mocca | Maximizing Opportunities in Coffee and Cacao in the Americas

FARMER LEVEL BASELINE REPORT

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EXECUTIVE SUMMARY

Funded by the United States Department of Agriculture's (USDA) Food for Progress Program, and Implemented by a Consortium led by TechnoServe, the Maximizing Opportunities in Coffee and Cacao in the Americas (MOCCA) project will help farmers overcome barriers that limit their capacity to renovate and/or rehabilitate their coffee and cacao trees by increasing their productivity while improving their marketing capacity, incomes and livelihoods. The International Center for Tropical Agriculture (CIAT) is leading the baseline assessment and evaluation of the project at two levels: market systems and farmer level. This report presents the farmer-level baseline results for surveyed farmers and provides a picture of beneficiary farmers' situation prior to project implementation, for MOCCA's main indicators. In the farmer-level evaluation, we followed a design where we will be comparing beneficiary farmers prior and post project implementation, to measure the contribution of MOCCA on the observed changes. We programmed a structured questionnaire to collect data using cell phones and interviewed 1,061 and 2,297 cacao and coffee farmers, respectively, across 127 coffee municipalities and 101 cacao municipalities.

Coffee results

Among coffee farmers, making joint decisions (including spouses or partners) about which inputs to purchase for coffee was low (19%). Farmers dedicated most of their land to grow coffee and it was rare for coffee farmers not to own land. Owning land with deed was more common in Central America than in Peru. Results show that intended beneficiary farmers grew 2.74 ha of coffee, ranging from 1.11 ha in Guatemala to 4.05 ha in Nicaragua. Farmers harvested 665 kg of green coffee per hectare, obtaining a gross annual income of a little over US$4,900 from coffee sales. Roughly, 39% of farmers reported their main buyer was an anchor firm participating in MOCCA, which suggests that the project could benefit farmers by facilitating access to these improved markets, as 48.5% reported their main buyer was an intermediary. When we disaggregate yields and income from coffee sales by sex, age of household head and coffee area we observe that, in general, male-headed households were better off than female-headed ones, and that both younger heads and farmers with smaller coffee area obtained higher yields but lower income from coffee sales than their older counterparts.

MOCCA not only measures whether a farmer adopts a particular practice, but also measures whether that practice is adopted well or optimally, using defined criteria. In coffee, we are

evaluating 33 of the practices MOCCA will recommend to farmers (many at these two levels of adoption). Most farmers reported they had adopted between 11 and 19 of the basic soon-to-be-promoted MOCCA practices, with an average of 14 practices, suggesting there is an opportunity for MOCCA not only to increase the number of practices farmers implement in their farms, but also to lift the number of practices implemented at optimal levels, according to MOCCA's curriculum.

It was more common for farmers to implement rehabilitation practices (63.41%) than renovation practices (24.13%), which is understandable given the different requirements of implementing each of them. Rehabilitating coffee plants was most common in Peru (74.4%), followed by Nicaragua (70.07%), Honduras (58.92%), Guatemala (58.25%) and El Salvador (44.12%). Renovating coffee was most common in Nicaragua (43.94%), followed by Peru (28.4%), Guatemala (17.2%), Honduras (14.28%) and El Salvador (11.42%). As one would expect, the share of farmers reporting limitations to adopt renovation practices was slightly higher than the ones reporting the same for rehabilitation practices, and in both cases, the main limitation was having the economic resources to implement them. The average age of coffee trees ranged from 4.73 years in Nicaragua to 8.27 years in Guatemala, with an average of 6.39 years for all countries.

62.88% of coffee farmers have a single coffee plot, while 22.58% have two, and 14.52% have three or more coffee plots. An in-situ diagnostic of the main coffee plot showed that a little over 82% of the trees in this plot were productive. Further, from all trees, 13.18% needed pruning and 6.2% needed stumping. Overall, roughly 7.56% of trees in the main plot needed renovation because of they needed to be removed or because there were physical failures (i.e., missing trees). Since we did not estimate the share of trees that needed renovation because of age or low productivity, this value is as a lower-bound estimate of the need of renovation in the main coffee plot.

Most farmers reported applying fertilizer in the agricultural year of reference (Table S 1). Fertilizing based on nutritional deficiencies was not common. Fertilizing the full amount required, applying the fertilizer under the treetop or in the fertilization band, and using methods to reduce fertilization costs were all common. The use of fertilizers varied depending on the tree age, and it was more common to fertilize productive plants, than young non-productive plants.

Implementing integrated pest management practices was not common, as only roughly one out of three farmers reported they implemented a pest & disease monitoring system in the agricultural year of reference. In general, most farmers reported both insect pests and diseases affected the crop. Among these farmers, implementing methods to control these was not common (35.35% for insect pests and 36.27% for diseases). Further, the two most common diseases were leaf rust (58.19%) and anthracnose (13.65%), and the most common insect pest was the berry borer (51.45%).

Most farmers reported their coffee plots had shade trees and more than one-half of them said they managed the shade crop. Doing soil conservation practices was common, as was implementing cost-saving practices to control weeds (particularly using a weed-wacker and scheduling weeding activities).

Table S 1. Summary of key coffee results

Farmers (%)	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Applying fertilizer in baseline year	90.47	92	94.13	86.25	72.84	85.48
Of farmers who apply fertilizer, those that do so based on nutritional deficiencies	7.71	13.52	39.4	16.75	23.42	21.07
Of farmers who apply fertilizer based on nutritional deficiencies, those who do so based on visual characteristics of plant	40.9	16.07	72.15	75.40	62.60	60.67
Of farmers who apply fertilizer based on nutritional deficiencies, those who do so using soil analyses	59.09	83.92	27.84	24.59	37.39	39.32
Fertilizing young non-productive plants	2.59	16.26	15.63	12.35	8.17	11.37
Of farmers fertilizing young non-productive plants, those doing so at the recommended time of the year	0	1.11	1.38	1.25	0.36	0.84
Fertilizing productive plants	60.37	81.12	82.74	55.77	44.55	64.38
Of farmers fertilizing productive plants, those doing so at the recommended time of the year	21.10	33.19	33.48	15.16	1.92	19.06
Applying fertilizer at the recommended location -- under the treetop or in fertilization band	91.56	40.55	63.47	69.72	92.77	67.92
Fertilizing full recommended dosage	75.57	89.89	91.82	79.11	73.22	82.93
Applying cost-reducing, alternative fertilization inputs recommended by MOCCA	47.43	32.22	61.29	26.25	53.72	50.42
Implementing any pest & disease monitoring system	18.73	41.11	28.40	39.09	25.81	30.78
Reporting pests affected their crop	99.56	98.28	97.59	100	98.38	94.74
Of farmers reporting pests affecting their crops, those utilizing methods to control them.	45.39	7.36	29.35	24.17	60.02	35.35
Reporting diseases affected their crop	99.34	93.13	97.10	100	99.14	98.29
Of farmers reporting diseases affecting their crops, those utilizing methods to control them.	66.98	35.49	30.54	29.14	30.46	36.27
Producing coffee with shade	70.25	50.33	74.47	76.06	56.42	64.08
Of farmers producing with shade, those managing shade	59.49	54.06	46.83	63.98	59.97	57.03

Table S 1. Continued

Farmers (%)	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Implementing soil conservation practices	89.87	85.93	83.6	82.7	88.92	86.33
Of farmers implementing soil conservation practices, those using cost-saving practices to control weeds	50.63	73.33	58.07	91.46	76.36	71.59
Renovated coffee plants in the year of reference	11.42	17.2	14.28	43.94	28.4	24.13
Rehabilitated coffee plants in the year of reference	44.12	58.25	58.92	70.07	74.4	63.41
Planting density (# trees/ha)	2,315	5,366	5,296	4,617	4,540	5,461
Mean age coffee plants	6.88	8.27	6.78	4.73	5.73	6.39
Farmers harvesting	91.75	94.29	98.13	99.29	98.82	97.21
Of farmers harvesting, those doing so selectively	57.89	35.71	25.92	6.34	16.33	24.84
Of farmers harvesting, those classifying coffee cherries after the harvest	74.82	53.61	58.71	40.81	63.07	57.74
Of farmers harvesting, those milling coffee in the farm	11.70	46.59	31.85	81.99	79.32	55.2
Of farmers milling, those removing coffee cherry pulp using water saving practices	90.00	94.09	97.65	99.41	97.41	97.43
Of farmers milling, those treating pulp waste	90.9	92.27	87.95	68.85	94.27	86.17
Of farmers milling, those treating waste water from wet milling	25.00	42.47	72.09	51.74	69.44	60.23
Of farmers milling, those treating any other waste water	n.a	93.55	100	99.11	92.30	95.73
Of farmers milling, those Fermenting coffee beans	100.00	100	100	100	100	100
Of farmers milling, those drying coffee beans	100.00	88.17	17.98	30.72	96.69	61.52
Of farmers drying, those verifying coffee bean moisture	77.77	65.41	64.91	33.33	97.79	74.38
Farmers aware of their cup grade (taza)	3.83	4.67	18.03	2.13	55.85	21.68
Of farmers aware of cup grade, those receiving price premium due to cup quality	16.66	0.88	26.92	0	21.69	11.75
Farmers knowing 3 or more physical characteristics that determine quality	26.6	34.15	39.57	53.91	71.25	48.75
With farm certifications	1.27	3.77	34.19	34.36	83.70	38.33
Systematically registering costs of production	14.64	25.11	30.67	32.46	62.66	37.15

Farmers reported a planting density averaging 4,561 coffee trees per hectare. Most farmers reported growing only one coffee variety and it was not common to grow more than four varieties. In El Salvador, the three most commonly grown varieties were Catimor (which is a family of leaf rust tolerant varieties rather than a variety itself, though many farmers in several countries utilize this term when naming their variety), Sarchimor and Salvadoreño. In Guatemala, the most common varieties were Caturra, Catimor and Catuaí. In Honduras, the most common varieties were Catimores including Lempira and IHCAFE 90. Catimor was the most grown variety in Nicaragua and Peru.

Of the 35.85% of farmers reporting having seed beds in the year of reference, and the 19.41% managing a nursery, only 31.04% prepared their substrate mix for their seed germinators and almost three out of four farmers reported disinfecting the substrate mix they prepare. Knowing where to acquire certified or verified planting material was not common (only one out of five farmers reported knowing this), and buying seedlings from certified nurseries was rare. This is unsurprising since certification systems are lacking for coffee nurseries in the region. Despite not knowing where to acquire certified or verified planting material, 49.16% of farmers were willing to pay more for them. In the closest town, it is very common for farmers to purchase fertilizers, pesticides and herbicides, but not coffee planting materials.

Most farmers harvested coffee. Approximately 5% of surveyed farmers in Guatemala and 8% in El Salvador had not harvested in the baseline production cycle most likely because their trees were too young, as the average reported tree age was 1.64 years and 3.67 years, respectively. Although few of them (24.84%) did selective harvesting (and doing this was rare in Nicaragua), it was quite common to classify coffee cherries after the harvest (57.74%). Roughly 55% of farmers milled coffee in their farm and among them, removing the pulp using water saving practices, treating pulp waste, treating any other waste water and fermenting the beans was more common than treating waste water from wet milling or drying coffee beans in the farm. Among farmers drying the beans, verifying their moisture during drying was common (74.38%). Drying coffee beans was least common in Honduras and Nicaragua because farmers typically deliver wet parchment.[1]

Although family and hired labor participated in all ten categories of activities done in coffee plots, the activities where household members and hired labor participated the most were the harvest, weeding, fertilizer application.

Few farmers knew their coffee cup grade (though knowing this was more common in Peru), and of them, <12% reported receiving a price premium because of the cup grade. Roughly, 48.75% of farmers could name at least three physical factors that could affect the coffee quality. Further, 38.33% of the farms were certified and a similar number systematically registers the costs of production.

In general, few farmers (28.35%) requested a loan in the production cycles of interest, except in Nicaragua (68.21%), and farmers reported micro-financers were the main source for the loan.

[1] Although a similar share of farmers in Honduras delivered wet and dry parchment coffee.

Receiving information about coffee research was unusual, and among the ones who received information, the main source was thru non-governmental organizations.

Farmers harvested an average of 665 kg of green coffee/ha (equivalent to 0.665 MT/ha or 10.24 qq/mz) and sold an average of 1,706 kg of green coffee, obtaining a gross annual income of US$4,940. Farmers' main coffee buyers were intermediaries, followed by an anchor firm collaborating in MOCCA (though this varied by country). Coffee was the main source of agricultural and total household income. Additional yield and sales details are in Table S 2.

Table S 2. Coffee: summary of yields and sales

Variables	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Coffee area (ha)	3.54	1.11	3.03	4.05	2.55	2.74
Coffee yields (kg green coffee harvested/ha	187.0	698.6	826.7	746.0	682.3	665.03
Annual amount of coffee sold (kg green coffee)	369.2	950.9	1,969.0	2,907.4	1,839.5	1,706.3
Value of annual coffee sales (US$)	1,601	2,417	5,298	7,685	6,170	4,940
Farmers (%) whose main coffee buyer is an intermediary	71.79	73.91	60.07	15.51	30.38	48.51
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**

The multivariate regression results for the adoption of renovation practices show that in El Salvador, only the distance between the farm and the closest town (negative effect) statistically affected the probability of implementing renovation practices. In Guatemala, this probability was affected by making joint decisions about purchasing coffee inputs (negative effect), the number of coffee trees (positive effect at a decreasing rate), altitude (positive effect at a decreasing rate), obtaining information of coffee research products from NGOs or Government (negative effect), and the age of coffee trees (negative effect). In Honduras, only making joint decisions about purchasing coffee inputs (negative effect) and the index of productive assets (positive effect) had an effect on the probability of implementing renovation practices.

Meanwhile, in Nicaragua, selling coffee to MOCCA's anchor firms (positive effect), the number of coffee varieties grown (positive effect), having shade in the coffee plots (negative effect), and obtaining information of coffee research products from NGOs or Government (positive effect) affected the likelihood of adopting renovation practices. Finally, in Peru, adopting renovation practices was influenced by the number of coffee trees planted (negative effect), the distance between the farm and the closest town (positive effect), the altitude (positive effect), having a male household head (negative effect), and the index of productive assets (negative effect).

The multivariate regression results for the adoption of rehabilitation practices show that in El Salvador, the coffee area (positive effect) and the time it takes to get from the farm to the closest market where farmers can buy inputs (negative effect) statistically significantly affected the adoption of rehabilitation practices. In Guatemala, this was affected by making joint decisions (both heads) about which inputs to purchase for coffee (negative effect), the number of MOCCA practices implemented (positive effect), if a household member migrated six months prior to the interview (negative effect), receiving remittances (positive effect), obtaining information of coffee research products from NGOs or Government (positive effect), and the age of the coffee trees (positive effect at a decreasing rate).

This was quite different in Honduras, where the number of MOCCA practices implemented (positive effect), selling coffee thru MOCCA's anchor firms (positive effect), the number of coffee varieties grown (positive effect), the distance to the nearest town where farmers can buy inputs for coffee (negative effect), having shade with coffee (positive effect), the age of the coffee trees (positive effect at a decreasing rate), and the index of productive assets (negative effect) had a significant effect on this likelihood.

In Nicaragua, making joint decisions (both heads) about which inputs to purchase for coffee (negative effect), the number of MOCCA practices implemented (positive effect), having shade with coffee (negative effect), obtaining information of coffee research products from NGOs or Government (positive effect), the age of coffee trees (positive effect), and the index of productive assets (negative effect) all affected the probability of adopting rehabilitation practices.

Finally in Peru, the likelihood of implementing rehabilitation practices was determined by the number of MOCCA practices implemented (positive effect), selling coffee thru MOCCA's anchor firms (negative effect), the distance to the nearest town where farmers can buy inputs for coffee (negative effect), the age of the coffee trees (positive effect at a decreasing rate), having shade with the coffee crop (negative effect), the index of productive assets (positive effect), and obtaining information of coffee research products from NGOs or Government (positive effect).

The regression results for coffee yields show that in El Salvador, age of household head (positive effect at a decreasing rate), the number of coffee trees/ha (positive effect at a decreasing rate), the number of MOCCA soon-to-be promoted practices implemented (negative effect at an increasing rate), obtaining information of coffee research products from NGOs or Government (positive effect), the altitude (negative effect at an increasing rate), having access to agricultural credit (positive effect), receiving remittances (positive effect), and the interaction between migration and receiving remittances[2] (negative effect) all had an effect on coffee yields.

In Guatemala, having a male household head (positive effect), the number of coffee trees per hectare (positive effect at a decreasing rate), the number of MOCCA practices implemented (positive effect at a decreasing rate), receiving remittances (positive effect), the age of coffee trees

[2] This means we constructed a variable equal 1 for households reporting that at least one household member had migrated within six months prior to the interview and that also reported anyone in the households received remittances (but not necessarily from the member who migrated, as the questions were not directly related). All other households had a value of 0 in this constructed variable.

(positive effect), and obtaining information of coffee research products from NGOs or Government (negative effect) statistically affected this outcome variable. In Honduras, yields were affected by the number of MOCCA practices implemented (positive effect at a decreasing rate), having at least one household member migrating within the previous six months (negative effect), having access to credit (negative effect), making joint decisions (both heads) about which inputs to purchase for coffee (positive effect), and male headed households making joint decisions (with the spouse) about which inputs to purchase for coffee (negative effect).

In Nicaragua, only the number of coffee trees/ha had a statistically significant effect (positive at decreasing rate) on yields. Finally, in Peru, the following factors affected yields: the age of the household head (positive effect at a decreasing rate), the number of coffee varieties grown (negative effect), the share of coffee trees susceptible to leaf rust (negative effect), the number of farm certifications (positive effect), the age of coffee trees (positive effect at a decreasing rate), and the index of productive assets (positive effect).

