household	Hired	Total
Fertilising	14.83	0.00	14.83
Mulching	0.00	0.00	0.00
Pruning	0.00	23.06	23.06
Pruning shade trees	0.00	0.00	0.00
Weeding	434.91	0.00	434.91
Spraying	9.88	19.77	29.65
(Re)planting	0.00	0.00	0.00
Harvesting	39.54	39.54	79.07
Breaking pods	15.18	79.07	112.00
Fermenting beans	49.42	0.00	49.42
Drying beans	0.00	0.00	0.00
Collecting diseased pods	0.00	0.00	0.00
Selling product	19.77	0.00	19.77
Training	6.59	-	6.59
Total	588.11	161.44	749.55

COST PER HA (GHC)

Activity	Hired labour	Materials	Equipment	Total
Fertilising	0	692	0	692
Mulching	0	0	-	0
Pruning	412	-	-	412
Pruning shade trees	0	-	0	0
Weeding	0	-	-	0
Spraying	124	173	0	297
(Re)planting	0	0	0	0
Harvesting	41	-	0	41
Breaking pods	124	-	-	124
Fermenting beans	0	-	-	0
Drying beans	0	-	0	0
Collecting diseased pods	0	-	-	0
Selling product	0	-	0	0
Training	-	-	-	0
Total	700	865	0	1,565

Figure 5 Farmer group report



04 Household and farm profiles

Gender, age and family composition

- On average, 11.3 people depend on the farm for their living, a larger number than the mean household size of 8.9 persons, since people not living in the household may still be dependent on the farm income.
- The average household consists of 2.3 adult women, 2.5 adult men, 2.1 girls (≤16) and 2.0 boys (≤16; **fig. 6**).
- 3.6% of farmers in the FFB sample is female (**fig. 7**).
- The average age among farmers is 47 (**fig. 8**).
- Farmers have on average 24 years of experience in cocoa farming.

Figure 6 Average Household Composition

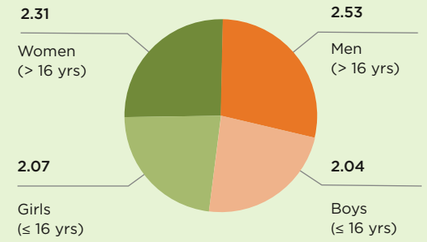


Figure 7 Gender of farmer

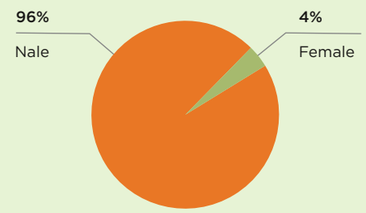
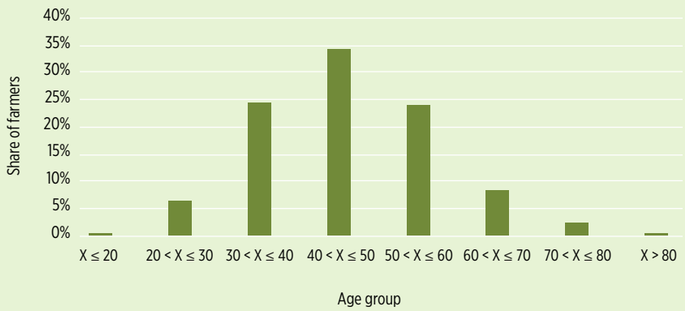


Figure 8 Farmers by age group



Education and decision making

- Formal education levels for both men and women are low, but women education levels are lower than those of men. 76% of women has not followed any formal education compared to 49% of men (**fig. 9)**.
- 21% of farmers have at least one caretaker who manages (part of) the farm in return of a share of the harvest (**fig. 10)**.
- On 8% of farms women are involved in making farm management decisions (**fig. 11**).
- No significant regional differences were found for education levels, except for the finding that men in Indénié-Djuablin were more likely to have completed primary school.
- For regional differences in gender concerning decision-making: women are more often involved in decision-making in Marahoué and Indénié-Djuablin, while women are most likely to not be involved in Lôh-Djiboua and Agnéby-Tiassa.

Figure 9 Education Level of the Male and Female Head of Household

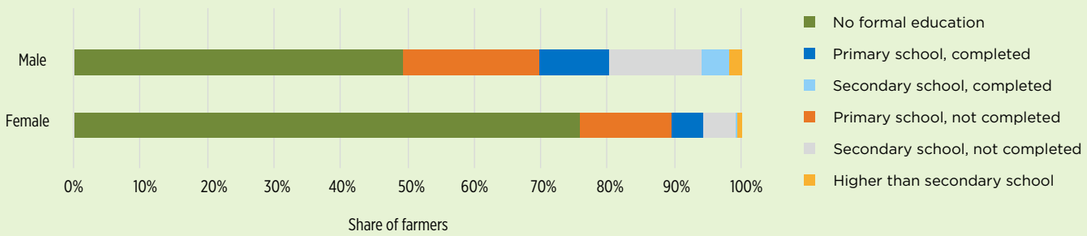


Figure 10 Farms with Caretaker

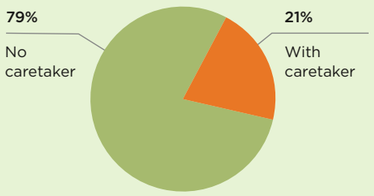
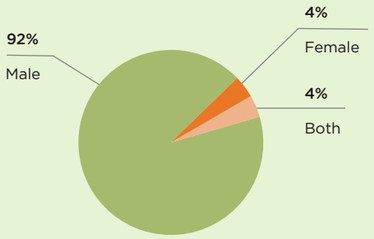


Figure 11 Gender of Decisionmaker



Farm size, cocoa trees and distance to market and certification

- The average total farm size of farmers is 4.2 hectares, while the median is 3.3 hectares, meaning that half of the farmers have a farm of 3.3 hectares or smaller and the average is somewhat elevated by a number of large farms.
- The value for cocoa tree density in the table below should be used with more care as this is based on estimates by farmers or field staff, not measurement.
- **Figure 12** shows the geographical distribution of total cocoa area per farmer.
- **Figure 13** shows the frequency distribution of total cocoa area per farmer, indicating how many farmers fall in each range of total cocoa area size.

Figure 12 Total Cocoa Area by Region (ha)

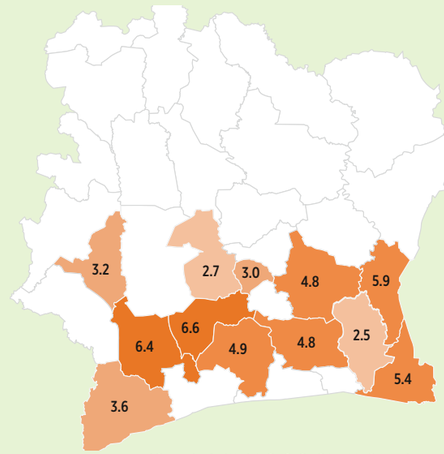


Figure 13 Frequency Distributon Total Cocoa Area

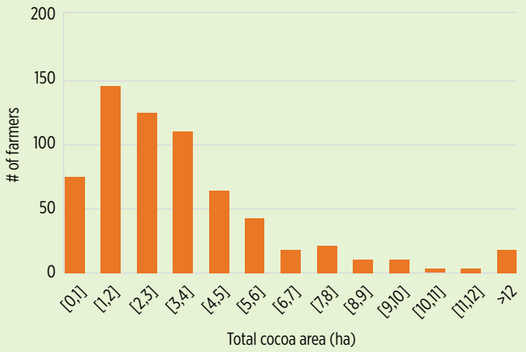


Table 1 Farm profiles

Variable	Unit	Mean	Median	Min	Max	Standard deviation
Distance to nearest market	Kilometer	9.9	7.0	0.1	57	9.7
Total farm size incl. other crops	Ha	6.0	4.7	0.7	54	5.1
No. of cocoa farm fields	Number	1	1	1	7	0.74
Total cocoa area	Ha	4.2	3.3	0.4	36	3.6
Share of land used for cocoa	%	76%	84%	9%	100%	26%
Cocoa tree density	Number/ha	1,400	1,400	500	2,300	166
Total no. of cocoa trees	Number	6,090	4,529	500	52,500	5,723
Age of majority of trees	Year	20	19	1	74	9

Farm size, cocoa trees, distance to market and certification.

- **Figure 14** shows the average age of the majority of cocoa trees that farmers have by region.
- **Figure 15** shows the frequency distribution of the distance to the nearest market per farm, indicating the number of farms in each range of distance to the nearest market where they can buy inputs.
- Eighty five percent of farmers in the sample are certified under Rainforest Alliance. This includes farmers originally certified under the UTZ standard, but as the two standards have merged we use a single indication.

Figure 14 Average Tree age by Region (years)

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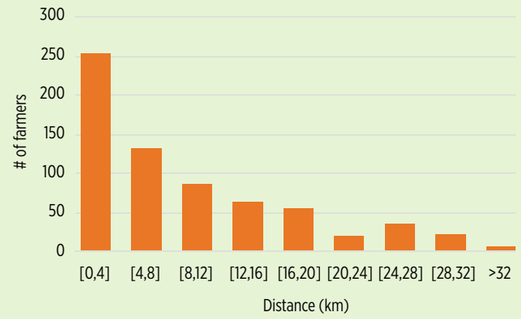
Figure 15 Frequency Distribution of Distance to Nearest Market



Comparison of FFB farm(er) characteristics to the KIT study.

- To assess to what extent the FFB-CCF sample is comparable to the general cocoa farming population in Côte d'Ivoire, we compared some key farmer and farm characteristics with KIT's study *Demystifying the cocoa sector in Ghana and Côte d'Ivoire (2018)*.
- The share of female farmers in FFB is much lower than among the respondents in the KIT sample. This is due to the fact that the KIT researchers specifically targeted to have a third of female respondents. In 5% of cases the head of the household was female in the KIT study, which does not differ significantly from the FFB sample.
- The education level of male and female heads of household appears to be much lower in the FFB sample, although this may be a difference in interpretation of the question or education categories. In any case, this indicates that the FFB sample is not particularly biased towards being higher educated, which is sometimes feared because of the requirement of being able to record data.
- Certification is much more common among the FFB farmers.

Table 1 Comparison of FFB cocoa farmer sample with KIT study

Variable	FFB sample	KIT sample	Sign. of difference	Comment
Farmer age (mean)	47 years	46 years	**	Distribution across age classes very comparable
Gender (% female)	4%	24% (resp.); 5% (hh head)	** (resp.); ns (hh head)	KIT study targeted one third female respondents, FFB sample was not targeted
Education level male head of household	30%	74%	**	% with completed primary school or higher
Education level female head of household	10%	46%	**	% with completed primary school or higher
Household size	8.90	6.98	**	Number of household members who usually live in the compound/house
Household received training in past year	n/a	15.5%	-	FFB data pending additional surveys
Certification	85%	7%	**	
Cocoa farm size	4.25 ha	4.19 ha	ns	
Age of majority of trees	20 years	16 years	**	
% households that own cocoa land	n/a	99%	-	FFB data pending additional surveys

* p<0.05; ** p<0.01; continuous variables tested using a t-test of independent means, categorical variables using a Chi-square test of proportions

05 Farm management

Labour use averages 592 hours (~11 hours/week) per ha cocoa area, with strong regional variation. Eighty-three percent of farm labour is done by men.