Cacao results

In general, only men make the decision about which inputs for cacao to purchase. Farmers dedicated most of their land to grow cacao, in average, 2.4 ha. Ecuador has the largest production area per producer (3.58 ha) among MOCCA target countries, while Guatemala farmers reported growing the lowest cacao area (1.02 ha). Farmers harvested 352.80 kg of dry cacao per hectare. Among MOCCA target countries, Peruvian cacao farmers obtained the highest yield, of 451.84kg dry/ha (0.45 MT/ha or 6.9 qq/mz), followed by Guatemala (350.96 kg dry/ha). Cacao in El Salvador is a young sector (most farmers are still waiting for their first harvest and yields were the lowest). Across MOCCA target countries farmers average annual sales of $1,824 with Ecuadoran farmers obtaining the highest sales -- generating annual cacao sales of US$3,189, followed by $2,387 among Peruvian cacao farmers. In Central America, sales are significantly lower. In Honduras, Nicaragua and Guatemala annual sales are US$ 509, US $686.82 and US$ 501.76 respectively.

When we disaggregate yields and income from cacao sales by sex and age of the household head, most differences were not statistically significant in the countries, except in Honduras, where male-headed households had higher yields. Also, in Nicaragua, there is a substantial difference in the value of annual cacao sales, with more than US$ 500 among male and female head houses. In contrast, when disaggregating these two indicators by size of cacao area, although yields were statistically similar regardless of the farm size, farmers with larger cacao areas (> 5 ha) obtained higher income from cacao sales (as they planted 10.78 ha vs. 1.72 ha for farmers with ≤5 ha). The latter was true for most countries except Guatemala and Honduras.

Renovation and rehabilitation (R&R) is at the core of MOCCA project indicators. While in coffee, renovation refers only to replanting, in cacao it refers to both replanting and grafting. Governments and donors have financed many renovation and rehabilitation activities in the cocoa sector. This kind of prior investments in the sector may explain why some of these indicators are performing well at the baseline. 17.62% of cacao farmers reported having replanted cacao plants in the agricultural year of reference, while 14.89% of cacao farmers reported grafting. Among MOCCA target countries Peruvian farmers (19.34%) reported highest use of grafting practices, followed by Honduras (14.94%), Nicaragua (13.38%), Ecuador (11,01%), El Salvador (10.67%) and Guatemala (9,58%).

Rehabilitating cacao trees was more common, 81.80% of farmers reported this practice. Rehabilitation of cacao trees was most widely adopted in Honduras (95.40%), followed by Guatemala (91.78%), Peru (87.64%), Nicaragua (84.50%), El Salvador (69.90%) and Ecuador (66.07%).

85.95% of cacao farmers have a single plot, while 11.78% have two. A diagnostic of the main cacao plot showed that among MOCCA target countries the share of productive trees was 72.17%. El Salvador has the lowest share of productive trees (30.40%), which given that cacao production is relatively new in this country, is no surprise. The country with the highest share of productive trees was Peru (84.56%) followed by Ecuador (75.36%). The percentage of trees that need renovation (replanting and grafting) is low (10.53%).

Only 37.87% of farmers reported applying fertilizer in the agricultural year of reference (Table S3) and doing this was most common in El Salvador (86.40%) and Peru (45.45%) and least common in Guatemala (19.17%), Honduras (19.54%) and Nicaragua (17.61%). In El Salvador, the CRS-implemented Alianza Cacao project, which has helped thousands of farmers establish cacao, gives away free fertilizer to farmers, explaining the high adoption of this practice in this country. While fertilizing based on nutritional deficiencies or applying the fertilizer under the treetop or in the fertilization band was not common, most farmers that fertilize reported they applied the full amount of fertilizer the plants required, except in Guatemala, where farmers reported only applying organic fertilizers.

Table S 3. Summary of key cacao results

Farmers (%)	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Applying fertilizer in baseline year	27.11	86.40	19.17	19.54	17.61	45.45	37.87
Of them, % of famers fertilizing based on nutritional deficiencies	18.94	28.15	9.58	6.89	2.11	11.42	12.91
Of farmers who apply fertilizer based on nutritional deficiencies, those who do so based on visual symptoms	83.72	86.21	14.29	66.67	100.00	42.86	65.69
Of farmers who apply fertilizer based on nutritional deficiencies, those who do so based on soil analysis	16.28	13.79	85.71	33.33	0.00	57.14	34.31
Applying only chemical fertilizers	54.10	60.67	0	23.53	80.00	58.97	56.36
Applying only organic fertilizers	16.39	6.74	100	70.59	8.00	26.15	23.69
Applying chemical & organic fertilizers	29.51	32.58	0	5.88	12.00	14.87	19.95
Applying fertilizer under the treetop or in fertilization band	13.65	41.74	n.a.	3.44	n.a	32.63	23.61
Fertilizing full amount required	61.54	83.13	0	60.00	39.13	81.94	75.24
Implementing any pest & disease monitoring system	15.56	17.48	28.77	32.18	32.39	33.57	26.83
Reporting insect pests affected their crop	2.26	11.76	4.35	0	11	23.13	13.38
And using methods to control pests	20.00	7.14	27.27	0.00	33.33	87.50	66.66
Reporting diseases affected their crop	98.19	58.82	91.30	100	92	97.11	94.37
And using methods to control diseases	59.90	33.33	76.19	71.21	77.95	79.95	72.51
Producing cacao without shade (% plots)	27.00	0	2.25	5.71	20.42	60.89	35.62
And where shade trees were planted in past 2 years	7.67	11.01	7.87	20.00	24.64	17.34	16.02
Implementing floor management methods	61.23	59.22	60.27	86.20	73.23	89.74	76.15
Incorporating organic matter between cacao rows	66.96	63.10	76.71	65.51	23.23	61.07	58.90
Doing renovation practices	14.09	11.65	13.69	21.83	15.49	21.44	17.62
Doing rehabilitation practices	66.07	69.90	91.78	95.40	84.50	87.64	81.80
Doing a diagnosis of their farm or cacao crop	25.67	12.62	22.53	34.48	25.71	32.68	27.70
Planting density (# trees/ha)	819	762	890	722	615	1,064	887
Mean age cacao plants	21.15	3.46	12.42	13.38	10.84	9.29	11.72
Harvesting	94.67	39.81	94.52	74.71	91.55	94.17	87.06
Doing selective harvest	92.07	39.80	94.52	67.81	90.84	85.54	82.37
Removing cacao beans from pods within 3 days of harvest	95.77	67.50	72.46	82.81	90.76	90.84	89.02

Fermenting the beans	15.85	5.82	0	1.14	2.81	44.98	22.62
Drying cacao beans	97.23	100.00	n.a.	100.00	100.00	100	99.59
Verifying beans moisture	14.09	2.91	n.a.	0	1.40	44.06	21.30
Who can identify physical characteristics that affect cacao quality	62.22	31.06	38.35	56.47	54.92	65.03	57.23
With farm certifications	77.77	0	73.97	67.05	51.40	28.67	45.60

Farmers implementing pest and disease monitoring systems was not common, as roughly only one out of four farmers reported the implementation of this practice in the agricultural year of reference. While almost every farmer reported diseases affected the crop, few farmers reported the incidence of pest insects. Approximately 72.5% of farmers reported implementing methods to control diseases, and 66.6% reported controlling insect pests; however, this greatly varied by country. Peru stands out as the country with the highest rate of adoption of these practices.

Roughly, in one out of three plots there were no shade (accompanying) trees, and only in 16% of the plots with shade trees, new (shade) trees were recently planted. Implementing floor management practices (live or dead barriers, cover crops, using herbicides) was common, as was incorporating organic matter between cacao rows. In contrast, only 28% of farmers reported conducting an assessment of their farm or cacao crop to determine the types of pruning required (El Salvador was the lowest).

Farmers reported growing an average of 887 trees/ha (lowest in Nicaragua and highest in Peru). 78.51% of farmers surveyed grew only one variety of cacao, and less than <4% reported growing more than three varieties. However, this varied by country. For farmers growing more than >1 variety, 69.64% established them in rows by variety. In Ecuador and Peru, the three most commonly grown varieties were Nacional, CCN-51 and EET-103, and CCN-51, Criollo and Nacional, respectively. In El Salvador, these varieties were Trinitario, Criollo and ICS-95. In Guatemala and Honduras, the three most commonly grown varieties were Catie-R1, UF-676 and Catie-R6, and ICS 95, Forastero and ICS-1, respectively. In Nicaragua is Trinitario, Hibrido and Criollo.

Of the 11% of farmers managing a nursery in their farm, few select cacao seeds for planting and the same percentage of farmers in the sample (i.e., all farmers managing nurseries) prepare substrates for cacao nurseries. Most farmers do not disinfect the substrate mix. The most common source of seedlings is their own farm, and only 27% buy seedlings. Of the latter, roughly one-half purchased them from a certified nursery (although none in Guatemala a few farmers in Peru reported this). Of the farmers who did not purchase seedlings from a certified nursery, only 35% know where to acquire certified or verified plants. Almost three out of every four farmers purchasing seedlings were willing to pay more for a certified or verified genetic material.

Most farmers (except in El Salvador, where trees were still very young) harvested cacao. Among farmers who reported not having harvested in the year of reference, the most common reasons were a lack of resources or having to work outside the farm. Doing selective cacao harvesting and removing the cacao beans within three days after harvest are implemented by more than 80% of farmers, except in El Salvador. The latter is explained because, in this country, 60% of farmers do not yet have harvests. While 22.62% of farmers reported fermenting the cacao beans, no farmer in Guatemala and less than 2% of farmers in Honduras did this. Almost every farmer who fermented beans said they dry beans and of them, only one in five verify the moisture during this process (and Peru and Ecuador drive this average as doing this is practically inexistent in Central America). It is important to mention that most of the fermenting process is done in *centros de acopio;* this explains the low percentages. Drying and Fermentation are practices recommended for the organizations

Although family and hired labor participated in all ten categories of activities done in cacao plantations, the main activities where household members and hired labor participated the most were the harvest and weeding.

57.23% of farmers identified physical characteristics that affect the quality of their cacao. Slightly less than one-half of farmers have some form of certification, and organic certification is the most common one.

Access to financial services for cocoa farmers across countries is deficient (15.01%). The higher percent of cacao farmers with access to formal finance in Peru (20.75%) and Ecuador (15.56%) as compared with El Salvador and Nicaragua (2.91% to 6.34%%).

Farmers harvested an average of 352.80 kg of dry cacao/ha and sold an average of 1,824 kg of dry cacao, obtaining a gross annual income of US$1,047 Farmers' main cacao buyers were a cooperative or farmer organization (except in El Salvador and Peru), followed by an intermediary (this also varied by country). Cacao was the main source of agricultural and total household income.

The multivariate regression results explore the variables associated with the adoption of renovation and rehabilitation practices and yields by country and overall. It is interesting to observe that for the three regressions the significance of variables differs greatly across countries with only one instance in which a variable was significant for all countries in the same regression (number of MOCCA practices was significant and positive for all countries for adoption of rehabilitation practices). Across countries and regressions, joint decision-making, the implementation of MOCCA practices, the number of cacao varieties planted, age of cacao plantations, altitude, family member migration and sex of head of household appeared as variables that seem to explain adoption of R and R practices and/or yields. Interestingly, land ownership, distance to nearest town, remittances, credit, shade crops and sources of information on cacao seemed to be less important as determinants of adoption of R and R and yields.

ACRONYMS USED

ABC	Alliance Bioversity International and CIAT
CIAT	Centro Internacional de Agricultura Tropical or International Center for Tropical Agriculture
DiD	Difference in difference
ha	Hectares; 1 ha=10,000 square meters
LWR	Lutheran World Relief
m.a.s.l.	Meters above sea level
MOCCA	Maximizing Opportunities for Coffee & Cacao in the Americas project
mz	Manzana; 1 mz=7,000 squared meters
n.a.	not applicable (only used in tables)
qq	Quintal; 1 qq=100 lb
TNS	TechnoServe

I. INTRODUCTION

1 INTRODUCTION

The Maximizing Opportunities for Coffee & Cacao in the Americas (MOCCA) project seeks to help farmers overcome barriers that limit their capacity to renovate and/or rehabilitate (R&R) their coffee and cacao plants by increasing their productivity while improving their marketing capacity, incomes and livelihoods (TechnoServe, 2019). TechnoServe (TNS) is leading the Consortium, and also leading coffee activities, while Lutheran World Relief (LWR) leads activities in cacao. Other members of the Consortium include Initiative for Smallholder Finance (ISF) and World Coffee Research (WCR). The project, which is funded primarily by the United States Department of Agriculture (USDA) in addition to contributions from The J.M. Smucker Company, JDE, Keurig-Dr. Pepper, Peet's, Nespresso, McDonald's, and Kellogg, will implement cacao activities in Ecuador, El Salvador, Guatemala, Honduras, Nicaragua and Peru, and coffee activities in all countries with the exception of Ecuador.[3]

The International Center for Tropical Agriculture (CIAT) is leading the MOCCA project baseline assessment and evaluation. The evaluation will focus on project impact at two major levels: the **market systems level** to test systemic changes in the coffee and cacao market systems, and the **farmer level** to evaluate the effect among beneficiary households and at the aggregate project level. The **market systems level** baseline assessment, described in a separate document submitted to TNS in 2019, provided an assessment of the country specific cacao and coffee market systems including supporting functions, identifying stakeholders and their behavior within the market system in which MOCCA will operate in each country. That report also included recommendations on how MOCCA might engage in these market systems to achieve its desired results. We implemented the **farmer level** baseline assessment in 2020 and 2021 and separated the baseline survey implementation in two cohorts: 2020 and 2021. This document presents the results of the baseline assessment at the farmer level for both cohorts. The farmer level evaluation focused on indicators that will be reported to USDA and that require baseline quantitative data (e.g., use of certified materials, agronomy and R&R practices, farmer yields, financing, access to information) and used primary data collected thru interviews with farmers. The overall MOCCA evaluation uses a mix of qualitative and quantitative approaches that draw from monitoring, household survey, focus groups, and key informant data.

The baseline assessment at these two levels is complemented by several technical assessments completed by MOCCA consortium members, as illustrated in Figure 1. These additional studies include: (i) an assessment of the potential for long term financial services, completed in December 2019; (ii) an assessment of the institutional research capacity, new funding capacity, and research dissemination capability in MOCCA countries, completed in 2020; and (iii) an assessment of the technical and administrative capacity of nursery operators, completed in 2020.

The project's theory of change postulates that if farmers understand the benefits of R&R, possess the knowledge and skills, and have access to high-quality inputs and affordable financing, they will implement low-cost R&R practices. This will allow an increase in their profitability and catalyze a cycle of R&R investments that will lead to a more secure and sustainable supply of coffee and

[3] From now on, we refer to these as MOCCA countries.

cacao for U.S. and other regional and international markets (TechnoServe & Lutheran World Relief, 2018). To achieve this, MOCCA will focus on seven major activities: 1) increase farmer knowledge and skills thru training, 2) facilitate buyer-seller relationships, 3) facilitate research and disseminate findings, 4) develop agro-dealers and/or other input suppliers, 5) facilitate agricultural lending, 6) develop capacity of trade associations, and 7) build capacity of regional platforms. We considered these aspects during the design of the evaluation for the MOCCA project.

The main objective of this report is to present the farmer-level baseline results for all surveyed farmers (i.e., cohorts 1 and 2). This assessment provides a 'picture' of beneficiary farmers' situation prior to project implementation, regarding MOCCA's main quantitative indicators, focusing on adoption of crop management practices (including renovation and rehabilitation) promoted by the project, yields, marketing strategies, access to information and services, among other. The discussion is complemented with results of the market system level assessment carried out in 2019. This report is organized in five sections. Section two describes the methodology (evaluation design, sampling, instruments, training and data collection, and data analysis) used for the farmer level baseline evaluation. Sections three and four present descriptive and regression results for coffee and cacao farmers at baseline, respectively. The last section provides recommendations for MOCCA project monitoring activities.

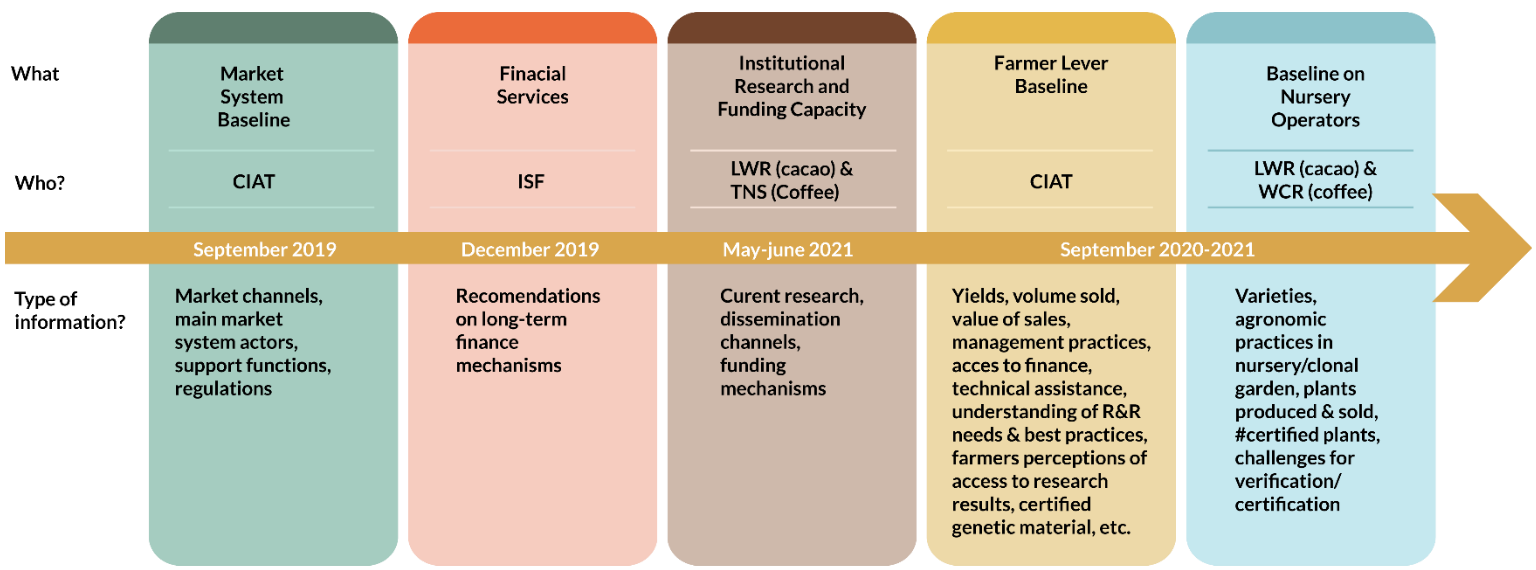

Figure 1. Assessment studies conducted in 2019-2021 under the MOCCA project

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II. METHODOLOGY

2 METHODOLOGY

In this section, we detail the methodology used for the quantitative farmer-level evaluation, focusing on the strategy followed for the baseline data collection.