- **Figure 16 and 17** show the mean hired labour time, household labour time and total labour time for men women and children in the household per farm and per hectare. Hired child labour was not recorded, hence no data on this is available.
- Mean total labour time in a year was 2,213 hours per farm and 592 hours per hectare. **Figure 18** shows the regional differences in mean labour time per hectare.
- 'Household labour' refers to labour carried out by the household members of the farmer, as well as caretakers.
- 'Hired labour' refers to labour carried out by people external to the household, including communal labour.
- Eighty three percent of all recorded labour was carried out by men, 13% by women and 4% by children in the household.

Figure 16 Labour Time per Farm, by Source and Gender*

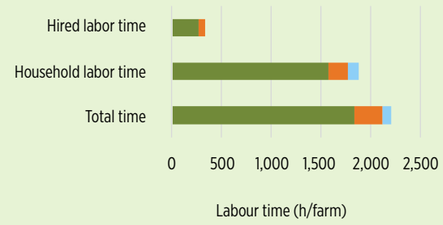
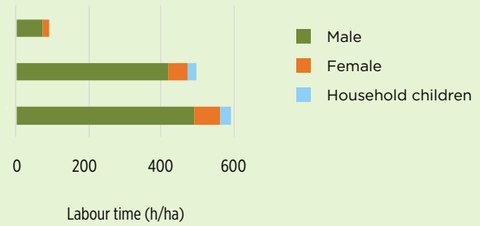
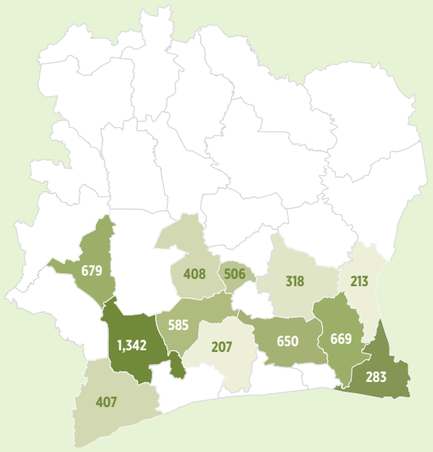


Figure 17 Labour Time per ha, by Source and Gender*



*As data on gender in labour activities was missing for 101 farmers, these graphs are based on a subset of the data consisting of 588 farmers.

Figure 18 Total Labour per ha by Region (hours/year)



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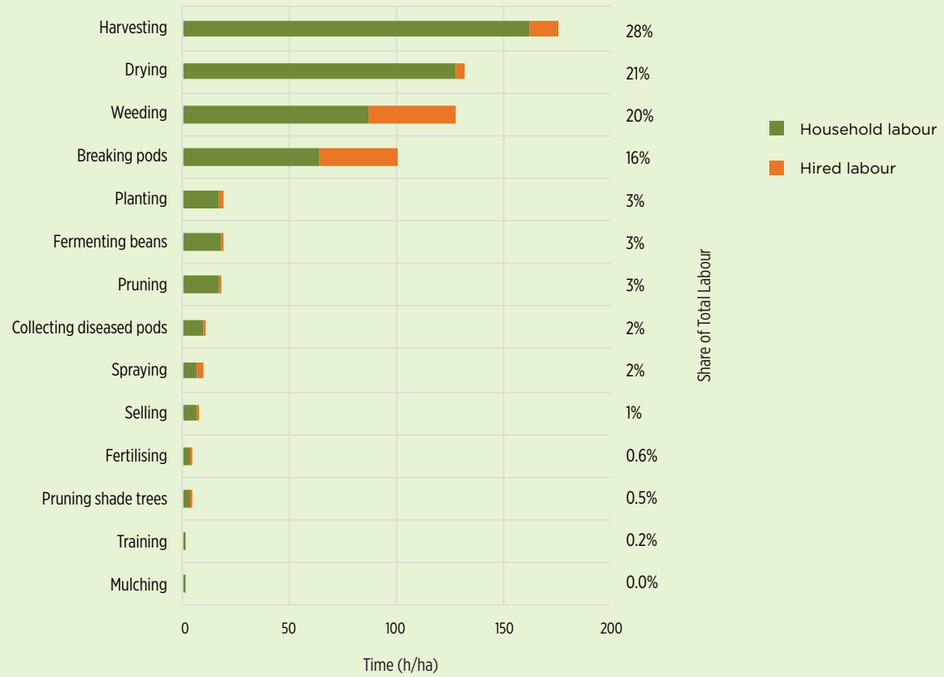
15.7% of total labour is carried out as hired labour, of which 83% is salaried. Labour is highly concentrated around the harvest.

- **Figure 19** shows the mean labour time per activity per hectare, and its composition of household and hired labour. Hired labour constitutes 15.7% of total labour, while the other 84.3% is carried out by the household.
- Harvesting, breaking pods, and fermenting and drying beans constitute 68.8% of total labour, indicating that labour is highly concentrated around the harvest.
- Per activity, hired labour is used mostly for breaking pods (37% of all breaking pods) for spraying pesticides (25% of all pesticide spraying labour) and weeding (32% of all weeding).
- It should be noted that not all labour classified as 'hired' was registered to receive payment. For 17% of hired labour, no salary was registered. A possible reason is that in the FFB system, communal labour is categorised as hired labour, since farmers do not pay a wage for this but tend to have expenses for providing food to the communal labourers. These expenses should be registered as the salary, but they can be forgotten and sometimes there are none. Another possible reason is that sometimes farmers pay a lump sum for spraying service as a whole, which covers labour, pesticides and machine rental. Since it is difficult to separate these costs, they could be entered under a different cost category than labour.

Figure 19 Labour Time per Activity per Hectare



Children were recorded to work at 48% of farms, on which 196 hours per farm per year are worked by children. Eighty percent of this labour takes place around the harvest. Workload per child is unknown.

- Mean working time from children under 16 years of age per farm across all farms is 95 hours per year. However, mean children's working time calculated for only the farms where children have worked equals 196 hours per year, which is about 3h45 per week and constitutes 11% of total labour on those farms.
- **Figure 20** shows that children are most likely to work on harvesting and breaking pods, 33% and 30% of farms, respectively, and that most hours were spent on these activities too, followed by processing. This means child work – like adult labour – concentrates around the harvest. These activities comprise 80% of the work effort children put in, equalling 78 hours on average. This leaves on average 20 hours per year for other activities.
- A distinction is made in the sector between child labour and child work. The first is when children perform heavy or hazardous tasks, or when tasks take place during school hours. The latter is when activities are light duty and not hazardous and do not take place during school hours. There is no hard distinction between hazardous and non-hazardous activities in cocoa production. Much depends on how an activity is conducted by a child and which, if any, tools are used. This information we do not have and we can therefore not make an uncontentious distinction between child work and child labour. Still, we think activities like breaking pods, harvesting, weeding and spraying have a higher hazard potential than other activities, hence the distinction in **Figure 20.**
- **Figure 21** shows the regional variance in child employment. However, children's working time could be unreported in some areas. The FFB system does not provide insight into workload per child, the exact age of children or on hired child labour.

Figure 20 Share of Farms Where Children Work and Hours Worked by Activity

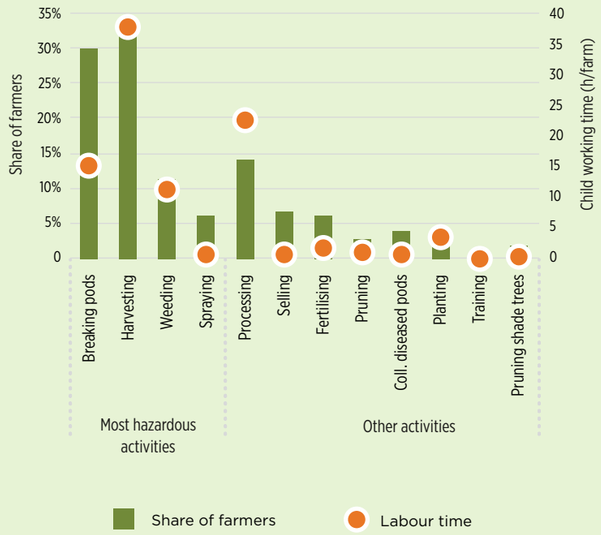
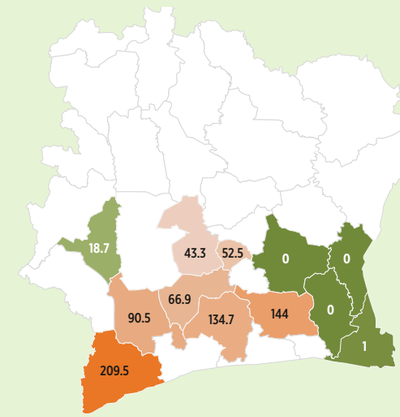


Figure 21 Child Work and Labour Hours per Farm by Region



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Mean daily wage for men is XOF 3,514, for women XOF 2,106. Spraying pesticides is the activity where hired labour is used most often.

- Fifty six percent of farmers use hired labour for spraying pesticides, 49% of farmers hired labourers for weeding and 29% of farmers hired labour for breaking pods (**fig. 22**). For all other activities, only 12% of farmers or less hired labourers.
- Note that the rate for spraying is pushed up by the use of spraying gangs, which are often paid a fixed amount that includes sprayer rental and pesticides.
- For all activities except harvesting, men earn more than women, although some activities are not carried out by women. It should be kept in mind that for the daily wages of women only 20 data points were available (of the 687 farmers in the sample), reducing the robustness and external representativeness of those numbers somewhat. However, it is telling that for 687 farmers, only 20 instances of paid labour for women were encountered.
- Weighted mean daily wage is XOF 3,514 for men and XOF 2,106 for women. The gender wage gap, which is calculated as the percentage of median earnings by women as the median earnings of men, amounts to 49%. Since only 20 datapoints were available on female wages, this gender wage gap is a rough estimation.
- Note that strong regional differences exist. In seven of the twelve regions 0% of hired labour is carried out by women (**fig. 23**).

Figure 22 Daily Rates for Hired Labour and Share of Farmers Using It by Selected Activities

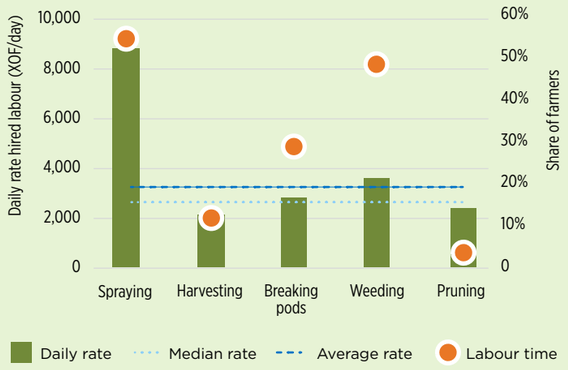
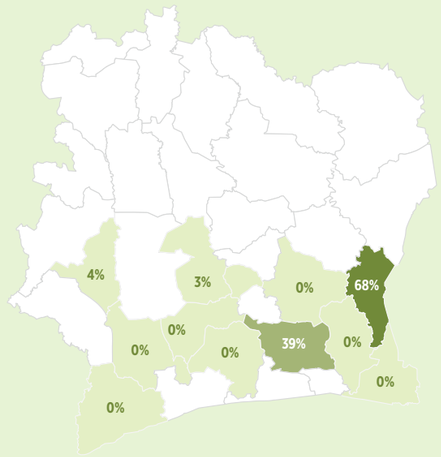


Figure 23 Share of Hired Labour by Women by Region



Labour efficiency is higher among larger farms, lower among smaller farms. Possibly, because cocoa trees still generate a base-level harvest, with little labour input.

- Here we divide farmers into ten equal-sized groups (deciles), by the size of their total cocoa area. Decile one contains 10% of farms with smallest cocoa area (<1.29 ha) and decile ten comprises of the 10% of farms with the largest cocoa area (8 to 36 ha).
- Labour per ha reduces as farm size increases (**fig 24**). This difference in labour per ha was significant between the group of smallest cocoa area and the rest of the groups. This effect probably exists because resources and labour time have to be spread over a larger area.
- Labour efficiency is significantly lower for the group of farmers with the smallest cocoa areas. Smaller farms tend to be managed more intensively, resulting in higher yields, but also more hours spent per Mt cocoa produced.
- Similarly, we see the factor by which labour increases, lagging the factor by which the acreage increases. Farmers in decile ten have acreages 13 times larger than those in decile one, while the total labour use is "only" a factor six higher.

Figure 24 Labour Use by Cocoa Area Deciles

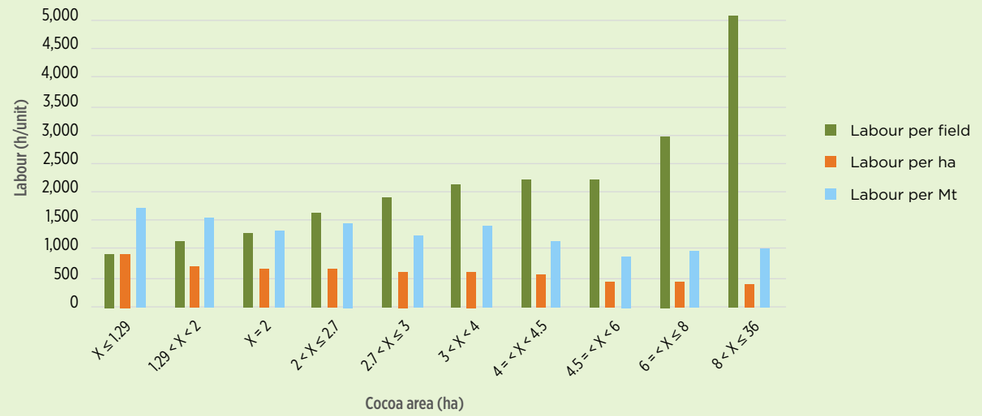


Figure 25 Acreage and Labour Use Factor Across Deciles (First Decile = Base)

The negative balances of nitrogen, phosphorus and potassium indicate that these nutrients could be depleted in the long term and are very likely a limiting factor in obtaining higher yields.

- The nutrient balances are calculated by subtracting the amounts of nitrogen (N), phosphorus (P) and potassium (K) contained in the cocoa beans harvested[1] from the volume N, P and K applied through fertilisers, compost and manure. This calculation does not take into account efficiency of uptake, availability to the tree, in-flow from sources such as rainfall deposition and losses from leaching.
- The average application rates of 2.7 kg P and 4.2 kg K per hectare are equivalent to one third (0.33) of a 50 kg bag of SuperCao per ha. The overall N application average of 0.2 kg/ha is equal to only 0.02 50 kg bag of Nitrabor. Although it depends on local soil characteristics, these rates are very likely to be well below recommended application rates and not at all in line with the volume of nutrients removed during the harvest.
- The low application rates and negative balances are partly caused by a large number of farmers who have not applied any nutrients (chemical or compost/ manure) in the analysed period.
- The table on the right shows that 30% of all farmers applied P and K, whereas only 6% applied N.
- Farmers who do apply nutrients (see table below) on average have a positive P-balances and a negative N- and K-balance.

1 Nutrient removal is based on the assumption that both beans and husks are removed from the farm. Extraction values were based on dry cocoa bean volumes, using average percentages N (3.4%), P (0.6%) and K (5.4%) from a review study by Van Vliet & Giller (2017)

Figure 26 Nutrient Application, Extraction and Balance

Table 3 Nutrient application rates and balances

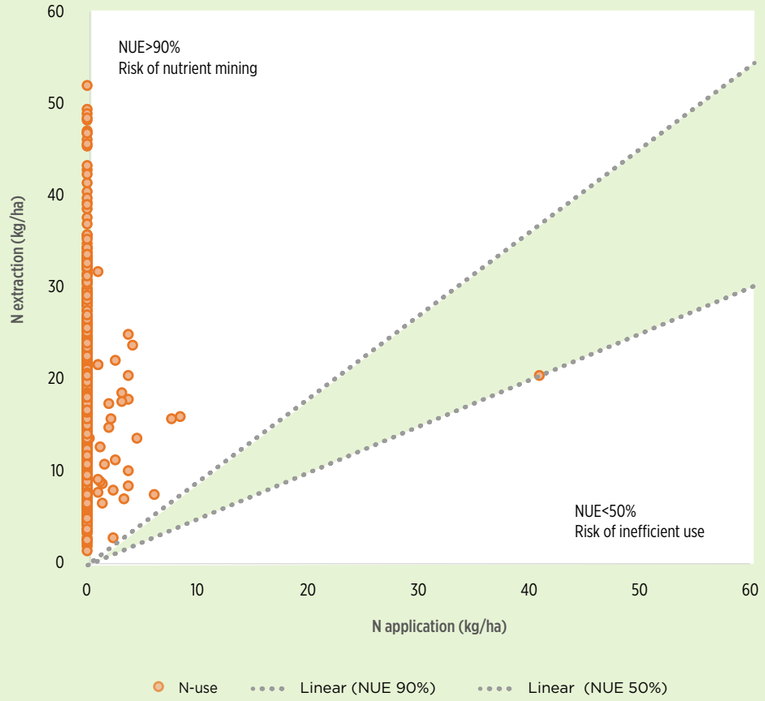
Nutrient	Number of farmers applying nutrients	Share of farmers	Average application rate (kg/ha)	Nutrient balance (kg/ha)
Nitrogen (N)	44	6%	2.93	-13.94
Phosphorus (P)	208	30%	8.8	5.23
Potassium (K)	208	30%	13.8	-19.33

Virtually all farmers are depleting their nitrogen stocks and thus reduce the fertility of their soils.

- Nitrogen use efficiency (NUE) can also be calculated as the percentage of applied nitrogen that is removed during the harvest.
- In the graph below:
  - The x-axis shows the amount of nitrogen applied through fertilisers, manure and compost;
  - The y-axis shows the amount of nitrogen removed through the harvest of cocoa pods;
  - For all points on the line 'NUE=90%' nitrogen removal through harvest is 90% of the amount of nitrogen applied through fertilisation;
  - For all points on the line 'NUE=50%' nitrogen removal through harvest is 50% of the amount of nitrogen applied through fertilisation;
- Farmers above the NUE=90% line are removing more nitrogen from their field than they apply and run a risk of mining (depleting) their soil with a risk of lowering soil fertility in the mid-term.
- Farmers below the NUE=50% line are using the nitrogen fertilisers inefficiently. This results in an increased risk of eutrophication of ground and surface water and also depresses farmers' profit margins.
- The wedge between NUE=90% and NUE=50% is a hypothetical optimal range which for now is based on values from the EU[2].
- The figure shows that none of the farmers are within the hypothesised optimal nitrogen application range. Virtually all farmers (even those who apply nitrogen) are in the range "Risk of nutrient mining" and thus depleting the nitrogen stocks in their soils. It is recommended that farmers increase nitrogen fertilizer use.

2 http://www.eunep.com/wp-content/uploads/2017/03/Report-NUE-Indicator-Nitrogen-Expert-Panel-18-12-2015.pdf

Figure 27 Nitrogen Use Efficiency by Farmer and Season



Inefficient phosphorus use and potassium mining result from low application rates and sub-optimal P-K ratios in chemical fertilizers.

- Farmers who apply P also apply K and do so through fertilizers that contain both in fixed ratios, such as SuperCao.
- We are uncertain if the 90% and 50% lines are appropriate for use in P and K (fig 1&2), but regardless of where the lines should fall, it is clear that nutrient application levels of P and K are not aligned to nutrient removal figures.
- Under our current hypothesis of the optimal range lying between the 50% and 90% use-efficiency lines, of all farmers just 7% have optimal P-application rates, whereas 2% have optimal K-application rates. For the tree to yield closer to its potential, all nutrients need to be applied in the optimal range. Therefore, even if P applications are in the optimal range for a given farmer, if this farmer does not also apply N and K optimally, the investment in P would be largely wasted.
- Under current application rates and ratios of Phosphorus and Potassium, it is recommended that farmers increase fertilizer use and shift to fertilizers with lower levels of Phosphorus.

Figure 28 Phosphorus Use Efficiency by Farmer

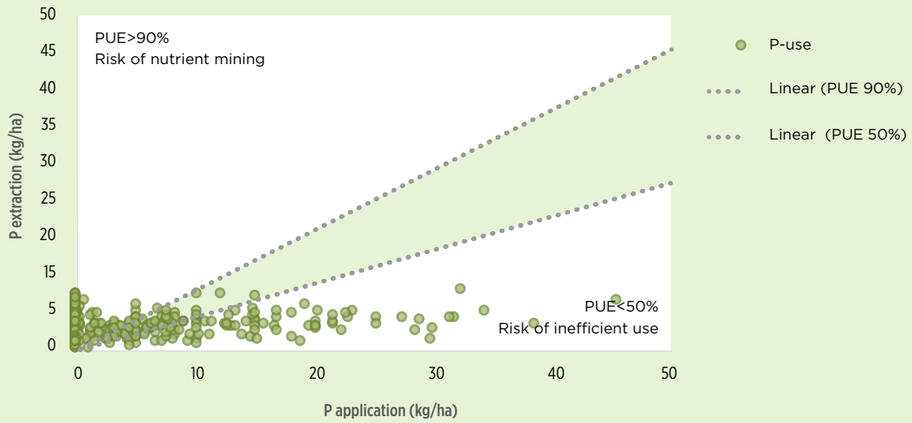
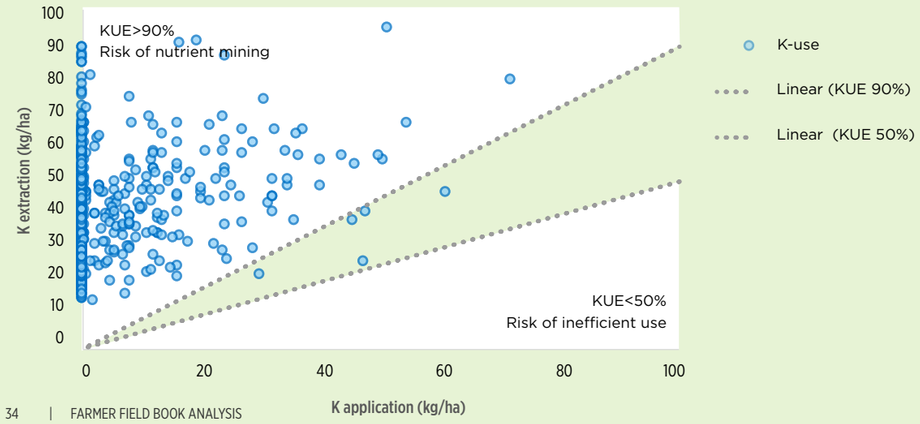


Figure 29 Potassium Use Efficiency by Farmer and Season

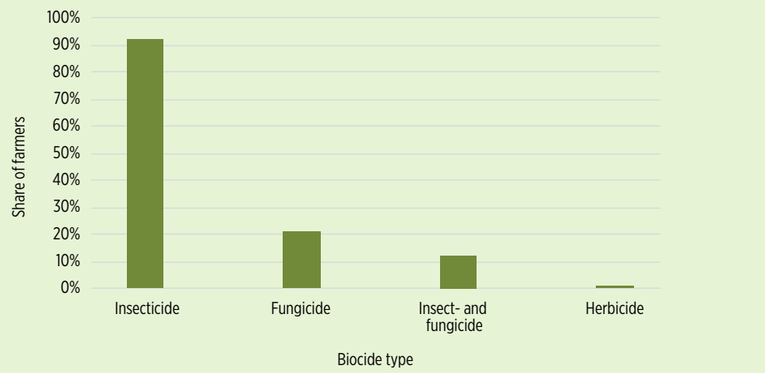


92% of farmers applied pest management activities. Of all farmers, 54% spent time on collecting diseased pods, 81% sprayed biocides. On 43% of farms both strategies were applied.