2.1 Evaluation design

Although the original plan to evaluate the impact of the MOCCA project on farmers considered using a difference-in-difference (DiD) design with propensity score matching,[4] we could not follow this design as the pandemic caused by COVID-19 made difficult obtaining information from potential counterfactual ('control') farmers in time for baseline data collection. Thus, we followed a "contingency design" we had originally proposed, where we will be comparing beneficiary farmers prior and post project implementation. Under this contingency design, we are measuring the contribution of the MOCCA project implementation on the observed changes, as we cannot entirely attribute such changes to the project because we do not have a counterfactual. Although the main limitation of this design is that some of the changes we may observe when collecting endline data could have happened because of factors unrelated to MOCCA, we plan to document these potential external factors as much as possible (with farmer-level, monitoring and qualitative data) and control for them during the analysis. In the rest of this document, when we mention impact evaluation or evaluation, we refer to the contribution of the project on observed changes among beneficiary farmers.

The MOCCA project is implemented in collaboration with partners including anchor firms, government agencies, and lenders in each country, and for this, agreements are signed between the MOCCA consortium and these partners. Given that the MOCCA consortium could not establish all agreements when farmer-level baseline survey activities started, we divided survey implementation into two cohorts (Figure 2). In Cohort 1, we sampled farmers from partners with agreements signed prior to September 2020 and implemented the survey between September 2020 and February 2021. In Cohort 2, we sampled farmers from partners with agreements signed after September 2020 and implemented the survey between April and August 2021. This document presents farmer-level results for data collected for both cohorts.

[4] Under this design, baseline and endline data from beneficiary and non-beneficiary (from 'control' villages) farmers would first be matched (using propensity score matching) and then analyzed using difference in difference methods. This would have allowed us not only to attribute the changes to the project, but also to reduce the risk of biased estimations.

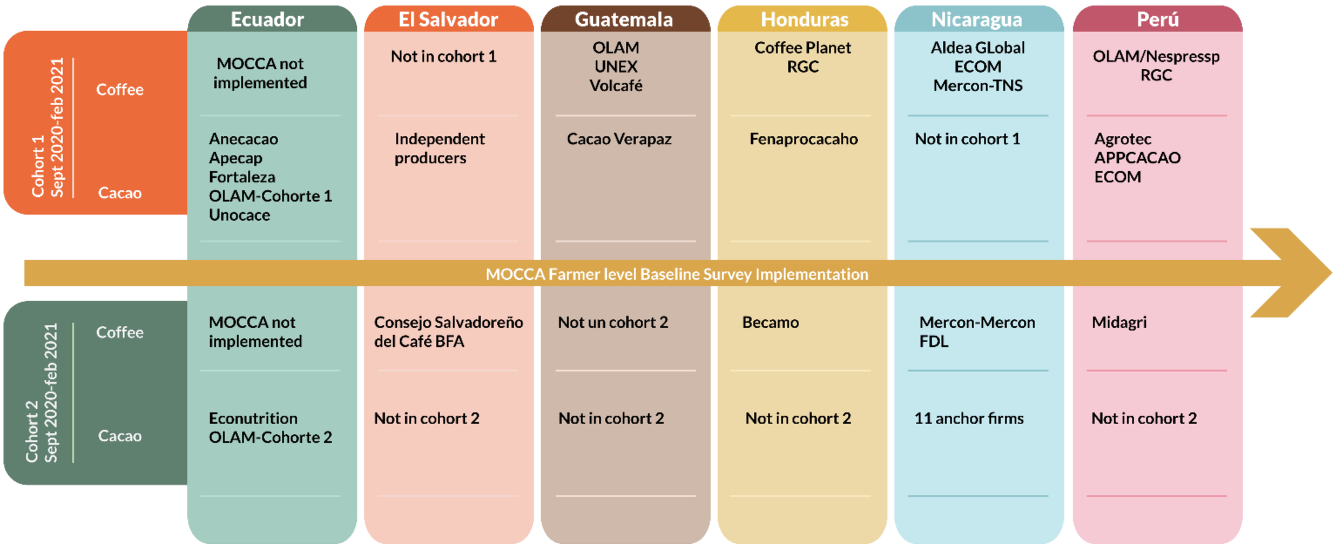


Figure 2. Farmer-level baseline survey implementation and anchor firms, by cohorts

2.2 Sampling methodology, sampling frame and sample

Originally, the MOCCA consortium had determined a sample size of 375 farmers per crop-country combination (six countries for cacao and five for coffee, for 11 crop-country combinations), for a total sample of approximately 4,125 farmers. However, during the evaluation design, for most[5] crop-country combinations we estimated the appropriate sample size using the following formula commonly used to estimate sample size using simple random sampling:

$$n = \frac{N * Z_{\alpha}^{2} * p * (1-p)}{d^{2} * (N-1) + Z_{\alpha}^{2} * p * (1-p)} \quad (1)$$

where *n* is the sample size, *N* the population of farmers that will be reached under MOCCA, Z_{α} is the z value at a 95% confidence level for a two tail normal curve (1.96), *p* is the proportion of farmers that will benefit from MOCCA (assumed at 0.5),[6] and *d* is the absolute precision level (assumed at 5%). Since we did not anticipate using simple random sampling due to cost considerations, we adjusted these estimations to account for a design effect (factor of 1.15)[7] and expected attrition (5%). Further, within each country, we distributed the sample size proportional to the square root of the population of each anchor firm, to better balance the representation of

[5] The exception was for cacao for the Central American countries, where we assumed the four countries were one region, and used this formula to estimate the sample size for the whole region (instead of for each country). Because of this, we performed the econometric analysis for Central America as a region, instead of for each country individually.

[6] We estimated the sample size using this formula prior to knowing that a counterfactual would not be possible to include.

[7] We assumed a primary sampling unit size of six (households) and intra-class correlation of 3%.

anchor firms with smaller beneficiary populations in the sample.[8] Table 1 shows the population (of expected MOCCA beneficiaries) and sample size for the evaluation of the MOCCA project per crop and country, for both cohorts, using the formerly described process.

Within each country, we identified the sample proportional to the municipality's population,[9] after excluding municipalities with less than 10 farmers, and farmers were identified at this level (not at the village level as originally proposed) because village level information was not available for all farmers in the sampling frame. We also identified replacement farmers at this level.

Table 2 presents the expected and realized sampling frame and sample size. As can be seen, the realized sampling frame was smaller than expected, because some farmer lists were not fully available at the time of sampling. This may have implications on the representativeness of our sample, but we will (in the future) conduct balance tests (if the data is available) to learn whether the 'unrepresented' portion of the population is systematically different from the population used as sampling frame, and determine how to minimize any bias this may cause in our inferences. Further, we were able to interview between 94.1% (cacao) and 108.7% (coffee; meaning we sampled more than expected) of the sampled farmers, completing 1,061 and 2,297 interviews for cacao and coffee, respectively.

Table 1. Population and sample size estimations for MOCCA evaluation, both cohorts

Sampling details	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Coffee							
Population	n.a.	5,000	9,000	7,600	11,033	6,800	**39,433**
Sample size	n.a.	430	445	441	447	437	**2,200**
Cacao							
Population	4,062	1,800	986	1,200	3,500	5,373	**16,921**
Sample size	385	106	101	86	148	432	**1,258**
Total sample	**385**	**536**	**546**	**527**	**595**	**869**	**3,458**

[8] In practice, this increases the proportion of smaller populations in the sample and decreases it for larger populations, thus balancing the representativeness of anchor firms with smaller target beneficiary populations.

[9] Except for cacao-Peru, where we identified the sample at the province level.

Table 2. Baseline sampling frame and sample size, cohort 1

Sampling	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Coffee farmers							
Sampling frame:	n.a.						
Expected		1,106	9,000	5,000	7,033	4,400	25,433
Realized		972	4,552	1,758	4,061	2,511	12,882
Sample size:							
Expected		344	445	441	447	437	2,114
Realized		316	455	427	422	677	2,297
Cacao farmers							
Sampling frame:							
Expected	3,151	1,800	864	1,200	3,500	5,373	12,388
Realized	3,894	1,878	489	532	1,406	4,284	11,077
Sample size:							
Expected	283	106	73	86	148	432	1,128
Realized	227	103	73	87	142	429	1,061

The sample at the project level included farmers from 81 coffee municipalities and 55 cacao municipalities[10] in cohort 1 and 46 coffee and cacao municipalities each in cohort 2 (Table A 1). As can be appreciated, the countries that included the most municipalities in the sample were Guatemala for coffee and El Salvador for cacao, and the ones with the least number of municipalities were Nicaragua and Guatemala for coffee and cacao, respectively. On average, sampled coffee farmers were located at a higher altitude (1,283 m.a.s.l.) than cocoa farmers (411 m.a.s.l.) Further, the proportion of male farmers in the sample was similar for both crops (75.91% for coffee and 74.74% for cacao) and enumerators took longer to complete the interview with cacao farmers (1.35 hr vs. 1.32 hr with coffee farmers). From now onwards, all the information refers to the full sample (i.e., both cohorts) of farmers unless otherwise specified.

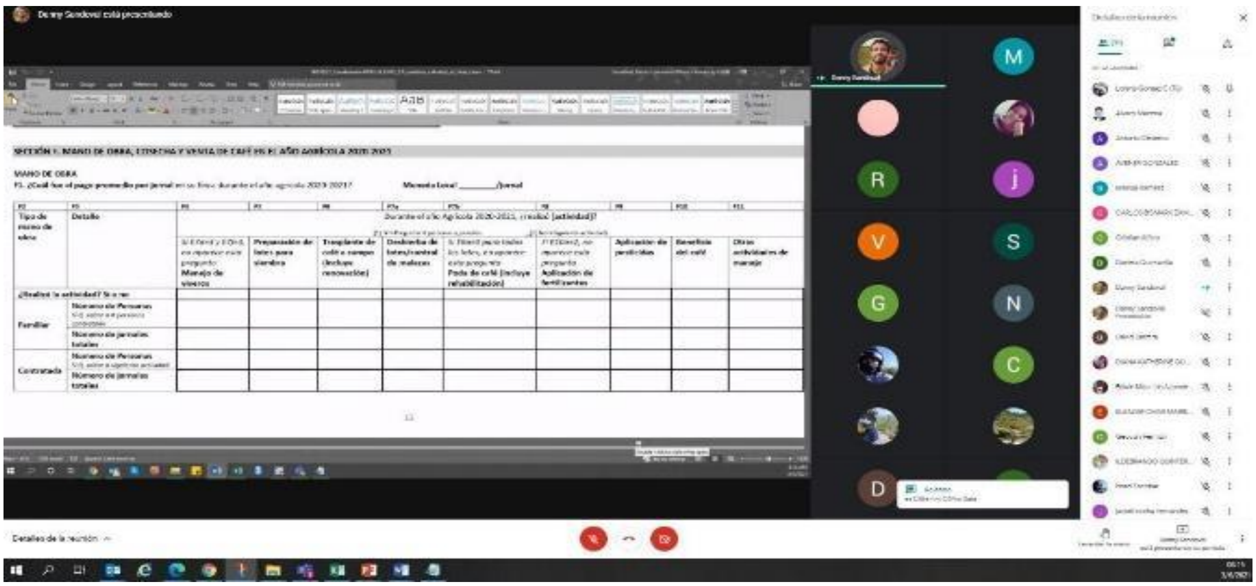
2.3 Instrument design

For data collection, we prepared structured instruments for coffee and cacao. While the coffee and cacao instruments included many identical sections (e.g., socioeconomic characteristics), they also differed to collect the appropriate information according to the crop (e.g., crop management), and to account for the differences in agricultural years between countries, and minor differences between cohorts.[11] The year of reference for almost every question[12] for cohort 1 was the 2019-2020 agricultural year and for cohort 2 was the 2020-2021 agricultural year, which for coffee and cacao included the period between February-January for Peru and May-April for Central American countries (i.e., considered months across two calendar years), and for cacao in Ecuador included

[10] Its equivalent for Ecuador is 'canton' and for Peru is 'district'.
[11] Instruments provided as nine separate annex documents, only in Spanish.
[12] For few questions, we inquired about the 12 months prior to the interview, or the previous two years, or without a time frame.

the period between January-December 2019. TNS and LWR staff validated these questionnaires so they will provide the needed information to respond to the MOCCA indicators, and to adapt it to the local culture and context of each country. To maintain consistency across countries, we prepared protocols for each main survey activity so field teams could follow these, which included: instructions for software installation and use, field manual for enumerators, field manual for supervisors, protocol to draw maps of the farm, and a video with instructions of how to identify sampling points in the main plot visited.

2.4 Training of enumerators, data collection and monitoring



Technicians[13] from the MOCCA project and its partners with experience in data collection collected the baseline data. This was possible because the interaction between these technicians and farmers at the time of data collection was minimal to non-existent, so we assume there will be no enumerator bias in the data.

CIAT, in collaboration with TNS, LWR and MOCCA staff conducted 19 virtual training sessions[14] and one in-person training session (in cohort 2) where enumerators, supervisors and project representatives/country coordinators participated (Table A 2). Each training lasted three full days and included a theoretical session where participants reviewed a printed version of the instrument, a practical session where participants used the software to review the questionnaire (as the interface is different than the printed version) and practice data entry, and a pilot session where enumerators interviewed a farmer not from the sample list. These sessions started on September 3 and ended on December 9, 2020 for cohort 1, and started on April 5 and ended in July 12, 2021 for cohort 2.

[13] These trainers will provide technical assistance and train farmers during MOCCA implementation. Within this document, we refer to them as enumerators.
[14] 14 in cohort 1 and 5 in cohort 2.

We programmed the instruments using CSPro® and enumerators used their project-provided phones to collect the data, soon after we finished the training. Enumerators had difficulties to upload the data on a daily base, because of network limitations; thus, they generally uploaded the data several days later, once a wireless connection was available. CIAT guaranteed data quality by performing weekly remote monitoring and sending a report to country teams, who partially addressed the inconsistencies identified in such reports. We performed additional data checks during the data-cleaning phase, and country teams helped clarifying these doubts.

Before proceeding, a few points are worth stressing about the data cleaning process. First, for many households in cohort 1, planted (coffee or cacao) area, amount harvested, amount sold and price received presented inconsistencies (after identifying outliers with values larger than three standard deviations from the mean). Second, to address this, together with TNS and LWR representatives we decided that, (a) LWR staff would call as many households as possible to confirm the cacao data, using a template prepared by CIAT. (b) TNS staff will also call farmers to confirm the coffee data, but for households included in their farmer registration database (they collected the same data for the same year of reference for some of the households with outliers problems) they will provide these data. The revised data were used in the analysis. This was not necessary in cohort 2, as the enumerators and country staff were able to clarify the doubts we had and it was not necessary to call farmers or use registration data.

Lastly, to comply with best practices regarding the protection of human subjects in research and data management, we obtained approval from CIAT's Institutional Review Board prior to the start of field activities (Annex 1) and trained enumerators accordingly so they follow these practices during data collection and management.

2.5 Data analysis

2.5.1 Strategy to complement with market systems assessment

While this document focuses mainly on the results from the farmer survey, where deemed appropriate, we have incorporated contextual information from the qualitative market-systems evaluation carried out in early 2019, to complement the observed results. A country level market systems analysis was carried out for each commodity in each of the MOCCA countries in order to understand the country level context within which MOCCA farmers operate, particularly in terms of the supporting market systems for finance, genetic material, research and technical assistance. MOCCA farmers, however, were selected within each country based on partnerships with selected partners such that the farmer level data presented here is representative not of the country level situation for farmers but of MOCCA beneficiaries, a subset of farmers. In this sense, the market system level analysis can sometimes help explain some of the variation found across countries where related to the overall context in which farmers operate, but it not the main determinant in most cases of farmer indicators at baseline. Taken together, the farmer and market systems level information at baseline can help inform strategies for improving outcomes for farmers considering the starting point for the different farmer beneficiary groups, the market systems level context in which those farmers operate, and additional indicators that seem to influence outcomes at baseline. Where appropriate, we have related key farmer level results to the existing country markets systems and analyzed how the latter might have affected farmer outcomes.

2.5.2 Descriptive statistics

Most of the analysis included descriptive statistics at the country level, and the project level (all countries combined), and we present mean values unless otherwise specified. Descriptive statistics allowed us to characterize the coffee and cacao-producing populations in the project's target intervention areas, and provides baseline values for both performance monitoring and the evaluation. For key MOCCA indicators, we present results disaggregated by sex of beneficiary farmer, age group (15-29 years of age vs. ≥30 years), area planted with the MOCCA crop of interest (≤5 ha vs. >5 ha), and by anchor firm. Further, for practices that MOCCA will promote we present results about the adoption of these practices at two levels: well and optimal, as defined in their training curriculum criteria.[15]

Although we constructed many variables, we detail a few we consider relevant for the readers to understand, next:

- Yields (kg harvested/ha): we estimated yields by dividing the amount harvested in green coffee or dry cacao by the area planted with each crop.
- Amount sold per area planted (kg sold/ha): we estimated this variable by dividing the amount sold in green coffee or dry cacao by the area planted with each crop.
- Income per area planted (US$/ha): we estimated this variable by dividing the income from coffee or cacao sales by the area planted with each crop and this variable refers to gross income.
- Income (US$): we estimated gross income from the crops of interest (coffee and cacao), agricultural income (includes coffee/cacao sales plus the sale of main two other crops), non-agricultural income (includes wages and remittances only), and total income (sums agricultural and non-agricultural income). Except for the income from the MOCCA crops, all other estimations should be read as a lower-bound estimate as they are not exhaustive.
- Index of assets: we estimated three indices, one for home assets (using ownership information for 7 assets), one for transportation assets (using ownership information for 3 assets), and one for productive assets (using ownership information for 11 assets). For this, we used Principal Component Analysis (PCA), following the methodology described by Filmer and Pritchett (2001) and McKenzie (2005). When using this method, by construction, the average value for the index is zero, and one interprets the sign and magnitude: negative values imply farmers are worse off in terms of the assets they own. We use these indices as a proxy for wealth and estimated it for the full sample (i.e., not per country), so the values provide a comparison across countries (these are the only variables estimated this way).

2.5.3 Multivariate regressions: Adoption of R&R practices and yields

To learn about the factors that may influence adoption of renovation and rehabilitation practices, and the factors that affect farmers' yields at baseline, we conducted multivariate analysis. In this section, we briefly detail the conceptual framework and empirical estimation done.

i. Conceptual framework and empirical estimation for adoption models

[15] Training curriculum details can be requested to TNS and LWR for coffee and cacao, respectively.

Following studies that study factors associated with the adoption of technologies in developing countries (Feder et al., 1985; Doss et al., 2003) and theoretical considerations (Gujarati, 2003), we assume that the farmers' decision to adopt or not a particular technology will be driven by the unobservable utility (U_i) derived from the technology, that is determined by one or more explanatory variables *X*. We denote U_i as:

$$U_i = X'_i \beta \qquad (2)$$

where X'_i is a vector of explanatory variables for the *ith* farmer. If we denote *Y=1* if the farmer adopts a technology and *Y=0* if it does not, we can assume that there is a critical level of the utility (U_i*), such that if U_i exceeds U_i*, the farmer will adopt the technology, otherwise she/he will not. This critical level U_i*, like U_i, is not observable, but if we assume it is normally distributed with the same mean and variance, it will be possible to estimate the parameters of the utility in (2). Given the assumption of normality, the probability that U_i* is less than or equal to U_i, can be computed as:

$$P_i = P(Y=1 \mid X) = P(U_i^* \leq U_i) = F(X'_i \beta) \qquad (3)$$

where *P (Y=1 | X)* means the probability that a farmer will adopt a technology, given the values of the independent variables X. Since our dependent variable is binary with 1 denoting adoption, and 0 otherwise, we estimate the model in (3) with a standard Probit regression to estimate the likelihood of adoption. Under this model, we are interested in the marginal effects of the independent variables on the dependent variable, and these are the values shown in the regression results.

ii. Conceptual framework and empirical estimation for yield models

We estimated a single-equation linear regression model to evaluate the factors that affect coffee and cocoa yields in farmers' fields. We assume that yields could be affected by the adoption of different technologies, access to inputs and services, experience, among other factors. Conceptually, yields of farmer *i* (Q_i) can be denoted by the function:

$$Q_i = F(X_i, K_i, W_i, F_i, Z_i, U_i,) \qquad (4)$$

where yield is a function of the use of inputs, X_i, the flow of services from the stock of knowledge (which can be represented by the adopted technologies), K_i, socioeconomic characteristics, W_i, financial-related variables, F_i, several quasi-fixed factors (like roads, communications, etc.), Z_i, and uncontrolled factors such as weather and pests, U_i (Alston et al., 1998, page 104). In this model, our dependent variable is continuous and positive, and we estimate (4) with Ordinary Least Squares (OLS) regression.

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III. RESULTS FOR COFFEE FARMERS AT BASELINE

3 Results for coffee farmers at baseline

In this section, we present the results for coffee farmers, divided in 11 sub-sections: decision making in the household, key MOCCA indicators, adoption of MOCCA-promoted practices, farm characteristics, access to and use of inputs and services, diagnostic of trees in the main coffee plot, coffee harvesting and income from coffee sales, other crops grown, socioeconomic characteristics, econometric regression results, and a summary. While we discuss the results for main variables (or indicators), we encourage the readers to see the tables and annex tables for more details.

3.1 Decision making in the household

To learn about decision making in the household, we inquired about how household heads took decisions for two key indicators, and whether the process was consultative. As we can see (Table 3), making joint decisions was rare, as only 19% of households reported making joint decisions about which farm inputs to purchase and 23.57% reported jointly deciding how to use the income from coffee sales. For these two indicators, joint decisions are more common in Peru (40% and 47.69%, respectively) and least common in Guatemala (5.95% and 6.9%, respectively). Further, it was more common for the male household head to take decisions about these two indicators alone (58.62% and 53.07%, respectively), compared to female household heads (13.77% and 14.31%, respectively), and in 63.66% of households, the household head took decisions about either of these two indicators alone.

While a particular decision could be taken alone or jointly, the process leading to that decision could be consultative; that is, the person(s) making the decision can consult with another household member or another person, and then decide (alone or jointly with the spouse or another person). Regarding the decisions about which farm inputs to purchase, in most male-headed households this decision was not consulted with anyone (42.07%) compared to female-headed households (10.81%), suggesting female-heads make this process more consultative. When consulting before taking the decision about which farm inputs to purchase, it was more common to consult with another household member (33.98%) and less common to consult with anyone outside the household. We observed the same trend in all countries. Table 3.

Table 3. Coffee: household decisions at baseline

Household (HH) decisions	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Decisions about which farm inputs to purchase (%):						
Male HH head only	53.51	70.95	71.60	73.52	36.00	58.62
Female HH head only	22.74	18.81	14.56	7.45	9.69	13.77
Both spouses	13.71	5.95	9.87	11.56	40.00	19.00
With whom did you consult to make decisions about which farm inputs to purchase? (%):						
No one, male headed HH	47.49	42.14	54.81	46.27	29.07	42.07
No one, female headed HH	21.73	10.23	13.08	5.14	8.15	10.81
Other HH member	14.04	26.90	18.51	37.07	55.53	33.98
Agricultural technician	10.03	2.61	2.71	5.91	2.46	4.20
Input supplier	1.33	9.04	2.46	4.37	2.61	3.97
Other	1.00	11.42	8.88	2.57	16.92	4.99
Who decided how to use the income from coffee sales (%)?:						
Male HH head only	51.50	67.85	62.96	66.83	29.84	53.07
Female HH head only	24.79	19.04	15.3	8.48	9.38	14.31
Both spouses	13.37	6.90	17.77	15.16	47.69	23.57
With whom did you consult to make decisions about spending coffee income? (%):						
No one, male headed HH	7.59	0.00	2.57	3.55	5.16	3.70
No one, female headed HH	8.54	0.00	2.34	14.21	5.90	1.65
My spouse	10.44	6.59	8.19	19.43	38.70	19.24
Farms (%) where inputs and coffee income use **decided** by:						
Household head only	71.57	85.47	75.80	70.43	34.30	63.66
Both heads	10.36	4.76	8.88	6.94	36.30	16.18
Farms (%) where decisions about inputs and coffee income use **consulted** with others:						
Household head only	69.23	52.38	67.90	51.41	37.23	52.88
Both heads	14.04	26.90	18.51	37.01	55.53	33.98
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**

3.2 Key MOCCA indicators

In this section, we first present key MOCCA indicators for each country, and then disaggregate these indicators by sex of household head, age category and size of the coffee area. For both coffee and cacao, USDA requests key indicators disaggregated by these variables using the following groups: (1) sex of household head: male vs. female headed households; (2) age of household head: 15-29 years vs. ≥30 years old; and (3) size of coffee area: ≤5 ha vs. >5 ha.

3.2.1 By country

On average, sampled farmers that will benefit from MOCCA reported growing 2.74 ha with coffee, ranging from 1.11 ha in Guatemala to 4.05 ha in Nicaragua (Table 4). Farmers reported harvesting 665 kg of green coffee per hectare (equivalent to 10.24 qq/mz), and yields were highest in Honduras (827 kg green coffee/ha) and lowest in El Salvador (187 kg green coffee/ha).[16] Further, few farmers (11.6%) stated they had access to financing for agriculture, and while less than 8% reported this in most countries, this was not the case in Nicaragua, where 38.44% reported having access to financing for agriculture.

Table 4. Coffee: MOCCA key indicators by country, at baseline

Key USDA indicators	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Yield (kg green coffee/ha)**	187.0	698.60	826.68	745.96	682.29	665.03
Coffee area (ha)**	3.54	1.11	3.03	4.05	2.55	2.74
Farmers (%) accessing financing for agriculture	1.7	4.1	7.35	38.44	7.13	11.61
Value of annual coffee sales (US$)**	1,600.77	2,416.74	5,297.50	7,685.43	6,170.36	4,939.76
Annual amount of coffee sold (kg green coffee)**	369.21	950.90	1,969.02	2,907.42	1,839.49	1,706.34
Farmers (%) with access to improved markets thru MOCCA's anchor firms	-	12.8	17.64	62.0	41.8	29.78
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**

*1 ha (hectare) = 10,000 square meters
** A total of 68 observations (18, 16, 19, 11 and 4 in El Salvador, Guatemala, Honduras, Nicaragua and Peru, respectively) were excluded for these variables because presented extreme values (much larger than 3 standard deviations above the mean, when estimating income from coffee sales/ha)

The amount of green coffee sold in the year of reference ranged from 369kg[17] (8.12 qq) in El Salvador to 2,907 kg (64 qq) in Nicaragua, with an average of 1,706 kg (37.5 qq) in the five countries. We observed a similar trend in the value of annual coffee sales, which averaged slightly

[16] To estimate yields in metric tons per hectare (MT/ha), divide values in kg/ha by 1,000. To estimate yields in quintals per manzana (qq/mz), multiply values in kg/ha by 0.0154.
[17] To estimate amount sold in quintals (qq), divide values in kg by 45.45.

above US$4,939 for all countries, ranging from US$1,601 in El Salvador to US$7,685 in Nicaragua. Given that these two variables directly depend on the coffee area planted, it is surprising that the amount sold is quite low in El Salvador, possibly explained by the low yields obtained. Finally, roughly 30% of farmers reported selling coffee to MOCCA's anchor firms, and it was more common for farmers in Nicaragua (62%) to sell to these firms, followed by Peru (41.75%), Honduras (17.64%) and far behind Guatemala (12.75%). The latter suggests that MOCCA could greatly benefit farmers by providing them access to improved markets through the anchor firms they collaborate with.

Based on the market system level analysis, we might have expected coffee farmers in Honduras to have the highest percent of farmers with access to financing given how relatively developed financial services for the coffee sector are in Honduras as compared to the other MOCCA countries. However, in the farmer sample for Nicaragua we find that farmers have the largest annual volumes sold and annual incomes from coffee as well as being more tightly linked with anchor firms who provide or facilitate access to finance. Greater coffee volumes and incomes plus a sales relationship with an anchor firm are all strong determinants of access to financing for farmers, suggesting that these may be as critical as the overall country financial services context in determining access to finance for farmers.

3.2.2 By sex of household head

Table 5 presents four of the key indicators discussed above, disaggregated by sex of household head. Although we observe statistically significant differences for most indicators when we average the information across all countries, these differences vary by country. Overall, male-headed households obtained higher yields (673 kg/ha vs. 611 kg/ha), had more access to financing for agriculture (12.36% vs. 6.55%) and obtained a higher value of annual coffee sales (US$5,311 vs. US$3,596). However, the differences in the coffee area planted and the share of farmers with access to improved markets thru MOCCA's anchor firms were not statistically significant at the 10% level. In El Salvador these indicators did not show statistically significant differences between male- vs. female-headed households. In Guatemala, male-headed households planted more area with coffee, obtained higher yields, had more access to financing for agriculture and obtained a much higher value of annual coffee sales, compared to female-headed households. While none of the differences between male- and female-headed households were statistically significant for these indicators in Honduras, male-headed households in Nicaragua had more coffee area and obtained a higher value of annual coffee sales.

In Peru, while male-headed households had more access to financing for agriculture and obtained a higher value of annual coffee sales, female-headed households had more access to improved markets thru MOCCA's anchor firms (Table 5). Finally, we provide detailed results for coffee area, yields and the value of annual coffee sales, disaggregated by anchor firm and sex of the household head, for El Salvador in Table A 3, Guatemala in Table A 4, Honduras in Table A 5, Nicaragua in Table A 6, and Peru in Table A 7. We encourage readers to review these tables for further information and as a reference, as we do not discuss these results.

3.2.3 By age category

For four of the indicators previously discussed, we estimated their averages disaggregated by the age of the household head comparing two age categories: heads 15-29 years of age (10.96% of sampled farmers) and heads 30 years or older (89.04% of sampled farmers) (Table 6). We observed statistically significant differences in the four indicators when averaged across all countries, and these differences varied by country. While older farmers planted more area with coffee (2.86 ha vs. 1.85 ha) and obtained a higher value of annual coffee sales (US$5,125 vs. US$3,447), these farmers had lower yields (652 kg/ha vs. 737 kg/ha) and fewer had access to financing for agriculture (11.09% vs. 15.98%) compared to younger farmers.

While none of the differences in these four indicators were statistically significant at the 10% level among Salvadorian and Guatemalan farmers, older Honduran and Peruvian farmers planted more area with coffee and obtained a higher value of annual coffee sales than younger farmers. Finally, in Nicaragua, we found statistically significant differences in all four indicators—older farmers planted more area and reported a higher value of annual sales, but obtained lower yields and fewer had access to financing for agriculture compared to their younger counterparts (Table 6).

3.2.4 By size of coffee area

We present results for three of the above indicators disaggregated by the size of the coffee area, comparing two groups: farmers with ≤5 ha (88.16% of sampled farmers) and farmers with >5 ha of coffee (11.84% of sampled farmers) (Table 7). Farmers with larger coffee areas reported lower yields and a higher value of annual coffee sales. While the former is possibly explained because it is easier to manage smaller areas, the latter was expected as larger farmers reported growing an average of 10.02 ha of coffee, compared to only 1.79 ha for farmers with ≤5 ha. We observed this same statistically significant trend for the value of annual coffee sales in all countries, and the same trend in yields in El Salvador and Nicaragua. Finally, we observed that the differences in the average coffee area between these two groups was largest in El Salvador (1.52 ha vs. 12.10 ha; an 10.58 ha difference) and smallest in Peru (2.28 ha vs. 7.15 ha; a 4.87 ha difference).

Table 5. Coffee: MOCCA indicators by sex of household head, at baseline

Key USDA indicators	El Salvador			Guatemala			Honduras			Nicaragua			Peru			All countries		
	Female	Male	p-value	Female	Male	p-value	Female	Male	p-value	Female	Male	p-value	Female	Male	p-value	Female	Male	p-value
Yield (kg green coffee/ha)	131.46	199.98	0.0199	572	723	0.0029**	850	822	0.6913	666	754	0.3204	788	657	0.1151	611.17	673.3	0.0480**
Coffee area (ha)	3.13	3.50	0.5556	0.80	1.23	0.0098**	3.04	3.00	0.9381	3.07	4.13	0.0851*	2.36	2.62	0.0867	2.39	2.82	0.2556
Farmers (%) accessing financing for agriculture	2.7	1.11	0.3151	0.93	4.73	0.0750*	7.36	7.14	0.9409	29.82	37.42	0.2722	4.02	8.13	0.0885*	6.55	12.36	0.0002***
Value of annual coffee sales (US$)	1556	1403	0.6239	1063	2846	0.0002***	5306	5200	0.8895	4729	8214	0.0954*	5407	6438	0.0470**	3596	5311	0.0000***
Farmers (%) with access to improved markets thru MOCCA's anchor firms	n.a.	n.a.	n.a.	12.14	12.61	0.8994	18.94	17.53	0.7537	52.63	62.88	0.1433	50.33	38.88	0.0127**	26.20	30.29	0.0746
Number of households	**111**	**179**		**107**	**317**		**95**	**308**		**57**	**326**		**57**	**326**		**519**	**1634**	
Note: p-value in parenthesis, and differences in means between groups are significant at the 10% level (*), 5% level (**) or 1% level (***)																		
*1 ha (hectare) = 10,000 square meters																		

Table 6 Coffee: MOCCA indicators by age of household head, at baseline

Key USDA indicators	El Salvador			Guatemala			Honduras			Nicaragua			Peru			All countries		
	15-29 yrs	≥30 yrs	p-value	15-29 yrs	≥30 yrs	p-value	15-29 yrs	≥30 yrs	p-value	15-29 yrs	≥30 yrs	p-value	15-29 yrs	≥30 yrs	p-value	15-29 yrs	≥30 yrs	p-value
Yield (kg green coffee/ha)	164.88	188.77	0.6887	775	691	0.2540	922	813	0.2228	944	714	0.0081***	573	693	0.2952	736.56	652.39	0.0179**
Coffee area (ha)	1.88	3.69	0.0737	0.88	1.14	0.2847	1.88	3.20	0.0757*	2.5	4.3	0.0036***	1.92	2.62	0.0007***	1.85	2.86	0.0000***
Farmers (%) accessing financing for agriculture	0	1.83	0.4873	4.44	4.07	0.9052	8.16	7.26	0.8215	51.72	36.26	0.0249**	4.54	7.42	0.3890	15.98	11.09	0.0248**
Value of annual coffee sales (US$)	1313	1628	0.5968	2349	2429	0.9057	3482	5543	0.0384**	4738	8170	0.0891*	3447	5125	0.0019***	3447	5125	0.0019***
Number of households	**26**	**272**		**45**	**393**		**49**	**358**		**58**	**353**		**66**	**606**		**244**	**1982**	

Note: p-value in parenthesis, and differences in means between groups are significant at the 10% level (*), 5% level (**) or 1% level (***)

*1 ha (hectare) = 10,000 square meters

Table 7. Coffee: MOCCA indicators by farm size, at baseline

Key USDA indicators	El Salvador			Guatemala			Honduras			Nicaragua			Peru			All countries		
	≤5 ha	>5 ha	p-value	≤5 ha	>5 ha	p-value	≤5 ha	>5 ha	p-value	≤5 ha	>5 ha	p-value	≤5 ha	>5 ha	p-value	≤5 ha	>5 ha	p-value
Yield (kg green coffee/ha)	209.74	99.77	0.004***	701	640	0.6107	836	768	0.4229	777	646	0.0656*	685	637	0.7455	681.72	540.81	0.002**
Coffee area (ha)	1.52	12.10	0.000***	0.89	7.21	0.000***	1.69	11.32	0.000***	2.34	9.57	0.000***	2.28	7.15	0.000***	1.79	10.02	0.000***
Value of annual coffee sales (US$)	1389	2479	0.009***	2069	12253	0.000***	3691	15191	0.000***	4373	18409	0.000***	5499	17716	0.000***	3754	13767	0.000***
Number of households	**240**	**58**		**424**	**15**		**351**	**57**		**314**	**97**		**636**	**37**		**1965**	**264**	

Notes: ha = hectares; p-values in parenthesis, and differences in means between groups are significant at the 10% level (*), 5% level (**) or 1% level (***)

*1 ha (hectare) = 10,000 square meters

3.3 Adoption of MOCCA-promoted practices

MOCCA developed a curriculum with the main crop management practices on which they will be training farmers. For coffee, this curriculum includes 17 modules and 42. However, some of these practices will be evaluated using alternative data sources, so for the farmer-level evaluation, we only considered 33 practices, which are summarized in Table A 8. Using this curriculum (July 24, 2020 version), we developed and included the appropriate questions in the data collection instruments to be able to evaluate the impact of MOCCA on most of these practices.