- A large majority (92%) of farmers apply pest management activities on their cocoa farms (**fig. 30)**.
- Fifty-four percent of farmers collected diseased pods. Collecting diseased pods and removing them from the farm limits the spread of diseases and pests and is therefore an important part of integrated pest management. Eighty-one percent of farmers reported biocide spraying activities.
- Sixty-seven percent of farmers spent time on both collecting diseased pods and spraying.
- Of the farmers who reported spraying activities, 92% applied insecticides and 20% applied fungicides. A negligibly small share of farmers (0.4%) applied herbicides (**fig. 31**).

Figure 30 Shares of Farmers applying Pest Management Techniques

Figure 31 Biocide Type Use by Farmers reporting Spraying Activities



Pest management by spraying biocides on average accounts for 2% of labour time on the farm and 26% of costs. Collecting diseased pods makes up 3% of labour time on the farm and 0.4% of costs.

- Farmers who collected diseased pods spent on average nineteen hours per hectare on this activity, at a cost of 290 XOF/ha (**fig. 32**). This average cost is very low because the work was often done by the household. Only 8% of farmers who collected diseased pods used hired labour of which half was unpaid (e.g. communal labour). If only those famers who actually had costs on collecting diseased pods are included, this results in an average cost of 6,387 XOF/ha/year.
- Less time is spent on spraying. Farmers who reported this activity on average spent 12 hours/ha. Yet costs are high at 13,731 XOF/ha on average.
- Farmers who applied both collecting diseased pods and spraying on average spent 42 hours/ha on these 2 activities at a cost of 17,059 XOF/ha (including labour).
- Taking into account only those farmers who applied the particular activity (**fig. 33**): Collecting diseased pods on average accounts for 3% of all time spent on the farm and for 0.4% of costs. Spraying on average accounts for 2% of all time spent on the farm and for 26% of costs. Applying both pest management activities on average accounts for 4% of time spent on the farm and for 26% of costs.

Figure 32 Labour and Cost Spent on Pest Management Activities

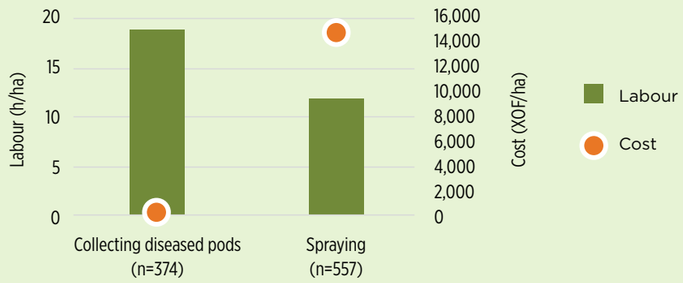
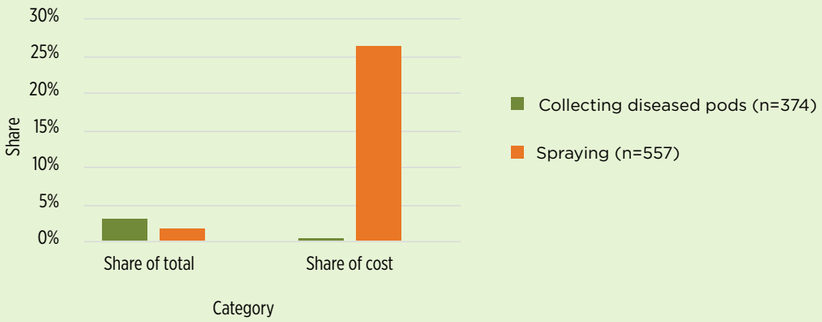


Figure 33 Share of Total Labour and Cost Spent on Pest Management



25% of farmers engaged in (re-)planting of cocoa. On the assumption that all planting is done to replace old trees, the tree replacement rate is 6.0% indicating an operational lifespan of 17 years.

- Farmers spent just over 10 h/ha on (re-)planting cocoa trees across the sample, and just over 40 h/ha for the 25% who engaged in this activity (**fig. 34**).
- The tree replacement rate is calculated by dividing the sum of new trees planted by the existing cocoa tree stock. We do not know for certain what share of the newly planted trees is for replacing old trees and what share is for the establishment of new farms. If we assume all planting is for replacement of old trees, then the replanting rate is 6.0%, at that rate every cocoa tree would be replaced in 17 years.
- We find strong regional variation in the replanting rate with Marahoué seeing nearly a third of its existing tree stock number being planted (**fig. 35**). This is also the region where the highest share of farmers engages in (re-)planting at 53% of the sample. Given that cocoa trees there are not significantly older than in other regions, we suspect it is unlikely that all planting there is for replacement of ageing trees. We think it is likely that new farms are being established there.
- The market share of hybrid seedlings supplied by CRNA is 21% (**fig. 36**).

Figure 34 Labour and Material Cost for Replanting

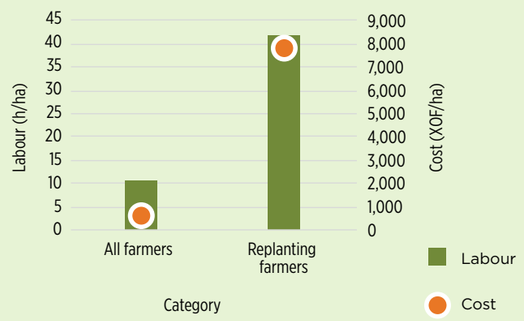


Figure 35 Replanting Rate by Region

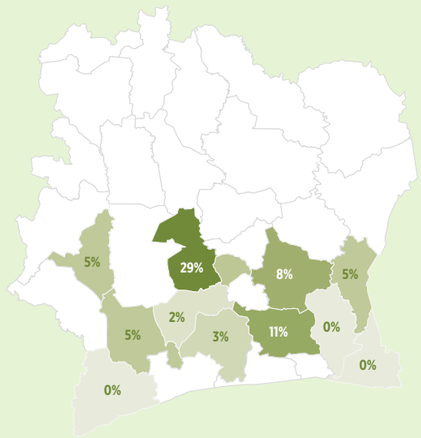


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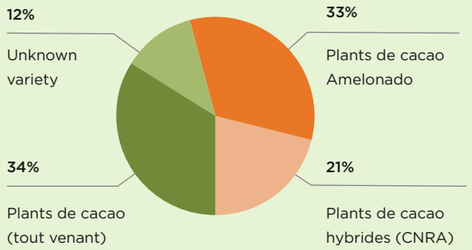
Figure 36 Share of Trees Planted by Variety



06 Yield

Average yield is 519 kg dry beans per hectare and 2,066 kg per farm. Slightly more than half (56%) of farmers produce between 200 and 600 kg/ha.

- The average FFB farmer had a production of 2,066 kg dry beans on their total cocoa farm acreage in Mar '18 to Feb '19. Yields are based on declared sales of dry cocoa beans. Yield per hectare was on average 519 kg dry beans/ha.
- The figure shows the percentage of farmers who fall in six yield classes. This shows that in 2018/19 36% of the farmers produced less than 400 kg/ha while 4% produce more than 1,000 kg/ha (**fig. 37**).
- The skewness of the yield data is 0.89, indicating a moderate long tail of higher yields by 1.6% of farmers who produce more than 3 standard deviations from the mean (**fig 38**).

Figure 37 Distribution of Farmers by Yield Class

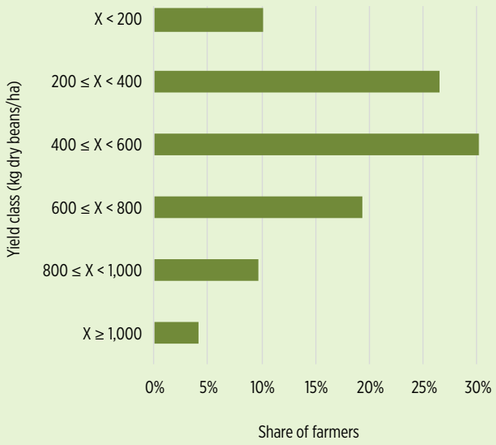
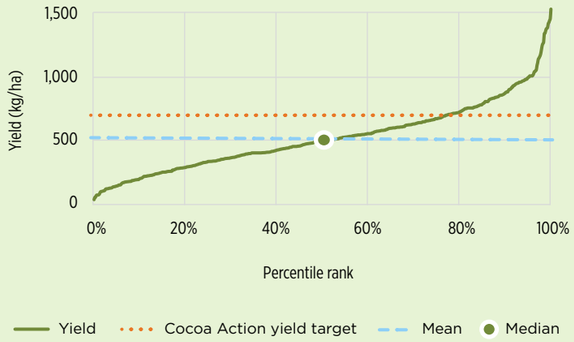


Table 4 Cocoa yield

Yield	Mean	Median	SD
Total cocoa area (ha)	4.3	3.3	3.6
Production per farmer (kg)	2,066	1,591	1,924
Yield (kg/ha)	519	496	266

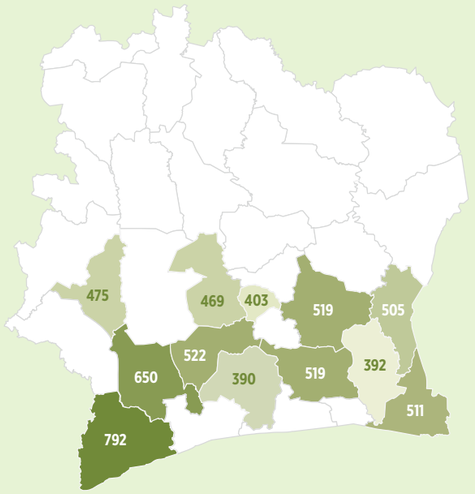
Figure 38 Sorted Yield Distribution by Famer's Percentile Rank



Average yield levels vary throughout the country and are highest in the Southwestern region of Côte d'Ivoire.

- The map shows the mean productivity for the regions in Côte d'Ivoire where farmers participated in FFB projects.
- Average yield levels vary by region. At 650 and 792 kg/ha respectively, yield levels in Nawa and San-Pédro are significantly higher than on most other regions.
- Regional differences could be caused by geographic, climatic or infrastructure effects. There could also be a data collection bias as information from different regions was collected by different data collectors and sometimes different companies. Additionally, differences with respect to the quality of organisation and service-provision of farmer cooperatives present in the different regions could play a role.
- As including weather data was outside of the scope of this study, inclusion of the regions in our regression analysis for yield may function as a proxy variable for weather data to some extent, but we think inclusion of weather data would allow for better explanation of the regional differences.

Figure 39 Yield by Region (kg/ha)



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Larger farms have a tendency for lower yield levels than smaller farms. Likely this is driven by lower investment and labour input levels per ha.

- There is a tendency for larger farms – in terms of total crop area, as well as cocoa area – to have lower yield levels than smaller farms (**fig. 40 and 41**).
- This seems logical as farmers who have large farms have to divide the time they can dedicate to their cocoa production over a larger area, especially when hesitant or unable to hire labour.
- Looking at labour time of each decile with respect to total cocoa area (**fig. 41**), there is a significant difference between the top three deciles of largest farms and the first two. Differences in yield levels are found between the decile of largest farms and the two deciles with smallest farms.