To read all tables in the rest of this section, the values of variables not indented represent values at the sample level. However, values of variables indented represent a sub-group; hence, are not at the sample level (instead, they are at a sub-sample level determined by the variable immediately above it). For example, the information about the percent of farmers doing renovation and/or pruning in their farm, and the percent of these farmers doing it well vs. optimally (all countries, Table 8) should be interpreted as: 68.7% of farmers in all countries reported doing renovation and/or rehabilitation, and of farmers who renovate and/or prune, 98.65% did it well and 1.34% did it optimally. To estimate the share of sampled farmers doing this well, you need to multiply both values (i.e., 68. 7% * 98.65% = 67.77%).

3.3.1 All practices

In this section, we summarize adoption of the 33 practices for which we present information for good and optimal levels of adoption. In every country, all farmers reported adopting at least one of the 33 practices (Table A 9). It was more common for farmers to adopt 11-19 practices (57.77% farmers) than 10 or fewer practices (29.64%) or 20 or more practices (12.58%). However, this varied by country and in El Salvador and Guatemala; it was more common to adopt 10 or fewer practices. Further, in Peru, a higher share of farmers reported adopting 20 or more practices than 10 or fewer practices (respectively, 20.23% vs. 11.37%), although adopting 11-19 practices was most common. On average, farmers reported implementing 14 of the 33 practices evaluated, ranging from 10 in El Salvador to 16 in Peru. However, farmers reported doing most practices well[18] rather than optimally (7 vs. 6 practices respectively), which suggest there is an opportunity for MOCCA to contribute to increase the number of practices that are adopted at optimal levels. In each country, the trend was the same.

3.3.2 Renovation and rehabilitation

MOCCA evaluates rehabilitation and renovation at two levels – doing it well refers to implementing each practice, while doing it optimally refers to implementing them based on a farm diagnostic. In the agricultural years of reference, 63.41% of farmers rehabilitated plants. Rehabilitation was more common in Peru (74.4%), followed by Nicaragua (70%), Honduras (58.92%), Guatemala (58.25%) and El Salvador (44.12%). Meanwhile in the agricultural years of reference, 24.13% of farmers renovated coffee. Renovating coffee was more common in Nicaragua (43.94% of farmers reported this), followed by Peru (28.4%), Guatemala (17.2%), Honduras (14.28%), and El Salvador (11.42%). It was more common to implement rehabilitation

[18] From now on, when we discuss doing a practice well vs. optimally, we refer to the criteria set by MOCCA in its curriculum.

practices than renovation practices, and although this varied by country, the same trend was observed in every country (Table 8).

Table 8. Coffee: adoption of Renovation & Rehabilitation practices at baseline

Renovation & Rehabilitation (R&R) MOCCA-promoted practices*	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Renovated coffee plants in year of reference	11.42	17.20	14.28	43.94	28.40	24.13
Of farmers renovating, % doing so optimally -- renovating based on production diagnostic tool	37.77	71.50	66.18	47.55	62.34	59.78
Rehabilitated coffee plants in year of reference	44.12	58.25	58.92	70.07	74.40	63.41
Of farmers rehabilitating, % doing so optimally -- rehabilitating based on production assessment	12.82	44.33	34.07	33.54	37.70	35.06
Farmers (%) utilizing a farm diagnostic tool	6.33	29.56	13.54	22.56	45.1	27.56
Of farmers utilizing diagnostic tool, % who used this tool to decide whether to prune	100	100.00	100.00	100.00	100.00	100.00
Of farmers who use diagnostic tool to decide whether to prune, % implementing a single pruning method	97.84	71.37	71.86	67.99	71.78	71.37
Of farmers who use diagnostic tool to decide whether to prune, % implementing 2 or more pruning methods	2.15	28.62	28.13	32.00	28.21	28.62
Number of households	**316**	**427**	**422**	**677**	**2297**	**427**
*Levels well or optimally as defined by MOCCA's criteria (see training curriculum for details)						

While only 24.4% of farmers reported utilizing a diagnostic tool in their farm, all of them said they use it to make pruning decisions (Table 8). Table 9 presents additional information about R&R practices. As we observe, only one out of four farmers reported renovating coffee during the agricultural years of reference. Few farmers consider it is not important to renovate coffee (Figure 3). Further, few farmers (12.34%) stated they had low to no knowledge about this practice. Farmers reported that the most common reasons to renovate coffee trees was the low yield of their crop (73.94%), followed by the low plant health (42.78%) and their plants died (33.16%).

Most farmers believe it is important to renovate coffee trees because it improves yields and the quality of their harvest (Table 9). Adopting R&R practices can be challenging, and we inquired about potential limitations for farmers to adopt these practices. As expected, a higher share of farmers reported there are limitations to adopt renovation practices (56.09%), compared to rehabilitation practices (46.39%) (Table 9; Figure 3). For both, the main limitation was having the economic resources to implement R&R practices, though this slightly varied across countries (Table 9). These results highlight the fact that to do R&R practices properly, farmers perceive they need financial resources and knowledge.

Table 9. Coffee: additional information about Renovation & Rehabilitation practices

Considerations	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Renovation						
Farmers (%) renovating coffee during the agricultural year of reference, and %...:	11.42	17.20	14.28	43.94	28.40	24.13
With low to no knowledge about this practice	14.28	8.57	13.33	10.74	14.89	12.34
Renovating coffee because of low yields	64.00	81.81	66.66	71.07	76.81	73.94
Renovating coffee because of poor plant health	20.00	28.78	48.88	42.14	52.17	42.78
Renovating coffee because of dead plants	32.00	16.66	28.88	28.09	47.10	33.16
Renovating coffee based on production diagnostic	8.00	9.09	0.00	3.30	10.86	6.83
Renovating coffee because of other reasons	0.00	0.00	0.00	4.13	5.79	3.29
Farmers (%) who think is important to renovate coffee in their farms, and...:	75.75	79.55	86.61	9.14	9.21	82.22
Reason 1 (and % farmers)	Improves yields (95.78)	Improves yields (87.36)	Improves yields (93.22)	Improves yields (86.79)	Improves yields (90.97)	Improves yields (90.50)
Reason 2 (and % farmers)	Improve coffee purchase price (8.02)	Improves quality of harvest (10.67)	Improve coffee purchase price (11.92)	Improves quality of harvest (30.31)	Improve coffee purchase price (37.90)	Improves quality of harvest (18.80)
Farmers (%) who consider there are limitations to adopt coffee renovation practices, and...:	7.68	51.11	37.55	59.47	59.34	56.09
Main reason (and % farmers)	Own economic resources (57.44)	Own economic resources (34.35)	Own economic resources (28.75)	Own economic resources (55.42)	Own economic resources (58.90)	Own economic resources (49.30)
Second reason (and % farmers)	Absence of labor force (40.63)	High implementation costs (18.26)	Own economic resources (24.81)	Access to credit (25.61)	Access to credit (32.29)	Access to credit (19.15)
Rehabilitation						
Farmers (%) rehabilitating during baseline year	44.12	58.25	58.92	70.07	74.4	63.41
Farmers (%) who consider there are limitations to adopt coffee rehabilitation practices, and...:	73.96	49.33	29.34	46.20	42.43	46.39
Main reason (and % farmers)	Own economic resources (59.17)	Own economic resources (25.68)	Knowledge about crop (42.50)	Own economic resources (52.81)	Own economic resources (52.03)	Own economic resources (43.31)
Second reason (and % farmers)	Absence of labor force (40.70)	Technical assistance (19.82)	Own economic resources (30.68)	Access to credit (16.54)	Technical assistance (32.59)	Own economic resources (23.40)
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**

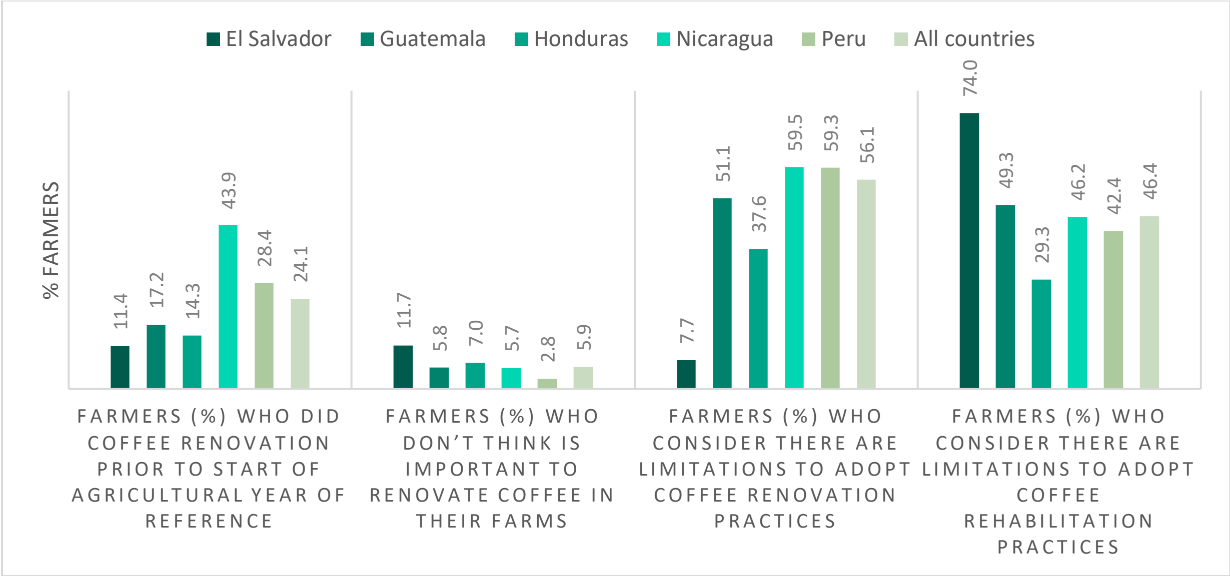


Figure 3. Coffee renovation & rehabilitation: beliefs and limitations, by country

3.3.3 Soil management

Regarding soil management practices, we focus on whether farmers implement soil conservation practices and consider two levels of adoption: doing it well if they do at least one MOCCA-recommended practice, and doing it optimally if they do two or more MOCCA-recommended practices.[19] We also discuss whether farmers implement cost-saving practices to control weeds at two levels: doing it well if they enact at least one practice, and doing it optimally if they implement two or more practices.[20]

Most farmers reported they implemented soil conservation practices and cost-saving practices to control weeds (Figure 4). This varied by country, and while doing the former was common in all countries, doing the latter was least common in El Salvador (50.63%) and Honduras (58.07%). Roughly 44% of farmers implemented soil conservation practices well (Figure 5), and this varied by country. While in Guatemala and Nicaragua more than one-half of farmers implemented this practice well, in Peru, El Salvador and Honduras, 62.12%, 63.73% and 63.86% of farmers respectively reported implementing it optimally, suggesting making an impact on the optimal adoption of this practice in these countries more challenging. Table 10 lists the soil conservation practices implemented, and as we can see, the most common one was covering the space between coffee rows with residues from weeding, followed by using dead covers.

[19] Includes live cover, dead cover and covering space between coffee rows with residues from weeding.

[20] Includes using a weedwacker, scheduling weeding activities, doing selective weed control and using herbicides.

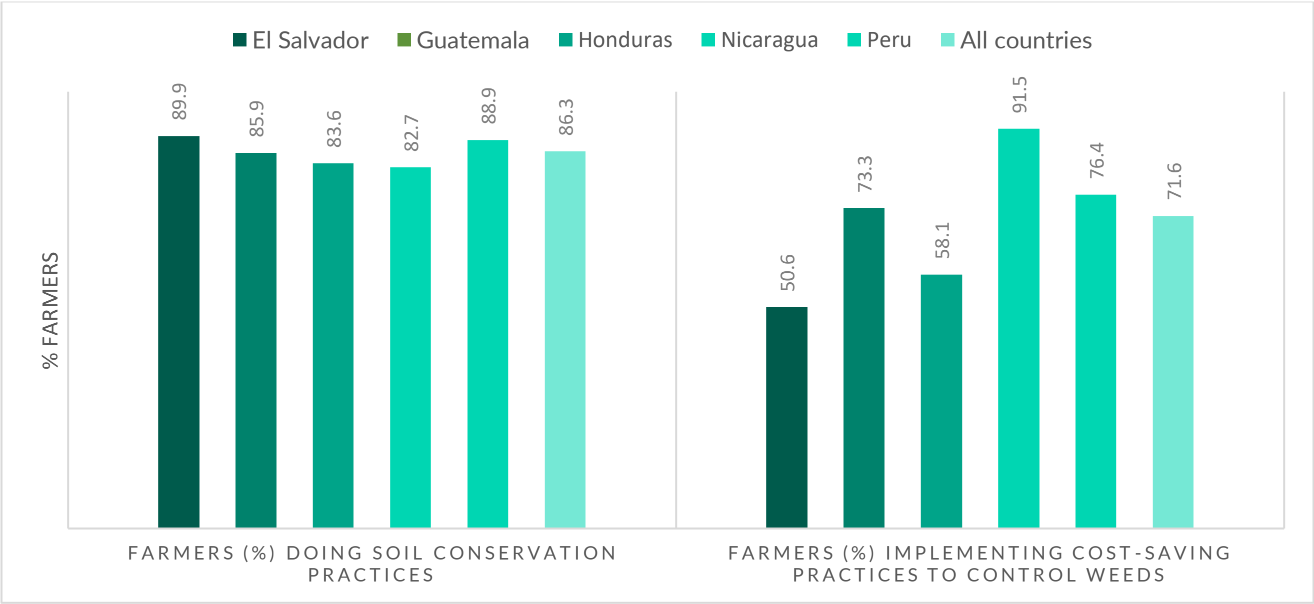


Figure 4. Coffee farmers doing soil conservation and weeding practices, by country

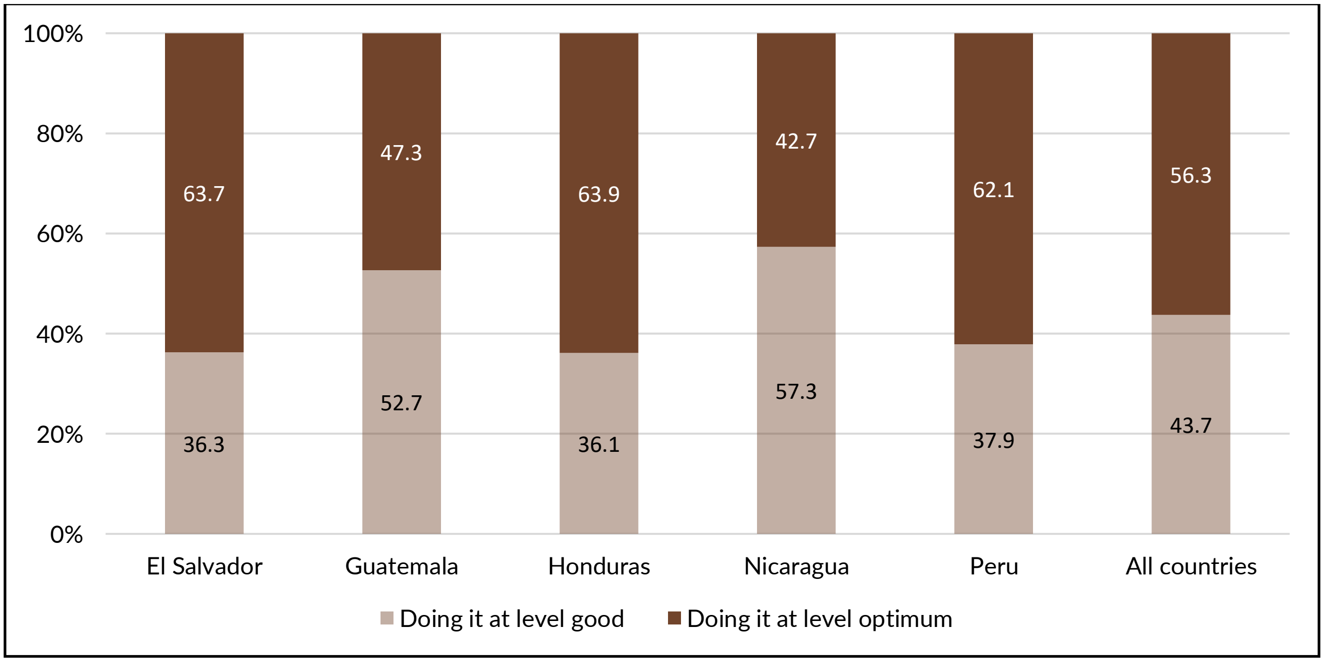


Figure 5. Coffee farmers doing soil conservation practices, by level

Regarding the implementation of cost-saving practices to control weeds, although slightly more than one-half of farmers (51.61%) implemented this well, the implementation at this level was more common in Peru (67.11%) and El Salvador (61.25%). In the other two countries, it was slightly more common to implement it optimally (Figure 6). Details about the types of cost-saving practices implemented are in Table 10. We observe that using a weed-wacker is more common (especially in Peru), followed by scheduling weeding activities and doing selective weed control. Finally, although the use of herbicides was less common, among farmers doing this, applying herbicides focalized (using a screen or other equipment) was common, as 54.13% of the farmers who applied herbicides reported doing this.

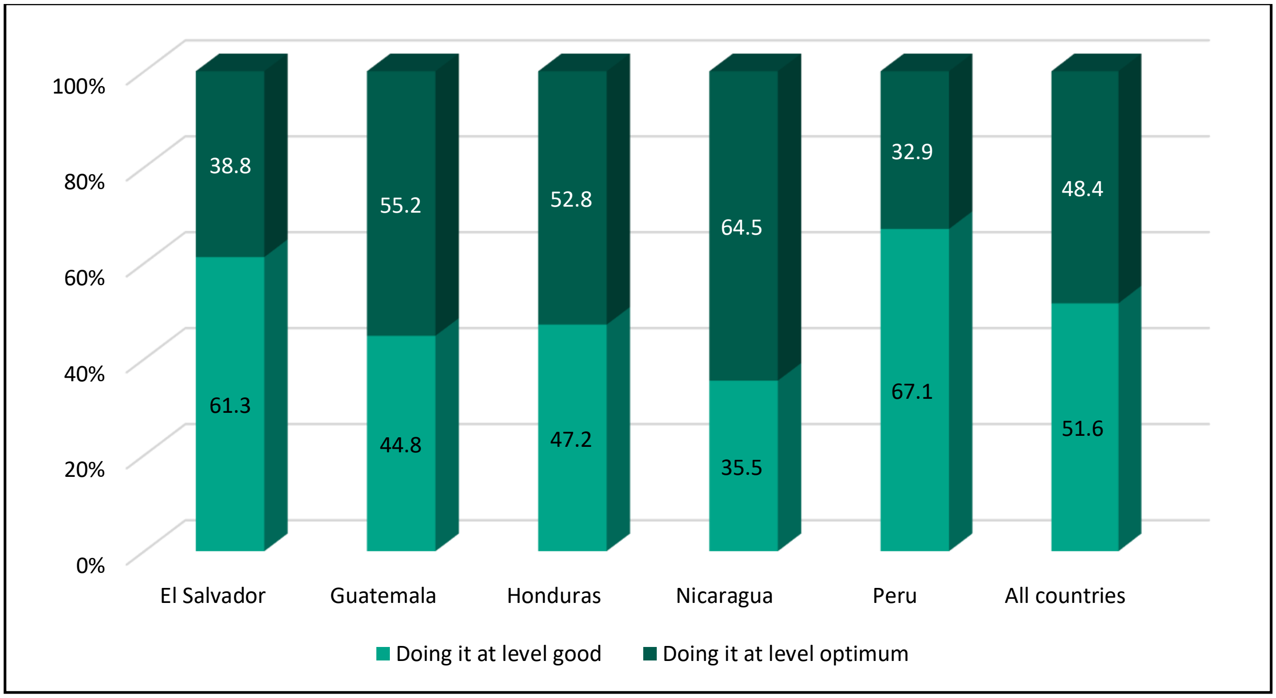


Figure 6. Coffee farmers implementing cost-saving practices to control weeds, by level

Table 10. Coffee: adoption of soil management practices at baseline

Soil management MOCCA-promoted practices*	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Implementing soil conservation practices	89.87	85.93	83.60	82.70	88.92	86.33
Applying one soil conservation practice recommended by MOCCA	36.26	52.68	36.13	57.30	37.87	43.67
Applying one soil conservation practice recommended by MOCCA	63.73	47.31	63.86	42.69	62.12	56.32
Types of soil conservation practices implemented (% farmers):						
Live cover	12.97	16.26	38.87	28.43	32.64	27.07
Dead cover	63.92	45.71	58.31	55.92	74.44	60.9
Cover space between coffee rows with residues from weeding	83.22	78.22	78.22	61.84	69.42	73.29
Of farmers implementing soil conservation practices, those using cost-saving practices to control weeds	50.63	73.33	58.07	91.46	76.36	71.59
Applying one cost-saving practice to control weeds recommended by MOCCA	61.25	44.84	47.17	35.49	67.11	51.61
Applying 2 or more cost-saving practices to control weeds recommended by MOCCA	38.75	55.15	52.82	64.50	32.88	48.38
Types of cost-saving practices implemented to control weeds (% farmers):						
Use of weed-wacker (or trimmer)	13.18	44.36	27.85	17.20	67.76	39.02
Schedule weeding activities	29.74	34.88	30.67	45.49	31.9	34.46
Selective weed control	29.74	34.88	30.67	45.49	31.9	34.46
Use of herbicides, and...:	19.3	32.22	19.2	75.11	0	26.39
If used herbicides, applied it focalized (% yes)	64.51	42.1	61.62	55.83	n.a.	54.13
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**
*Levels well or optimally as defined by MOCCA's criteria (see training curriculum for details)						

3.3.4 Plant nutrition

In this section we discuss nine of the practices described in the MOCCA curriculum, and for each, we provide information for two levels of adoption: doing the practice well and doing it optimally.

Fertilizing based on nutritional deficiencies

Among coffee farmers fertilizing based on nutritional deficiencies, a good level of adoption means using a table of visual symptoms while an optimal level of adoption involves conducting a soil analysis.

Most farmers (85.48%) reported applying fertilizers in the agricultural year of reference (Figure 7). Fertilizing based on nutritional deficiencies was not common (only one of every five farmers did this), and among farmers fertilizing based on nutritional deficiencies only 39.32% use soil analyses. The country where the highest share of farmers fertilizing based on nutritional deficiencies was Honduras (39.4%), though just 27.84% of these farmers conducted soil analyses (or 10.96% of all farmers who fertilize). Following Honduras was Peru (23.42%), where 37.39% of farmers fertilizing based on plant nutritional deficiencies conducted soil analyses (or 8.76% of farmers who fertilize). The country with the lowest share of farmers fertilizing based on nutritional needs was El Salvador, where only 7.71% do so, and of those who do, 59.09% conducted soil analyses, equivalent to 4.56% of farmers who fertilize their coffee plants (Table 11).

Frequency, timing, and fertilization dosage of young, non-productive plants

When evaluating the frequency of fertilization of young, non-productive plants, a good level of adoption corresponds to fertilizing 3 times per year, while an optimum level of adoption corresponds to fertilizing 4 times per year. When analyzing whether farmers are applying fertilizer to young non-productive plants at the right times, MOCCA recommends at both good and optimal levels applying fertilizer between May and November in Central America and between September and March in Peru. Finally, when considering the dosage or amount of fertilizer farmers apply, a good level of adoption is achieved by farmers applying some but not the entire dosage required by the plant, while an optimal level of adoption is obtained by applying the entire dosage required by the plant.

11.37% of coffee farmers fertilized young, non-productive plants, and of these 89.93% applied fertilizer three times per year (good adoption level) and 10.06% fertilized them four times a year (optimal adoption level). The country with the most optimal frequency of fertilization was Peru (15.38%), while the country with the lowest number of farmers applying fertilizer four times per year was El Salvador (0%). Only 0.84% of coffee farmers fertilized young non-productive plants at the right times. 17.06% of coffee farmers applied a partial dosage and 82.93% applied the entire dosage required by plants as per MOCCA recommendations. The country where the highest share of farmers adopted an optimal dosage was Honduras (91.82%), while the country where the lowest share of farmers adopted an optimal dosage of fertilizer was Peru (73.22%).

Frequency, timing, and fertilization dosage of productive plants

When evaluating the frequency of fertilization of productive plants, a good level of adoption corresponds to fertilizing twice a year, while an optimum level of adoption corresponds to fertilizing three times a year. MOCCA evaluates the timing and fertilizer dosage applied to productive plants in the same way it does for young, non-productive plants.

64.38% of coffee farmers applied fertilizer to productive plants, and 86.57% of coffee farmers fertilized productive plants two times per year while 13.42% fertilized them three times per. The country with the highest share of farmers applying fertilizer to productive plants at an optimal frequency was Nicaragua (15.15%), while the country with the lowest share of farmers applying fertilizer to productive plants at an optimal frequency was El Salvador (7.36%).

Location of fertilizer application

When considering whether farmers are applying the fertilizer in the best location, where the plant will be best able to make use of it, a good level of adoption corresponds to using a broadcast application near the roots, while an optimal level of adoption corresponds to applying it directly under the treetop (la copa), or if diluting fertilizer, applying in the fertilization band.

67.92% of farmers reported applying the fertilizer under the treetop or in the fertilization band (optimal adoption), and all remaining farmers broadcasted it randomly close to the roots (good adoption). However, almost every farmer in Peru and El Salvador reported an optimal level of fertilizer application form (Table 11), which suggests that MOCCA should not dedicate efforts to train farmers on this technique in these countries.

Use of alternative methods to reduce fertilization costs

Farmers applying one alternative fertilization method to reduce cost – including the use of organic fertilizer prepared with farm waste, mountain microorganisms, coffee pulp, or diluted fertilizer apply alternative methods at what MOCCA considers a good adoption level. An optimal level of adoption requires applying more than one of the above-mentioned approaches to reduce fertilization costs.

Only 50.42% of farmers said they used methods to reduce fertilization costs, and almost everyone did this well (Table 11), suggesting there is an opportunity for MOCCA to train farmers on how to do this, and how to do it optimally.

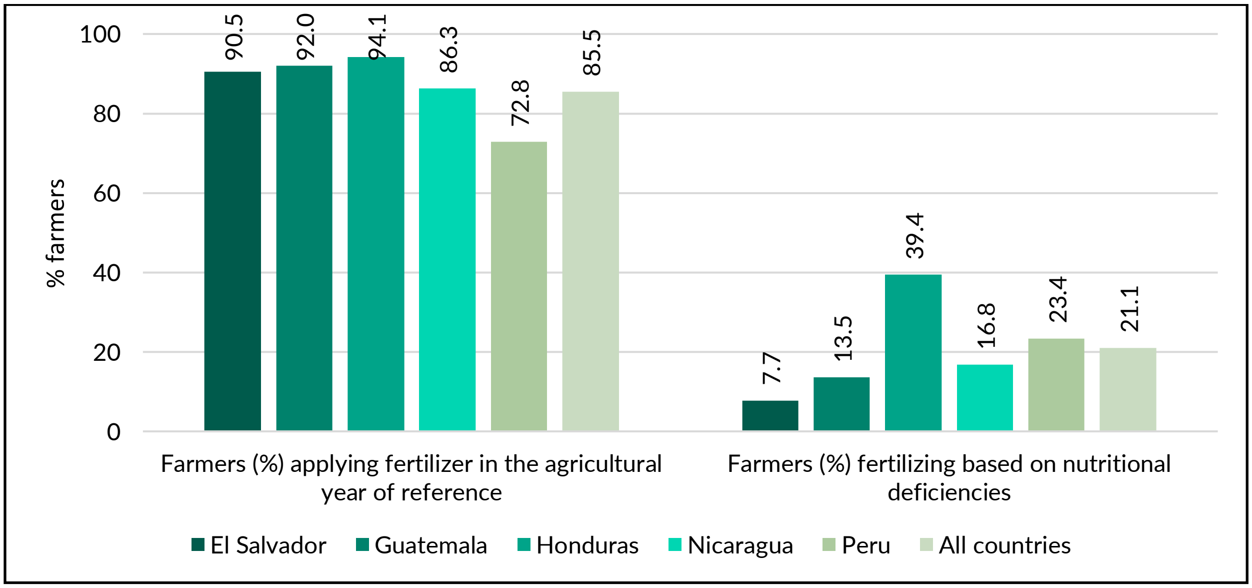


Figure 7. Coffee farmers applying fertilizers to coffee, by country

Table 11. Coffee: adoption of crop nutrition practices at baseline

Nutritional MOCCA-promoted practices*	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Applying fertilizer baseline year	90.47	92.00	94.13	86.25	72.84	85.48
Of farmers who apply fertilizer, those that do so based on nutritional deficiencies	7.71	13.52	39.40	16.75	23.42	21.07
Of farmers who apply fertilizer based on nutritional deficiencies, those who do so based on visual symptoms	40.9	16.07	72.15	75.40	62.60	60.67
Of farmers who apply fertilizer based on nutritional deficiencies, those who do so using soil analyses	59.09	83.92	27.84	24.59	37.39	39.32
Fertilizing young non-productive plants	2.59	16.26	15.63	12.35	8.17	11.37
Of farmers fertilizing young non-productive plants, % who do so 3 times a year	100.00	87.23	92.10	93.93	84.61	89.93
Of farmers fertilizing young non-productive plants, % who do so optimally -- 4 times a year	0.00	12.76	7.89	6.06	15.38	10.06
Of farmers fertilizing young non-productive plants, those doing so at the recommended time of the year	0	1.11	1.38	1.25	0.36	0.84
% who do so at the recommended time of the year	100.00	100.00	100.00	100.00	100.00	100.00
Fertilizing productive plants	60.37	81.12	82.74	55.77	44.55	64.38
Of farmers fertilizing productive plants, % who do so 2 times a year	92.63	85.22	86.50	84.84	85.71	86.57
Of farmers fertilizing productive plants, % who do so optimally -- 3 times a year	7.36	14.77	13.49	15.15	14.28	13.42
Of farmers fertilizing productive plants, those doing so at the recommended time of the year	21.20	33.18	33.48	15.16	1.92	19.06
Fertilizing between May-June and July-September (level good)	11.94	3.97	1.39	6.25	0.00	4.56
Fertilizing between May-June, July-September and Sept-Oct (level optimal)	88.05	96.02	98.60	93.75	100.00	95.43
Farmers (%) fertilizing the...:	63.38	65.76	66.58	87.05	72.09	71.32
Partial amount required (level well)	24.22	10.11	8.17	20.88	26.77	17.06
Full amount required (level optimal)	75.57	89.88	91.82	79.11	73.22	82.93
Farmers (%) spreading the fertilizer...:	98.03	99.25	100	99.44	100	99.39
Randomly close to roots (level well)	8.43	59.45	36.52	30.27	7.22	32.07
Under the treetop or in fertilization band (level optimally)	91.56	40.54	63.47	69.72	92.77	67.92
Applying cost-reducing, alternative fertilization inputs recommended by MOCCA	47.43	32.22	61.29	26.25	53.72	50.42
% using at least one method to reduce fertilization costs (organic fertilizer prepared with farm waste, OR dilutes fertilizer)	100.00	100.00	100.00	90.47	100.00	99.62
% who do so optimally -- uses two or more methods to reduce fertilization costs (organic fertilizer with farm waste AND dilutes fertilizer)	0.00	0.00	0.00	9.52	0.00	0.38
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**

*Levels well or optimally as defined by MOCCA's criteria (see training curriculum for details)

3.3.5 Integrated pest management

In this section we discuss three of the practices described in the MOCCA curriculum, and for each, we provide information for two levels: doing the practice well, and doing it optimally. For farmers implementing any pest & disease monitoring system, doing it well means they implemented such system, and doing it optimally means they applied a standardized (pest & disease) sampling protocol. For farmers using methods to control pests, doing it well means using at least one method for each pest identified, and doing it optimally means using more than one method for each pest identified. For farmers using methods to control diseases, doing it well means using at least one method for each disease identified, and doing it optimally means implementing a strategy according to the disease identified.

To implement an integrated pest management, several factors are necessary, including having a pest & disease monitoring system and using the appropriate methods to control pests. Only 30.78% of farmers reported they implemented a pest & disease monitoring system in the agricultural year of reference, and the proportion of farmers reporting this was highest in Guatemala (41.11%), followed closely by Nicaragua (39.09%), Honduras (28.4%), Peru (25.81%) and far behind by El Salvador (18.73%) (Table 12). While most farmers reported insect pests and diseases affected their coffee crop, using methods to control pests and to control diseases was not common (35.35% of farmers reporting insect pests affected their crop used methods to control them and 36.27% of farmers reporting diseases affected their crop used methods to control them) (Figure 8). In Figure 9, Figure 10 and Figure 11 we illustrate, among farmers implementing these three practices, the level at which farmers do them.