Figure 40 Yield versus Total Cocoa Area by Farmer

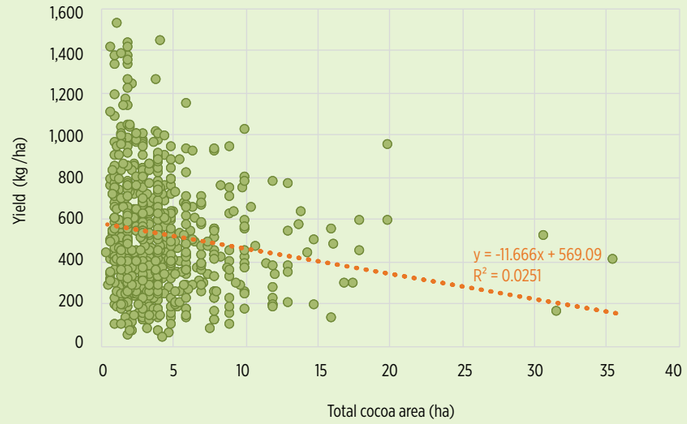
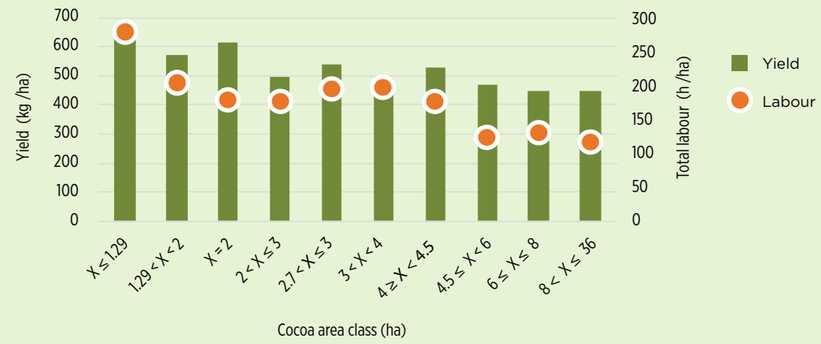


Figure 41 Yield and Total Labour by Decile of Farm Size



22% of farmers have yield levels equal to or higher than the Cocoa-Action yield target. These farmers tend to have smaller farms, a higher farm income, more labour hours per hectare and a higher incidence of child work.

- Cocoa Action member companies have committed to realize a yield increase to 700 kg/ha for 300,000 farmersin Ghana and by 2020[3].
- Twenty-two percent of FFB farmers currently have yield levels equal to or higher than the target. If our sample is representative of the sector, then this would indicate that presently 132,000 out of the 600,000 Ivorian cocoa farmers meet the target.
- We compared farmers below the yield target of 700 kg/ha (n=155) with farmers above the yield target (n=535). The table on this page shows the results of that comparison.
- Farmers above the yield target have smaller cocoa areas, higher costs per hectare, more labour hours for fertilisation, collecting diseased pods and pruning, and a higher income per hectare.
- Perhaps worryingly, farmers above the yield target also make greater use of children to work on their farms. This is probably driven by greater assistance of children during harvesting and processing.
- Overall, the logic behind trying to obtain higher yields to reduce poverty is a sound one at the local level: farmers that meet or exceed the target have 2.6 times higher net incomes from cocoa. A pertinent question that remains is what happens to cocoa prices if increasing numbers of farmers meet or exceed the target.

3 https://www.worldcocoafoundation.org/wp-content/uploads/2018/07/161026-CocoaAction-Roadmap-v1.0.pdf

Figure 42 Share of Farmers Above and Below Cocoa Action Yield Target

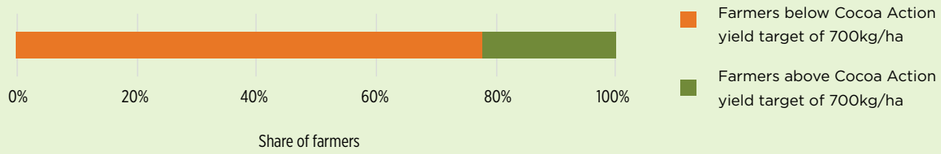


Table 5 Comparison of farmers above and below Cocoa Action yield target

Aspect	Unit	Yield level		Statistical significance
		<700 kg/ha	≥700 kg/ha	
Total cocoa area	ha	4.51	3.36	p < 0.01
Total cost	XOF/ha	48,814	96,830	p < 0.01
Fertilising labour	h/ha	2.8	5.7	p < 0.01
Collecting diseased pods labour	h/ha	8.1	17.9	p < 0.01
Pruning labour	h/ha	14.0	32.4	p < 0.01
Weeding	h/ha	110	158	p < 0.01
Child work	h/ha	21	54	p < 0.01
Cocoa income	XOF/farm	1,336,924	2,087,873	p < 0.01

More productive farmers generate a larger share of total cocoa supply, despite farming smaller cocoa areas.

- To compare farmers' contribution to total supply to their productivity or yield, farmers were divided in ten roughly equal-sized groups (deciles) sorted by yield (in kg/ha). The table and graph below show for each decile which share the farmers in that group contributed to total production.

Figure 43 Share of Total Production and Average Cocoa Area by Yield Deciles

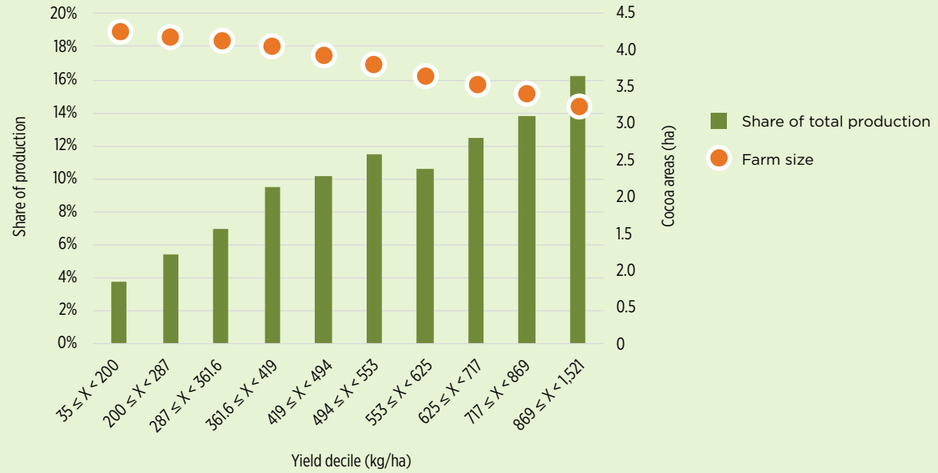


Table 6 Cocoa production by yield deciles

Decile	Nr. of farmers	Yield range (kg/ha)	Total production (kg)	Share of total production
1	69	35≤x<200	50,892	3.7%
2	70	200≤x<287	73,933	5.3%
3	68	287≤x<361.6	96,365	6.9%
4	69	361.6≤x<419	131,108	9.4%
5	69	419≤x<494	140,157	10.1%
6	75	494≤x<553	159,676	11.5%
7	63	553≤x<625	147,630	10.6%
8	69	625≤x<717	172,374	12.4%
9	69	717≤x<869	190,889	13.8%
10	69	869≤x<1,521	224,937	16.2%

Production is concentrated at a relatively small share of the total farm population. The 20% largest producers are responsible for 47% of the total cocoa production in the sample.

- Production from FFB farms totalled 1,421 Mt in the 2018 season.
- Production across quintiles of farmers by production differs considerably, see the table at the bottom of this page.
- The top 20% of farmers produce almost half of total production, the bottom 50% of all farmers together produce only 14%.
- For (semi-) commercial service delivery where revenues from cocoa are used in part to finance services to farmers, it may be challenging to reach the lowest level of suppliers, yet these make up a significant share of the farmer numbers in the supply base.

Figure 44 Supply concentration

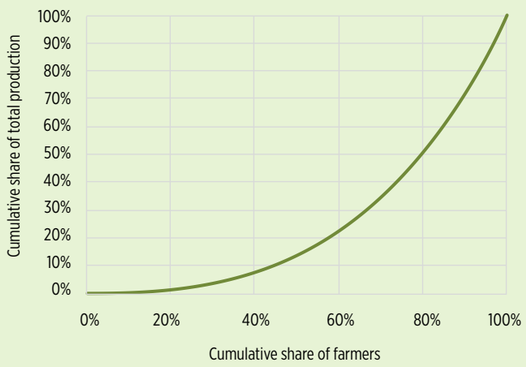


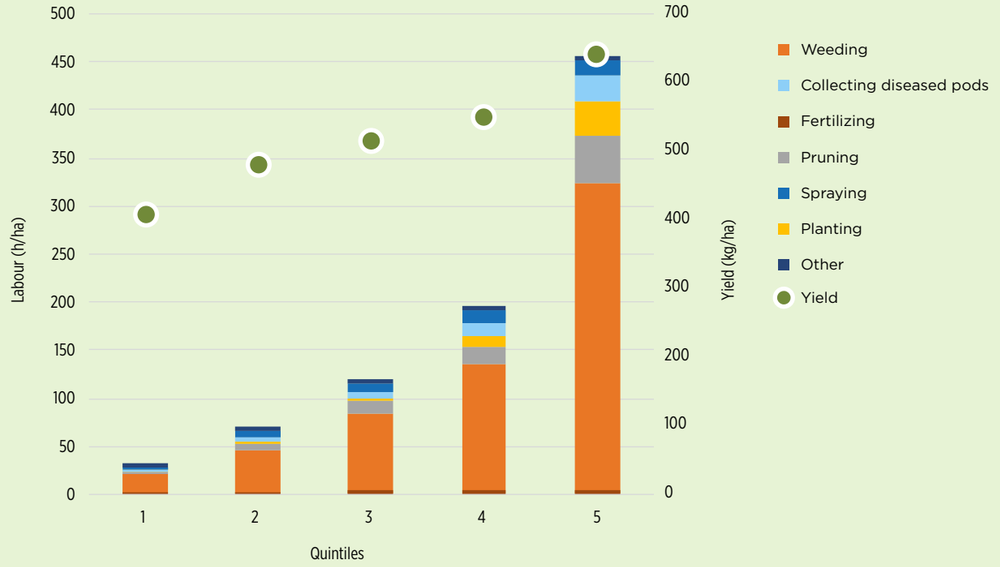
Table 7 Cocoa production by quintiles

Quintile by production	Total production (Mt)	Share of total production
Bottom 20%	68	5%
Lower middle 20%	136	10%
Middle 20%	225	16%
Upper middle 20%	330	23%
Top 20%	662	47%
Total	**1,421**	**100%**

Average yield levels show some increase with labour time spent on weeding, pruning, planting, collecting diseased pods, fertilising and spraying pesticides.

- There is quite some variation in how much time farmers spend on their farms and their productivity. To investigate this further we divided farmers in five equally sized groups (quintiles) according to their labour hours per hectare, excluding time spent on harvesting and processing. Classes range from 1 (20% farmers with the least time spent) to 5 (20% farmers with most time spent).
- The figure shows that there is a tendency that yield levels increase with time spent. Yield levels are significantly different between all quintiles except for quintiles 2&3 and 3&4.
- Weeding takes up a large share of total labour (excluding harvesting and processing). Total weeding labour per hectare is significantly different between each quintile.
- Also in relative terms, quintiles 4&5 spent more time on weeding than the other quintiles.
- Total pruning labour differs significantly between quintile 1 and all other quintiles, as well as between quintile 5 and all other quintiles. Total pruning labour time did not differ significantly between quintile 2, 3 and 4.

Figure 45 Labour for Pre-Harvest Activities and Yield Levels by Quintiles of Total Labour per Hectare



A regression model with household and farm (management) characteristics explains 37% of the observed variability in yield.

- The table below shows the results of a stepwise regression using a range of control variables (region, household and farm characteristics) as well as farm management variables (inputs and labour). The resulting model can explain 37% of the variation in the dependent variable Yield (kg dry beans/ha).
- The left side of the table indicates which variables were initially included in the model. The stepwise regression procedure then removes variables that do not have a significant correlation with yield.
- The variables that remain (and are thus significant) are indicated with a plus or minus sign in the table, meaning they are positively or negatively correlated with yield.
- The right side displays the regression coefficients for significant variables. They can be interpreted as change in yield per unit change of the variable, all else being equal.
- In this model we are not able to control for weather conditions. Integrating that would make the model more robust and may give better insight still into which activities and investment correlate strongest with yield.

Table 8 Linear regression model for cocoa yield

Variable category	Variable	Positive, negative or no effect	Unit	Regression coefficient	Coefficient as % of mean yield (519 kg/ha)
Region	Guémon	+	Dummy	97	+19%
	Nawa	+	Dummy	285	+55%
	San Pédro	+	Dummy	353	+68%
	Marahoué		Dummy		
	Gôh	+	Dummy	160	+31%
	Lôh-Djiboua	+	Dummy	131	+25%
	Yamoussoukro	+	Dummy	166	+32%
	Agnéby-Tiassa	+	Dummy	151	+29%
	Moronou	+	Dummy	274	+53%
	Indénié-Djuablin	+	Dummy	270	+52%
	Sud-Comoé	+	Dummy	254	+49%
	La Mé (baseline)				
Household	Women involved in decision making	+	Dummy	101.4	+20%
	Household size		#		
	Gender of the farmer		Dummy		
	Cocoa growing Experience/Age		Years		
	Education		Dummy		
Farm	Cocoa area	-	Ha	-9.2	-1.8%
	Planting density		Trees/ha		
	Age of trees		Years		
Inputs	Training		Days/family		
	Total N applied		Kg/ha		
	Total P applied		Kg/ha		
	Total K applied	+	Kg/ha	2.8	+0.5%
	Spraying material costs	+	1,000 XOF/ha	8.9	+1.7%
Labour	Collecting diseased pods	+	Days/ha	11.4	
	Fertilizing		Days/ha		
	Pruning	+	Days/ha	5.3	+1.0%
	Pruning shade trees		Days/ha		
	Weeding	+	Days/ha	0.9	+0.2%
	Spraying		Days/ha		

Region, involvement of women in decision-making, farm size, nutrient application, pruning and pest management have significant correlations with yield.

On this page the regression model on the previous page is further explained and interpreted.

- **Region**
  Yield change and % yield change for the regional variables are to be interpreted as changes with respect to baseline region La Mé (lowest yield). The region where farms are located has a significant relation with yield. This could be explained in three ways: first, there could be geographic, climatic and infrastructure effects. Secondly, there could be a data collection bias as information from different regions was collected by different data collectors, each following their own approach in interviewing. Thirdly differences with respect to the quality of organisation and service-provision of the coops present in the different regions could play a role.
- **Women involved in decision making**
  There is a positive relation between yield and women being involved in farm management decisions. All else being equal, farms where the woman or the man and woman together make farm management decisions have 20% higher yields. On average, such farms are significantly smaller than those where men make all the decisions, yet it is not likely to be the sole explanation. No alarming collinearity level was found for shared decision-making between farm size or any other explanatory variable. This suggests that households with shared decision could simply be making better decisions.
- **Cocoa area**
  There is a negative correlation between farm size and yield which can probably be explained by limited time and resources. We saw earlier that on larger farms the amount of labour drops in line with the lower yield levels such farms tend to achieve.
- **Nutrient application:**
  Application levels of K show a significant positive correlation with yield. P application rates were not involved in the regression model due to extreme collinearity: farmers applying K simultaneously apply P, due to the type of fertilizer they use. No correlation between N application and yield was found. This is most likely due to the small number of farmers applying this nutrient to their fields.
- **Pest management:**
  There are positive correlations between collecting diseased pods, weeding labour & spraying material costs and yield. The latter may seem surprising when assuming that farmers only apply these activities in case of presence of pests. Yet, under the assumption that farmers only spray if they can afford it, it could well be that farmers who spray are better off than their non spraying peers who are also confronted with diseases and hence experience lower yields as a result of pest and disease pressure. Similarly, collecting diseased pods and weeding indicate more intensive farm management contributing to increasing yields. We suspect that this correlation is illustrative of how more intensively managed farms are performing better.
- **Pruning cocoa trees:**
  We also see a positive correlation with pruning of cocoa trees. As yield usually has a delayed response to pruning it would be interesting to see how this year's pruning will correlate with 2019/20 yields.

07 Farm economics

Farmer revenue was on average 1.52 million XOF per farm or 385,428 XOF per hectare. Mean profit was 1.29 million XOF per farm with a standard deviation of 1.30 million XOF, indicating a very large spread.

- FFB farmers generated an average revenue of 1.52 million XOF or 385,428 XOF/ha in the 2018/19 analysis year.
- Mean profit was 1.29 million XOF per farm with a standard deviation of 1.30 million XOF, indicating a very large spread of profit made among farmers. Expressed per hectare, mean profit was 325,592 XOF (**fig. 46**).
- Costs on average equal 16% of farmers' revenue per hectare (**fig. 47**).
- During last season, every XOF spent by farmers, has returned 5.4 XOF in profit (the Benefit-Cost Ratio).

Figure 46 Revenue, Total Cost and Profit per Farm and per ha

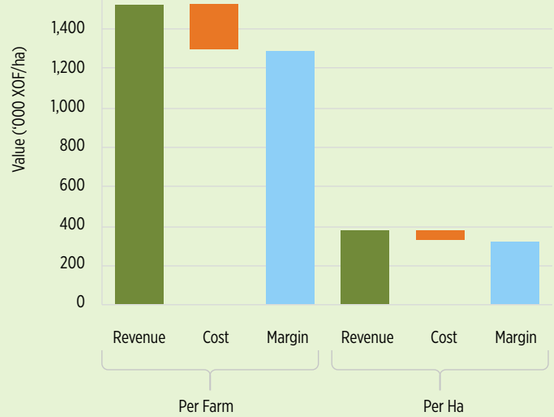
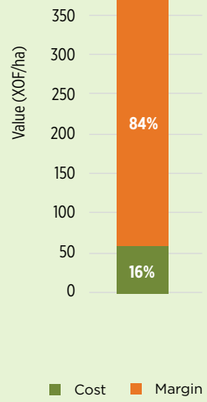


Figure 47 Revenue Breakdown per Ha by Cost and Margin



Per Mt cocoa, farmers earn a profit of 626,280 XOF, which equals 636 XOF or 0.95 EUR per kg. Hired labour is the largest cost item, while fertiliser and pesticides account for most of the remaining costs.

- Per Mt dry cocoa beans, farmers had on average a revenue of 750,224 XOF, total costs of 173,089 XOF and a profit of 626,280 XOF. This is excluding opportunity cost related to household labour (**fig. 48**).
- Hired labour is the largest cost item at 73,976 XOF/Mt, making up for 60% of all costs (**fig. 49**).
- Fertiliser is second largest at 17,781 XOF/Mt which represents 15% of the costs.
- Biocides account for another 12% of the costs. Other material and equipment rental cost are minor cost items which add up to 13% of the costs.

Figure 48 Revenue, Costs and Profit per Mt cocoa

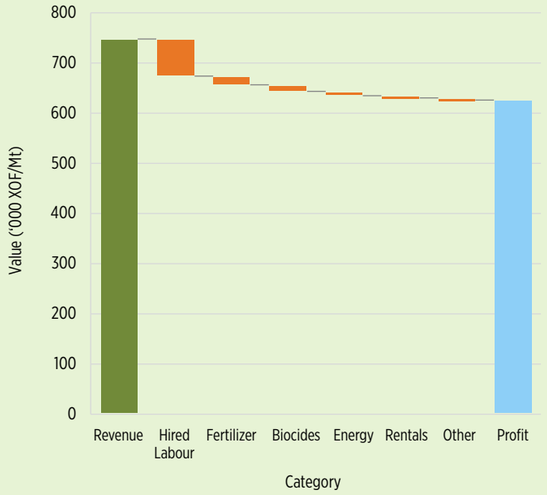
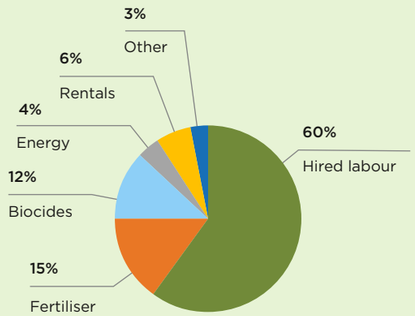


Figure 49 Cost Break-Down per Mt Cocoa



Investment levels show large variation with respect to size and distribution over different investment categories. Yields increase with investment levels.

- To investigate farmers' investments, we divide farmers in five equally sized 'investment classes' (quintiles) sorted by total expenses per hectare, excluding opportunity costs. The classes range from 1 (20% farmers with lowest costs) to 5 (20% farmers with highest costs).
- Average yields increase with investment levels. Statistically, the fourth and fifth quintile show higher yields than the first and second (**fig. 51**). The only significant difference in profits is found between farmers in class 4 and 1.
- **Figure 52** shows that farmers in each investment class distributed their investments somewhat differently across categories. Farmers in the fifth quintile spent a significantly larger share of their investments on hired labour which depresses their profit margins despite having higher yields. For a "pure-play" cocoa farmer who is exclusively focussed on the crop and derives nearly all income from it, being in class 4 is the optimal situation. Farmers in the first and second quintile spent a smaller share of investment on biocides and almost nothing on fertilisers. This may indicate that being able to buy fertilizer is a luxury that many farmers cannot afford, although there are also farmers who think fertilisers are not required for cocoa.

Figure 50 Average Investment Cost per Ha by Investment Class

Figure 51 Yield and Profit by Investment Class

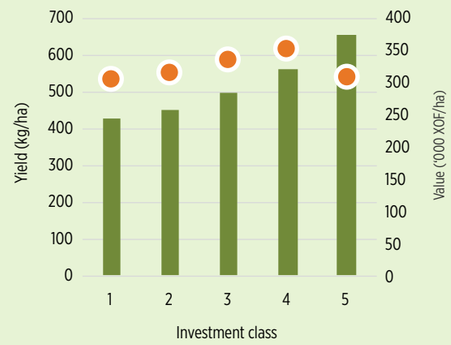
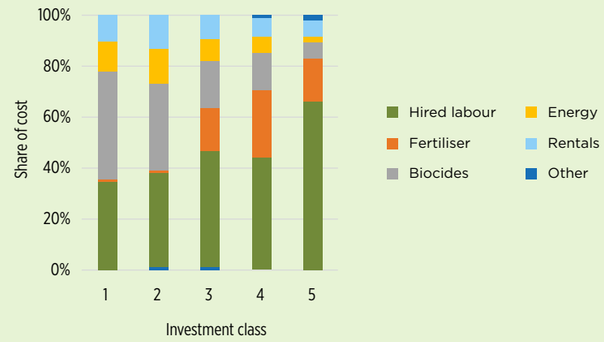


Figure 52 Relative Cost Breakdown per ha by Investment Class



A regression model for profit, with household and farm (management) characteristics, explains 29% of the observed variability in profit.