Finally, while few farmers (17.97%) reported an incidence of berry borer in their coffee crop, this pest was slightly more problematic in Peru and Honduras, followed by Nicaragua, El Salvador and Guatemala. In every country, all farmers reporting berry borer incidence in their crop mentioned they did field evaluations when controlling this pest (Table 12).

Table 12. Coffee: adoption of integrated pest management practices at baseline

Integrated Pest Management (IPM) MOCCA-promoted practices*	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Implementing any pest & disease monitoring system	18.73	41.11	28.40	39.09	25.81	30.78
% of farmers implementing pest & disease monitoring, % doing so at good level of adoption -- monitoring pest and disease incidence	16.94	7.56	6.61	6.06	18.39	10.51
% of farmers implementing pest & disease monitoring, % doing so at good level of adoption -- monitoring pest and disease incidence	83.05	92.43	93.38	93.93	81.6	89.48
Reporting pests affected their crop	99.56	98.28	97.59	100	98.38	94.74
Of farmers reporting pests affecting their crops, those utilizing methods to control them.	45.39	7.36	29.35	24.17	60.02	35.35
Of farmers using control methods, % using 1 for each pest identified	59.44	72.72	79.67	69.60	88.36	78.81
Of farmers using control methods, % using more than one for each pest identified	40.5	27.27	20.32	30.39	11.63	21.11
Reporting diseases affected their crop	99.34	93.13	97.10	100.00	99.14	98.29
Of farmers reporting diseases affecting their crops, those utilizing methods to control them.	66.98	35.49	30.54	29.14	30.46	36.27
Of farmers using control methods, % using 1 for each disease identified	59.24	85.53	78.12	65.85	92.68	76.51
Of farmers using control methods, % using more than one for each disease identified	40.75	14.46	21.87	34.14	7.31	23.48
Farmers (%) reporting berry borer incidence, and % farmers...:	12.65	6.15	23.41	18.95	24.37	17.97
Doing field evaluations to control berry borer	100.00	100.00	100.00	100.00	100.00	100.00
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**
*Levels well or optimally as defined by MOCC1A's criteria (see training curriculum for details)						

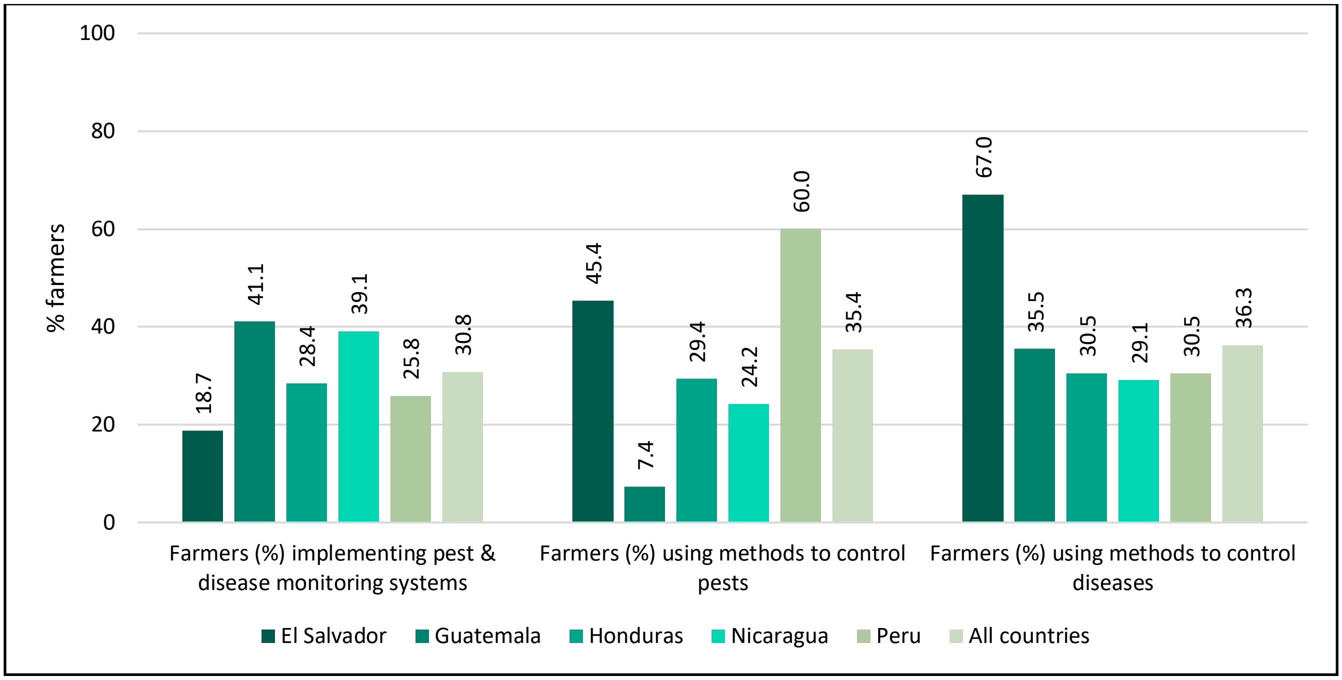


Figure 8. Coffee: pest & disease monitoring systems and control methods, by country

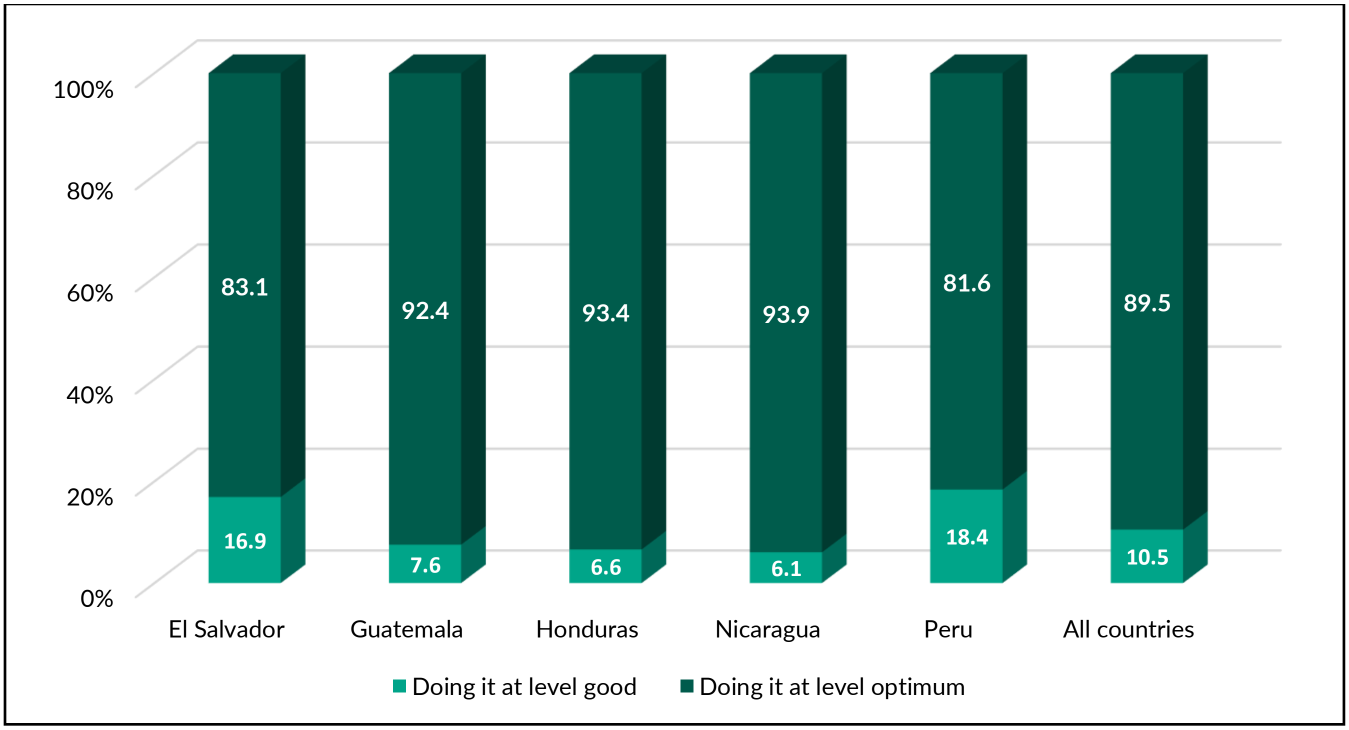


Figure 9. Coffee farmers implementing pest & disease monitoring systems, by level

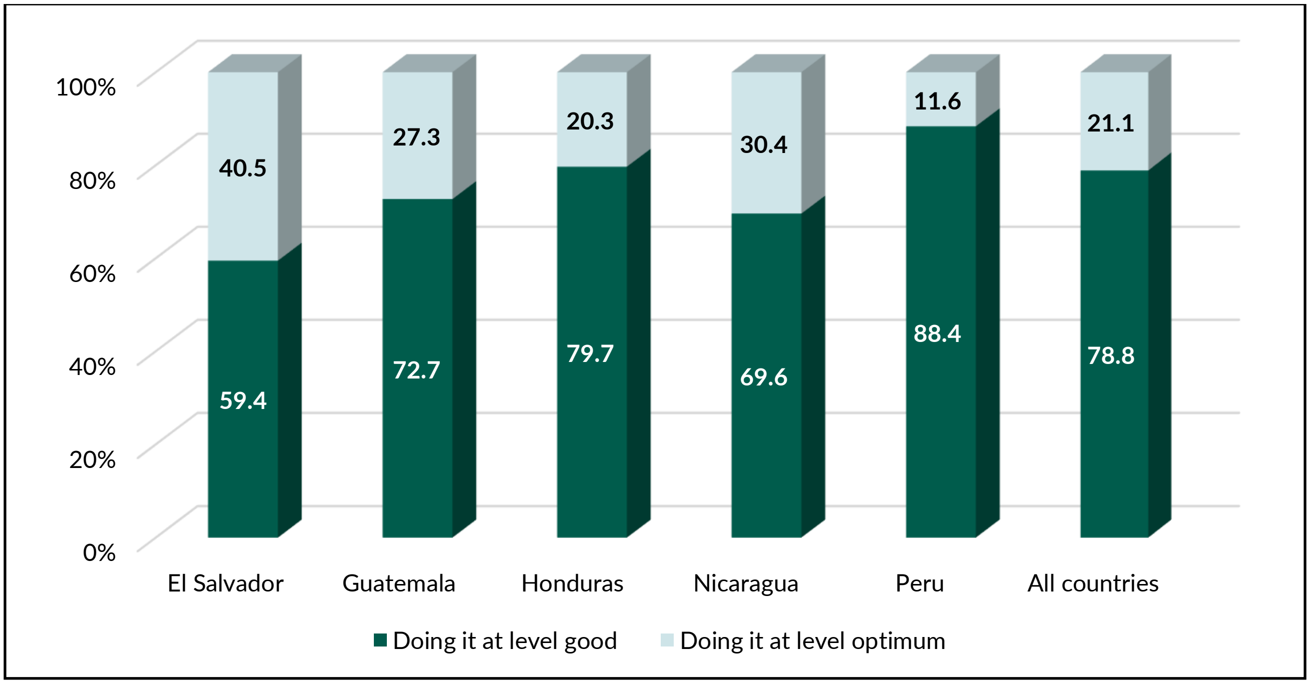


Figure 10. Coffee farmers using methods to control pests, by level

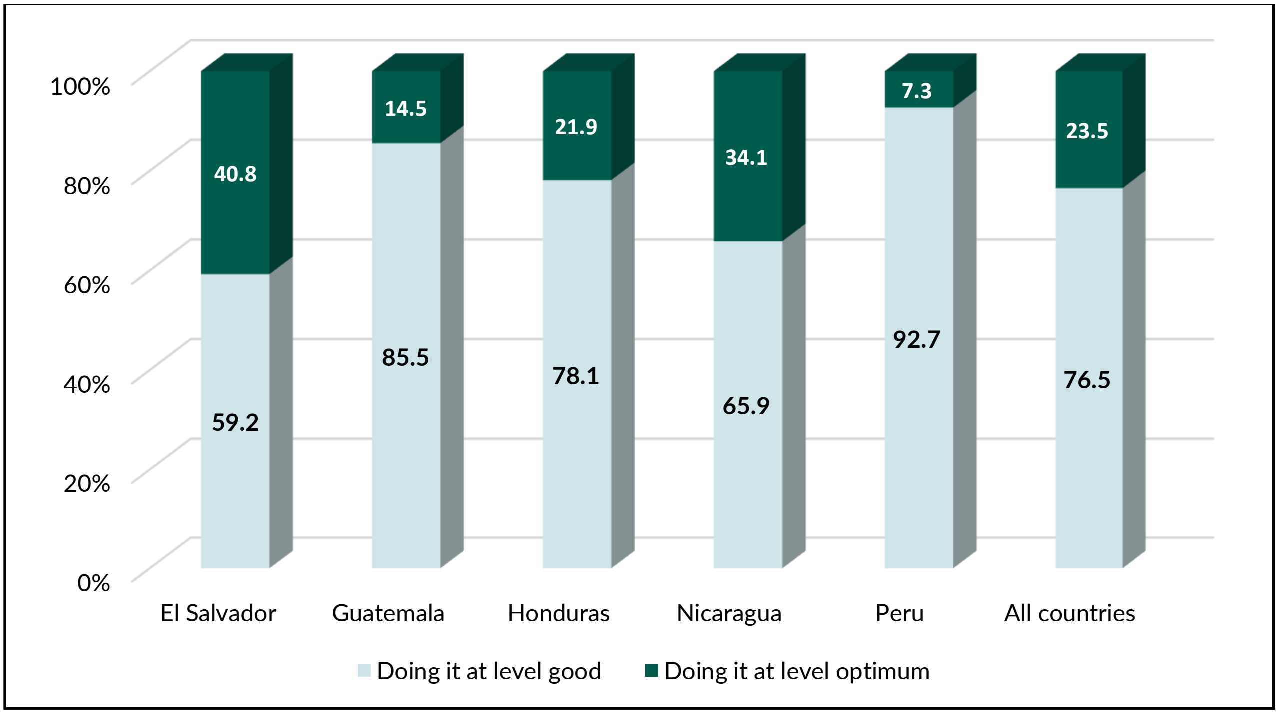


Figure 11. Coffee farmers using methods to control diseases, by level

3.3.6 Shade crops management

In this section we discuss two of the practices described in the MOCCA curriculum, and for each, we provide information for two levels: doing the practice well and doing it optimally. For farmers with existing shade systems, doing it well means having 25% shade or if have not planted shade trees recently (few years back), and doing it optimally means considering the farm location and environmental conditions to regulate the shade and having either adequate shade or if have not planted shade trees recently. For farmers doing coffee shade management, doing it well means the shade is managed/pruned, and doing it optimally means the shade is managed/pruned after the harvest (before rains start).

The management of shade in the coffee crop is important to maintain the health of the plantation and yields, among other factors. The results show that overall, 64.08% of farmers reported their coffee plantations had shade crops, and the share of farmers reporting this was lowest in Guatemala (50.32%) and highest in Nicaragua (76.06%) (Table 13). Approximately two out of every three farmers reported shade levels in what MOCCA considers it to be well, and one out of three did it optimally, which suggests that the project could help to lift the number of farmers who manage shade optimally, up from not using shade crops or from having shade at well level. Further, only 57.03% of farmers reported managing the shade crops, and among these, most did so optimally.

Table 13. Coffee: adoption of shade crops management practices at baseline

Shade crops management (SCM) MOCCA-promoted practices*	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Producing coffee with shade	70.25	50.32	74.47	76.06	56.42	64.08
Of farmers with shade crops, % doing so at good level -- has 25% shade or more OR there is less than 25% shade but shade trees have been planted in the last 3 years	80.63	65.50	69.49	54.51	73.03	68.20
Of farmers with shade crops, % doing so optimally -- has adequate level of shade (at least 25%) and that considers location of the farm and temperature to plant shade trees	19.36	34.49	30.50	45.48	26.96	31.79
Managing shade	59.49	54.06	46.83	63.98	59.97	57.03
Of farmers managing shade, % that prune shade crops	2.65	6.09	7.00	12.96	5.17	6.87
Of farmers managing shade, % that prune shade crops at the right time (after harvest	97.34	93.90	93.00	87.03	94.82	93.12
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**
*Levels well or optimally as defined by MOCCA's criteria (see training curriculum for details)						

3.3.7 Seed bed and nursery

In this section we discuss four of the practices described in the MOCCA curriculum, and for each, we provide information for two levels: doing the practice well, and doing it optimally. For farmers selecting coffee seed, doing it well means selecting seed from outstanding, highly-productive plants, or purchasing genetic material from a certified/verified nursery; and doing it optimally means selecting plants considering environmental factors, pests and diseases incidence, and market demand. For farmers preparing substrate mix for the establishment of seed germinators, doing it well means this mix has at least 30% of sand, and doing it optimally means using the MOCCA-recommended mix (50% sand, 30% organic matter, and 20% soil). For farmers disinfecting substrate mix, doing it well means disinfecting the substrate, and doing it optimally means following MOCCA recommendations (disinfecting with solarization or boiling water). Finally, for farmers selecting plants for transplanting, doing it well means choosing plants free of pests and diseases and choosing vigorous/robust plants, and doing it optimally means choosing plants free of pests and diseases and choosing vigorous/robust plants and choosing plants with 4-6 pairs of leaves.

At baseline, 35.85% and 19.41% of farmers reported they managed coffee seed beds and nurseries, respectively (Table 14). Surprisingly, having seed beds and nurseries within the farms was extremely rare in El Salvador and Honduras. In contrast, having seed beds was surprisingly high in Guatemala. Among farmers who managed seed beds or nurseries in their farms, 92.41% said they selected the seeds for planting, and most reported doing this optimally according to MOCCA criteria.