- The table below shows the results of a stepwise regression using a range of control variables (region, household and farm characteristics) as well as farm management variables (inputs and labour). The resulting model can explain 29% of the variation in the dependent variable Profit (XOF/ha).
- We used the same variables as for the yield-model, and added cost variables to complement the profit model and take into account the (possible) profit-depressing effects of costs involved with particular farm management activities.
- The left side of the table indicates which variables were initially included in the model. The stepwise regression procedure then removes variables that do not have a significant correlation with profit.
- The variables that remain (and are thus significant) are indicated with a plus or minus sign in the table, meaning they are positively or negatively correlated with profit.
- The right side displays the regression coefficients for significant variables. They can be interpreted as change in profit per unit change of the variable, all else being equal.

Table 9 Linear regression model for cocoa-based profit

Variable category	Variable	Positive, negative or no effect	Unit	Regression coefficient	Coefficient as % of mean yield (519 kg/ha)
Region	Guémon	+	Dummy	83,257	+26%
	Nawa	+	Dummy	232,959	+72%
	San Pédro	+	Dummy	278,016	+85%
	Marahoué		Dummy	79,057	+24%
	Gôh	+	Dummy	114,016	+35%
	Lôh-Djiboua	+	Dummy	99,130	+30%
	Yamoussoukro	+	Dummy	93,461	+29%
	Agnéby-Tiassa	+	Dummy	119,775	+37%
	Moronou	+	Dummy	156,380	+48%
	Indénié-Djuablin	+	Dummy	140,950	+43%
	Sud-Comoé	+	Dummy	114,884	+35%
	La Mé (baseline)				
Household	Women involved in decision making	+	Dummy	59,133	+18%
	Household size		#		
	Gender of the farmer		Dummy		
	Cocoa growing Experience/Age		Years		
	Education		Dummy		
Farm	Cocoa area	-	Ha	-7,546	-2.3%
	Planting density		Trees/ha		
	Age of trees		Years		
Inputs	Training		Days/family		
	Hired labour costs per ha	-	1,000 XOF/ha	-456	-0.1%
	Total N applied		Kg/ha		
	Total P applied		Kg/ha		
	Total K applied		Kg/ha		
	Spraying material costs	+	1,000 XOF/ha	4,010	+1.2%
Farm management	Collecting diseased pods	+	Days/ha	6,054	+1.9%
	Fertilizing		Days/ha		
	Pruning	+	Days/ha	3,348	+1.0%
	Pruning shade trees		Days/ha		
	Weeding	+	Days/ha	652	+0.2%
	Spraying				

Region, involvement of women in decision-making, farm size, nutrient application, pest management, pesticide costs and costs for hired labour have a significant relation with profit.

On this page the regression model on the previous page is further explained and interpreted.

- **Region**
  The region where farms are located has a significant relation with profit. Similar reasons causing difference in yield could explain the differences in profit.
- **Women involved in decision making:**
  There is strong positive relation between profit and women being involved in farm management decisions. All else being equal, farms where the woman or the man and woman together make farm management decisions have 18% higher profits. This is not surprising given the correlation between women involved in decision making and yield.
- **Cocoa area:**
  As with yield, a negative correlation is found between farm size and profit. All else equal, an extra hectare of cocoa area on a farm depresses profit levels per ha by 2.3%.
- **Nutrient application:**
  No relation between K application and profit was found, although K application (and thus P-application, see section on nutrient management and yield model) correlate positively with profit. It is likely that suboptimal fertilizing practices of farmers result in insufficient data available to find significant correlations between nutrient application and profit.
- **Farm management:**
  As with yield, profit correlates positively with farm management activities weeding and collecting diseased pods.
- **Spraying costs:**
  Spraying costs were chosen as proxy for spraying activities. The advantage of using spraying costs is that they reflect the quality and quantity of the spraying material which is likely more important than the labour time used to apply them to the fields. In profit models the added value of this variable is the intuitive interpretation: Applying spraying material pays off; all else being equal, farmers earn 4,010 XOF for every 1,000 XOF spent on spraying materials. No significant effect of spraying labour time on profit was found.
- **Labour costs:**
  The regression model shows a negative correlation between hired labour costs and profit. This is probably because farmers hiring labour have lower profits than farmers who did the same activity with household labour. Note that although farm management activities by hired labour come at a cost and thereby depress profits, farmers usually do not have a choice, because it concerns essential farming activities.

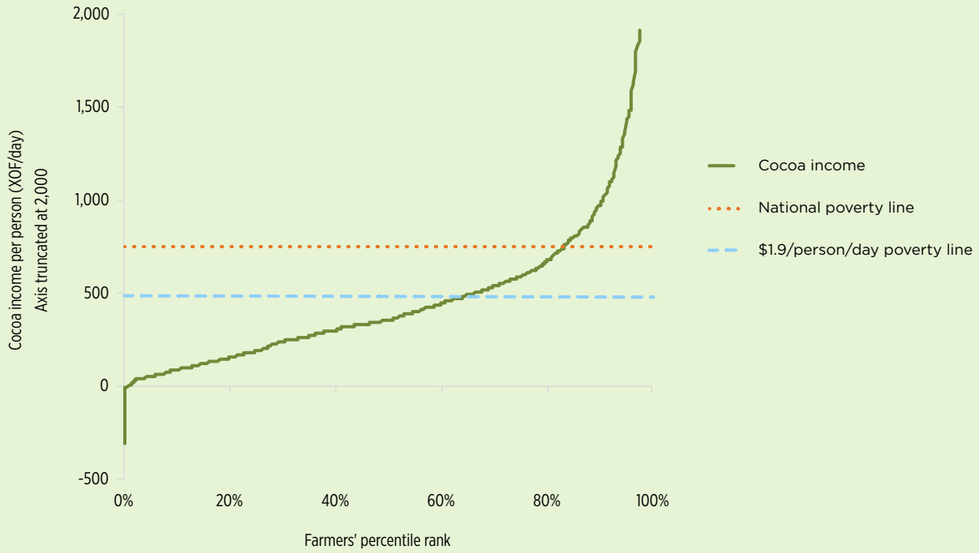
Sixty-four percent of farmers earned an income from cocoa that is insufficient to pass the World Bank's absolute poverty line of 1.90$ per person per day.

- To analyse where the FFB farmers are compared to the poverty threshold **on basis of their cocoa income**, we use the World Bank international poverty line definition of 1.90 $/person/day and the Côte d'ivoire national poverty line.[4]
- The 1.9$/person/day was converted to Local Currency Units (XOF) using the private consumption PPP factor from the 2011 ICP round, extrapolated to 2018 using the domestic Consumer Price Index to correct for inflation. This results in a poverty threshold of 482 XOF/person/day in 2018. The national poverty line is set at 757 XOF/day.
- Each farmer's yearly cocoa income was converted to a daily income per person by dividing by household size and was benchmarked against the poverty lines.
- The figure below shows the distribution of farmers income, ordered from low to high. The cocoa income line intersects the 1.90$ poverty threshold at 64% and the national poverty line at 83%. This means that 36% of farmers earns an income above the poverty line and 17% of farmers earn an income from cocoa sufficient to pass the national poverty line.
- Approximately 10% of the farmers (between 65% and 75% on the X-axis) are above, yet very close to the 1.9$/person/day poverty line. A minor dip in cocoa prices would push these families below the poverty line again.
- Several reports[5] indicate that cocoa farmers derive around 80% of their income from cocoa. If we apply that ratio to this data, 53% of farmers would still be below the international poverty line and 77% below the national one.

4 http://documents.banquemondiale.org/curated/fr/277191561741906355/pdf/Cote-dIvoire-Economic-Update.pdf

5 For example: https://www.afd.fr/en/cocoa-farmers-agricultural-practices-and-livelihoods-cote-divoire

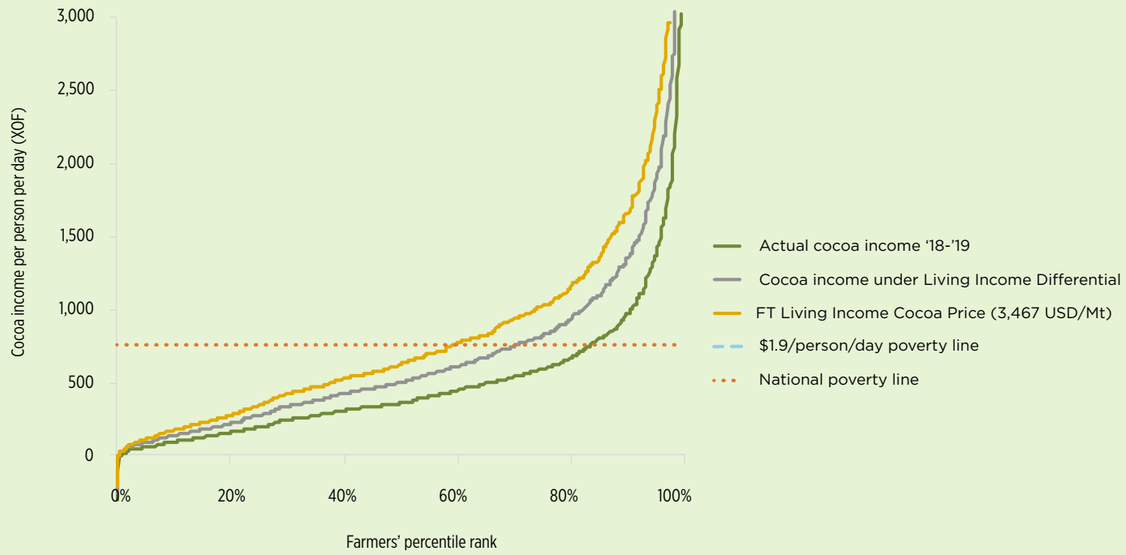
Figure 53 Distribution of Farmer Income Relative to Poverty Line



All else being equal, the Living Income Differential or the Fairtrade Living Income price could increase the share of farmers gaining a cocoa income above the extreme poverty line from 36% to 52% and 63%, respectively.

- Calculations on this page consider income from cocoa only. Many farmers have some sources of additional income, so this over-estimates the share of farmers below the poverty line.
- Here we show the shares of FFB farmers living above and below the Ivorian national poverty line and the international absolute poverty line ($1.9/person/day) under three price scenarios:
  1. Last season's price;
  2. The recently proposed Living Income Differential (LID) of 400 USD/Mt FOB on top of the market price; and
  3. The Fairtrade Living Income price of 3,467 USD/Mt.
- To make the calculations for the farmer's income under the Living Income Differential it was assumed that the full price of 400 USD/Mt (0.40 USD/kg) is paid to the farmer. However, it is uncertain how much of this price will end up being paid to the farmer. In reality this is likely to be less. Therefore, the price scenario depicted by the graph presents the best-case scenario.
- In the case of the Living Income Differential or the Fairtrade Living Income, 52% or 63% of farmers, respectively, would have a cocoa income above the international extreme poverty line. The current share of farmers with an income above absolute poverty is 36%.
- We conclude that higher cocoa prices can help. The Fair Trade price has the potential to decrease the percentage of farmers living in extreme poverty from 64% to 37%, a substantial difference. The Living Income Differential makes less impact, since even if the full differential is paid to the farmer, the percentage of farmers with a cocoa income below absolute poverty is 48%. In practice, it is likely that even more farmers earn below this.

Figure 54 Distribution of Farmers' Actual Total Income and of Potential Cocoa Income With Living Income Differential per Household Against Living Income Benchmark

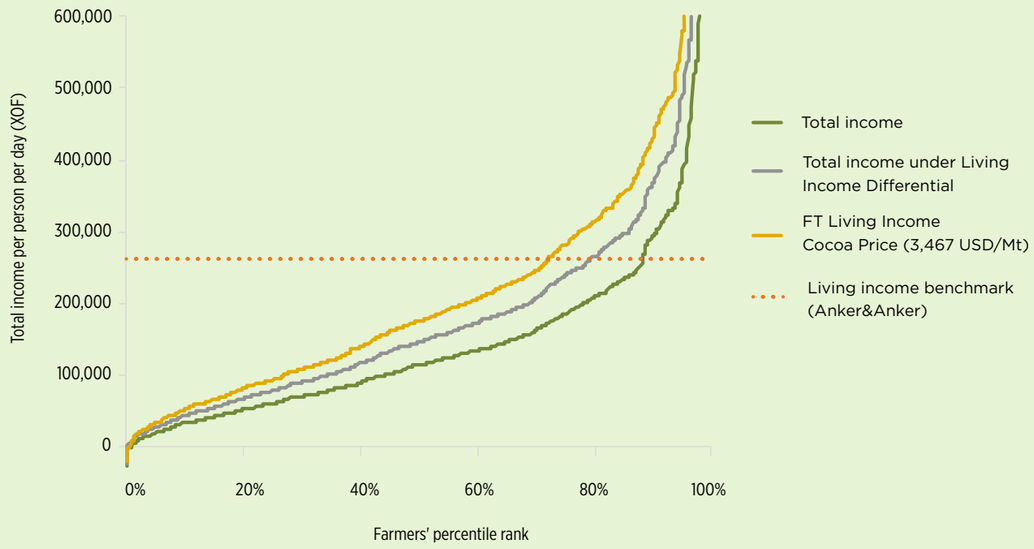


All else being equal, under the Living Income Differential or the Fairtrade Living Income price, the share of cocoa households expected to gain a *household income* above the Living Income Benchmark increases from 12% to 21% and 28%, respectively.

- The graph on this page is similar to the one on the previous page. On this page however, **additional sources of income are considered**, both monetary and non-monetary. Furthermore, in order to compare to the Anker & Anker Living Income Benchmark, income is calculated per household per month instead of per person per day as was done on the previous page.
- Combining CCF data and an data from an AFD study[6], we calculated cocoa income to constitute 94.7% of a farmer's monetary income.
- Based on data of 374 Ivorian cocoa farmers, it was estimated that the value of food grown for home consumption equals 23% of total income. Including this value, cocoa income represents 73% of a farmer's total income (monetary and non-monetary).
- With these values, an estimated non-cocoa income was calculated for each farmer in the 2018/19 season. For the price scenarios, the non-cocoa income was added to the modelled cocoa incomes.
- In the current situation, 12% of cocoa households earns a **total income** above the Living Income Benchmark. In case of the Living Income Differential or the Fairtrade Living Income price, we estimate this to increase to 21% and 28%, respectively.
- Under either of the scenarios, at least 72% of cocoa households does not gain a living income as calculated based on the Anker & Anker methodology.
- The share of households below the Living Income Benchmark is much higher than the share of farmers below the absolute poverty line. The LI Benchmark expressed per person per day (Anker & Anker calculated it for the average family size of 6 persons) is 2.98 times higher than the absolute poverty line.

6 https://www.afd.fr/en/cocoa-farmers-agricultural-practices-and-livelihoods-cote-divoire

Figure 55 Distribution of Farmers' Actual Total Income and of Potential Cocoa Income With Living Income Differential per Household Against Living Income Benchmark



To lift 80% of the farmers above the international poverty line, average yield levels need to be 734 kg/ha. Achieving this may have adverse effects on occurrence of child labour.

- Since cocoa price effects on poverty have their limitations, we calculated what average yield level would have to be to lift 80% of the farmers above the poverty line on cocoa income alone. For this we use the profit margin per kg cocoa that farmers currently above the poverty line obtain and for each farmer below the poverty line divide that value by the income gap they face to meet the poverty line, while controlling for household size. This results in an additional cocoa volume required for each farmer, which is then divided by the cocoa farm size to arrive at the required yield level.
- We find that yields among the 80% best performing farmers need to increase by 30% from an average of 563 kg/ha to 734 kg/ha (**fig 56**).
- Aiming for this is not without risk. Currently, farmers who exceed the 734 kg/ha yield level use significantly more working time from children, both on a per ha basis as well as in absolute terms (**fig 57**).

Figure 56 Current and Required Yield Distribution to Lift 80% of Farmers to or Above the Poverty Line

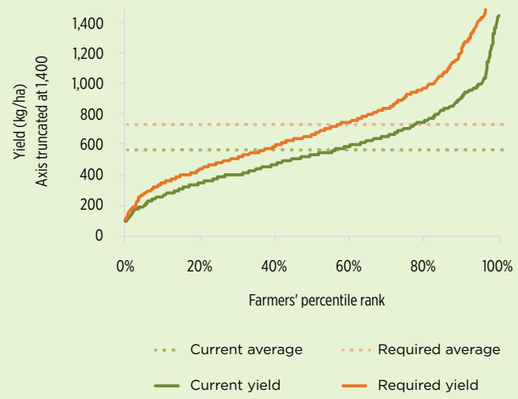


Figure 57 Children's Working Time on Farms Above and Below the Required Yield Level to Lift 80% of Farmers Above the Poverty Line

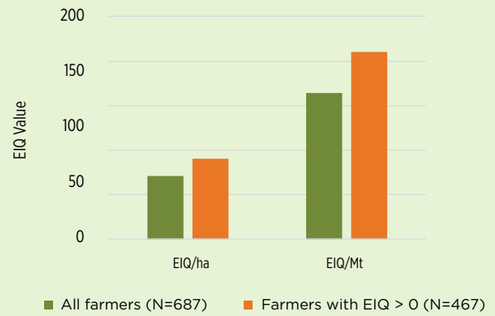
08 Environment

The Environmental Impact Quotient Field Use Rating, a measure for environmental toxicity of pesticide use, is relatively low and equals 7 per hectare and 16 per Mt cocoa produced.

- The Environmental Impact Quotient (EIQ) Field Use Rating[8] is a measure to compare the environmental impact of pest management strategies.
- A higher EIQ Field Use Rating corresponds to a higher (detrimental) impact on the environment and health of the applicators of pesticides.
- The EIQ Field Use Rating = EIQ of a substance * % active ingredient * application rate.
- To calculate this, the FFB software draws the EIQ values of toxic substances from a database in which the EIQ of many substances is recorded as a compilation of acute toxicity levels and long term toxicity for various organisms, half life in soil and plants, as well as groundwater and run-off potential.
- The average EIQ Field Use Rating for all farmers, including those that do not spray, is 7 per ha (see figure). Excluding farmers with 0 EIQ, this figure is equal to 9/ha.
- EIQ/Mt cocoa equals 16 for all farmers and 21 for spraying farmers only.
- We were not able to retrieve publicly available EIQ Field Use Rating reference values for cocoa production. In absence of cocoa-data we can make a comparison with other perennial crops like coffee. In an FFB project in Vietnam, the average EIQ Field Use Rating of farmers that use biocides is much higher at 36 per ha.

8 The EIQ and EIQ Field Use Rating were developed by members of the NYS Integrated Pest Management Program at Cornell University. More info here: https://nysipm.cornell.edu/eiq

Figure 58 Environmental Impact Quotient per Ha and per Mt



Twenty percent of the FFB farmers are responsible for 83% of the total EIQ for the production of cocoa. Eighty-three percent of farmers have an EIQ per Mt below the mean of 16 EIQ/Mt.

- The distribution of EIQ Field Use Rating values in figure 1 shows that 83% of the farmers are below the average EIQ Field Use Rating of 16 per Mt.
- Figure 2 shows that the 20% farmers with the highest total EIQ Field Use Rating are responsible for 83% of total EIQ Field Use Rating for the production of cocoa in the sample during the analysis period.
- Practically, this means that if the biocide footprint were to be reduced, one would need to work closely with a relatively small number of farmers and advise them on biocide use reduction and/or switching to less toxic alternatives.

Figure 59 Distribution of farmers' EIQ per Mt

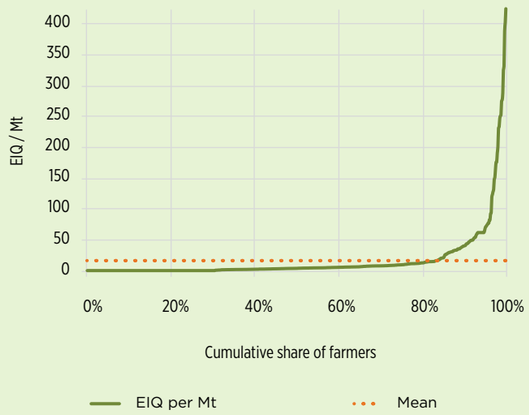
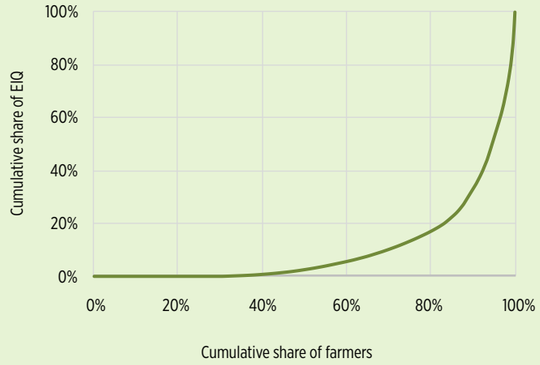


Figure 60 Share of cumulative EIQ by cumulative share of farmers



Mean emissions equal 42 kg CO_2e per farm and 30 kg CO_2e per Mt of produced cocoa. Energy use forms the largest share (46%) of CO_2e emissions. Just 14% of all farmers produce half of total CO_2e emissions.

- Different types of emissions from different types of fertiliser are standardised according to their global warming potential in CO_2 equivalent values (CO_2e) to arrive at a single emission value for each type and a total value.
- Most of the farms were established more than 20 years ago, which in footprint analyses allows us to negate the emissions associated with establishment of the cocoa farm.
- Under these conditions, we see on the average farm: 46% of emissions are caused by energy use, 26% by biocides use and 29% by fertiliser use. These figures shift slightly to 48%, 27% and 25% respectively if we look at per Mt emissions (**fig. 61**).
- **Figure 62** shows that the 50% of farmers with the lowest per farm CO_2e emissions are responsible for only 10% of all emissions, whereas 50% of all CO_2e emissions are caused by the 14% most emitting farms.
- 66% of all FFB farmers are below the mean emission level per farm of 42 kg CO_2e.

Figure 61 CO_2e Emissions per Mt and per Farm by Source

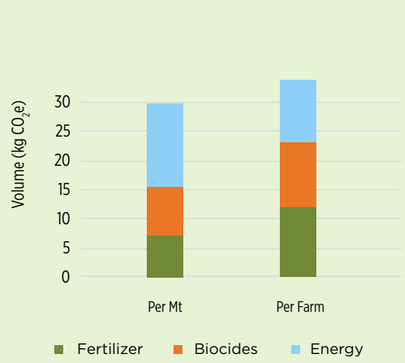
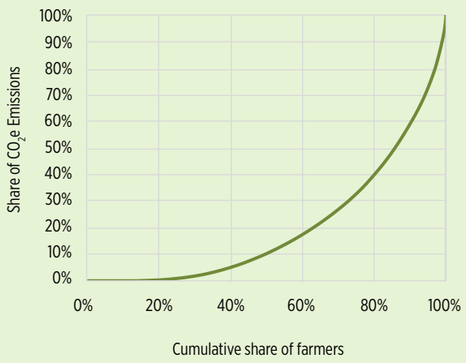


Figure 62 Share of Cumulative CO_2e Emissions by Cumulative Share of Farmers



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