Roughly 31% of farmers prepared substrate mix for their seed germinators, and everyone was doing this well, suggesting MOCCA can not only increase the share of farmers who make this in situ, but who also do it optimally. Further, while almost three out of four farmers reported disinfecting the substrate mix, there is an opportunity to teach many how to do this optimally, as most did it well, except in El Salvador and Peru. Finally, selecting the coffee plants before transplanting them was not common, possibly because farmers may decide to plant every plant from their nursery, not only the best, perhaps due to the implications of doing this—not transplanting everything means losing all the investment made in the 'lower-quality' plants.

As mentioned above, 35.85% and 19.41% of farmers reported they managed coffee seed beds and nurseries in the agricultural year of reference, respectively (Table 14). Farmers with seed beds reported planting an average of 2.44 kg of seed, and the amount planted was highest in Nicaragua (3.13 kg) and lowest in El Salvador (0.34 kg) (Table A 10). Figure 12 illustrates where farmers with seed beds source their seed. As we can see, in every country except El Salvador, the most common source was selecting it from outstanding trees from their farm. Although this was clearly the main source in most countries, in Guatemala and El Salvador, receiving free seed and purchasing seed were also important sources. As Figure 12 shows, only 15.98% of farmers reported buying seed for their seed beds. Among them, only 22.11% of farmers reported knowing where to acquire certified or verified planting material, and no farmer in El Salvador reported this. Despite this, a little over four out of five farmers reported the quality of the seed purchased was good or excellent (Table A 10).

Farmers managing coffee nurseries reported they produced a little over 3,900 seedlings (Table A 10), and most of them (68.73%) came from their own farm (Figure 13). The latter was true mostly for Nicaragua and Peru, and was rare in El Salvador, where the main source of seedlings was obtaining it for free (although in practice, this is not important as <1% of farmers in this country managed a seedbed or a nursery). On average, 18.11% of farmers with nurseries reported buying seedlings (except in El Salvador, as no farmer bought seedlings in the year of reference) and most purchased them from a neighbor (43.1%) or non-certified nurseries (31.03%). Buying seedlings from certified nurseries was reported by 16.37% of farmers only, and none reported this in Nicaragua. Despite this, 81.14% of farmers said the quality of the seedlings was good or excellent (Table A 10). Finally, among farmers purchasing seed or seedlings, 49.16% were willing to pay more for a certified or verified genetic material (Figure 14), and this share was highest in Peru (68.94%) and lowest in Nicaragua (22.56%).

Table 14. Coffee: adoption of seed bed and nursery-related practices at baseline

Seed bed and nursery (SB&N) MOCCA-promoted practices*	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) managing a coffee seed bed in their farms	0.63	95.78	8.49	40.28	26.8	35.85
Farmers (%) managing a coffee nursery in their farms	0.95	10.44	8.25	37.44	29.73	19.41
Farmers (%) selecting coffee seeds for planting, and % farmers…:	80.11	84.58	95.91	92.97	97.5	92.41
Of farmers selecting coffee seeds for planting, % who selected from highly-productive plants, OR purchases genetic material from a certified/verified nursery	0.00	0.93	2.71	6.34	2.89	3.05
Of farmers selecting coffee seeds for planting, % who selected plants considering environmental factors, pests & diseases incidence, and market demand	100.00	99.06	97.28	93.65	97.10	96.94
Farmers (%) preparing substrate mix for seed germinators, and % farmers…:	50.00	21.31	27.50	18.18	47.36	31.04
Of farmers preparing substrate mix, % who includes at least 30% sand	100.00	100.00	100.00	100.00	100.00	100.00
Of farmers preparing substrate mix, % that uses MOCCA-recommended mix (50% sand, 30% org. matter, 20% soil)	0.00	0.00	0.00	0.00	0.00	0.00
Farmers (%) disinfecting substrate mix, and % farmers…:	66.66	69.11	65.21	83.14	68.64	73.25
Of farmers disinfecting substrate mix, % that do so with any method	0.00	87.23	63.33	85.81	22.22	57.32
Of farmers disinfecting substrate mix, % that follows MOCCA recommendations (solarization or boiling water)	100.00	12.76	36.66	14.18	77.77	42.67
Farmers (%) selecting coffee plants for transplant (renovation or replacement), and % farmers…:	0.00	8.00	28.00	46.92	41.21	36.59
% doing so at good level of adoption -- Follows 2 criteria: chooses plants free of pests and diseases AND chooses vigorous/robust plants	n.a.	66.66	78.57	53.57	45.58	52.9
% doing so optimally -- Follows 3 criteria: chooses plants free of pests and diseases AND chooses vigorous/robust plants AND plants	n.a.	33.33	21.42	46.42	54.41	47.09
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**

*Levels well or optimally as defined by MOCCA's criteria (see training curriculum for details)

It is interesting to note that while Honduras had the strongest genetic material system for coffee of all countries based on the market system level assessment, Honduran farmers surveyed were the most likely to use seeds from their own farms to produce seedlings instead of purchasing seeds. A very small percentage of Honduran coffee farmers produced coffee seedlings in the reference period (8.49%), and the majority of those who did it used seeds from their farm, all from coffee plants purposely selected for harvesting seed. Honduran farmers purchasing seed had the highest proportion (45.23%, double most other countries) of farmers who reported knowing where to obtain certified or verified planting materials. Similarly for farmers purchasing seedlings from non-verified sources, Honduras had the highest percentage (36.84%, almost double or more the percent for other countries) of farmers who knew where to obtain certified seedlings. Honduras, along with Guatemala were the two countries with highest percentages of farmers who purchase seedlings, and, in both countries, the same percentage of farmers reported purchasing their seedlings from certified nurseries (12%). This seems to suggest that the relatively more developed genetic material system in Honduras is reflected in greater farmer knowledge of where to obtain certified material, and some use of those sources, while the majority of farmers continue to produce their own coffee seedlings on farm with seed from elite trees on their farm. See Table A 10 for more details.

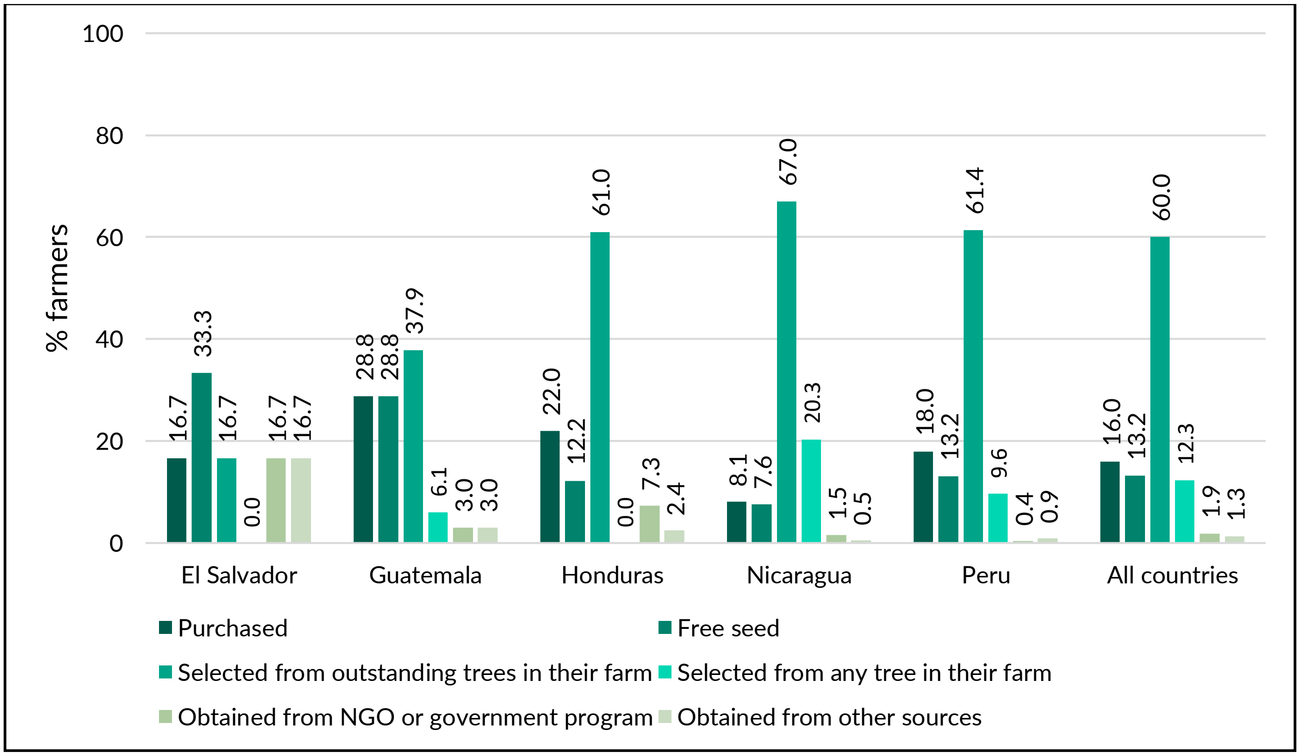


Figure 12. Coffee: source of seed used in seed beds, by country

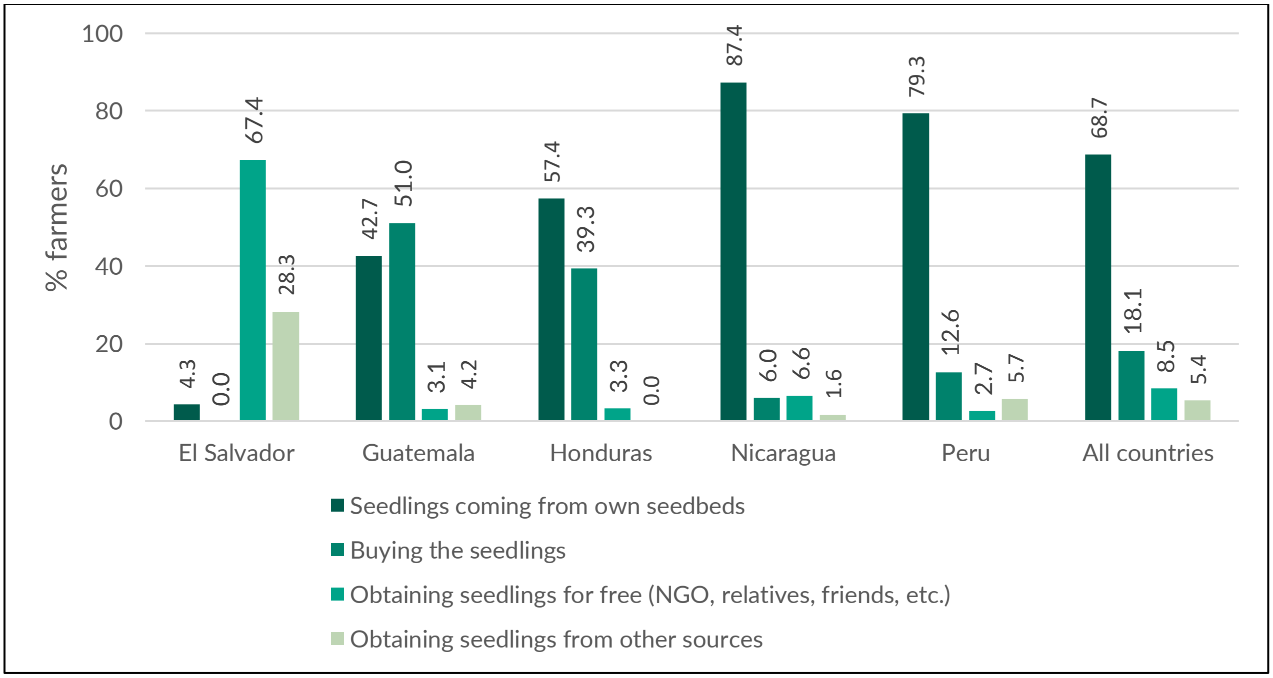


Figure 13. Coffee: source of seedlings, by country

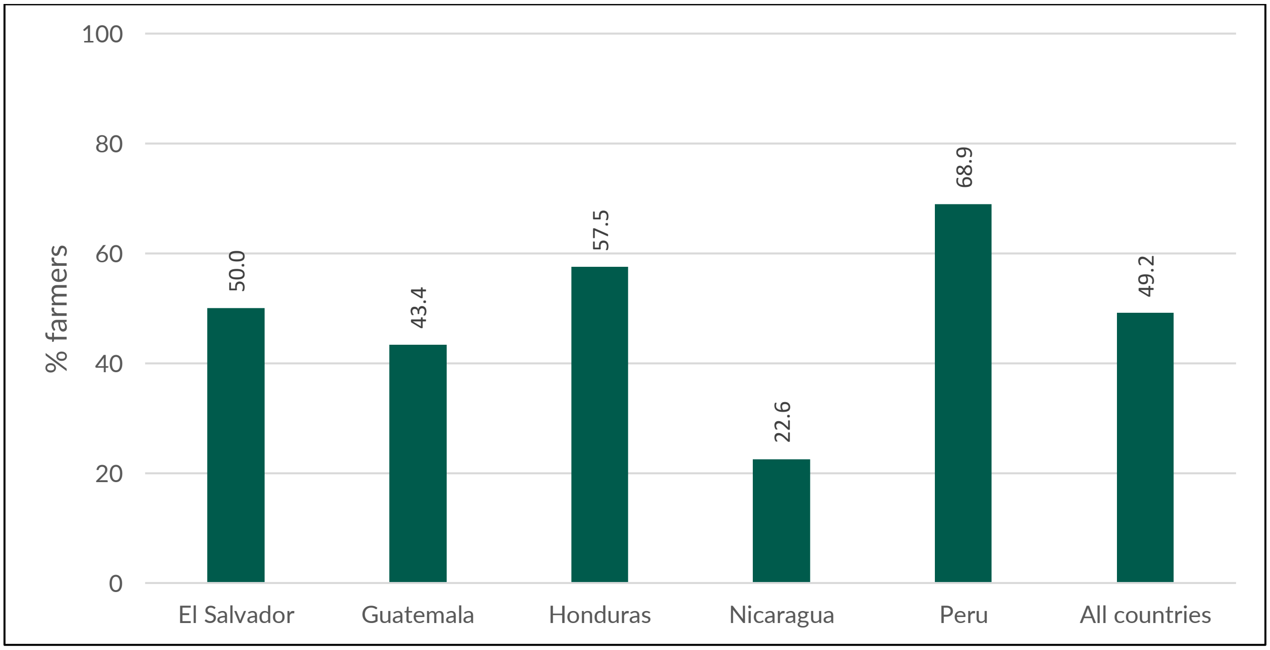


Figure 14. Coffee farmers willing to pay more for certified or verified genetic materials, by country

3.3.8 Selective harvest, post-harvest and processing

In this section we discuss nine of the practices described in the MOCCA curriculum, and for each, we provide information for two levels: doing the practice well, and doing it optimally. For farmers implementing various harvest practices, doing practices well means doing selective harvest according to field sample indicating 75% of ripe cherries, and doing it optimally means doing selective harvest according to field sample indicating 85% of ripe cherries and implementing additional harvests ("repela" and "pepena") to reduce the risk of berry borer incidence. For farmers doing cherry pulp removal, doing it well means removing the pulp same day it was harvested and doing it optimally means removing the pulp without water and transporting the pulp without the use of water (i.e., dry method). For farmers fermenting coffee, doing it well means the coffee was fermented for <12 hrs and doing it optimally means the coffee was fermented for more than 12 hrs. For farmers drying coffee beans, doing it well means drying in a patio (no infrastructure) and doing it optimally means drying using an infrastructure. For farmers measuring the coffee moisture during drying, doing it well means measuring a 12% moisture using touch and visual methods, and doing it optimally means measuring a 12% moisture using an instrument.

For farmers classifying cherries after harvest, doing it well or optimally means the coffee cherries were classified (separated high from low-quality cherries). Because of this, all farmers who classified cherries were categorized under the optimal level. For farmers treating waste water, doing it well means doing any waste water treatment and doing it optimally means having a protocol (or recipe) to treat waste water. For farmers treating pulp waste, doing it well means managing (treating) the pulp and doing it optimally means having an infrastructure to make pulp compost. Finally, for farmers treating waste water from milling, doing it well means doing any water treatment and doing it optimally means having a protocol to manage waste water from milling and having infrastructure on farm for this.

Although most farmers reported harvesting coffee, 3% said they were not able to harvest their crop, and this share was slightly higher in Guatemala and El Salvador (Figure 15), mostly because farmers who did not harvest reported their coffee trees were too young. Among farmers harvesting coffee, 24.84% said they implemented selective harvest practices, and this was slightly more common in El Salvador, compared to the other countries. Most farmers implementing selective harvest did this at level good (Table 15). Despite this, 57.74% of farmers said they classified coffee cherries after the harvest.[21]

Only 55.2% of farmers reported milling coffee in their farms, and this was highest in Nicaragua (81.99%) and lowest in Peru (9.32%). Using water for milling is an important activity that can have large environmental impacts, and learning about its use and treatment is important. Of farmers milling coffee in their farms, most (97.43%) farmers did cherry pulp removal using water saving practices (Figure 16), and although more than 94% did this well, given the low share of farmers that do this optimally (Table 15), it is an activity that can be improved. While treating pulp waste was common (86.17% farmers did this), treating waste water from wet milling was less common

[21] Given that the MOCCA criteria for this practice is the same for both levels good and optimum, if farmers did this practice, we classified them under optimal. This is why 100% are in this level.

(only 60.23% of farmers did this). Despite this, most farmers (95.73%) reported treating waste water from other activities.

Although all farmers who milled coffee reported fermenting it in their farm and most did so optimally (though this varied by country), only 61.52% of those farmers reported drying coffee beans in their farm. Finally, among farmers drying coffee, measuring coffee beans moisture during this post-harvest process was extremely common in Peru, and least common in Nicaragua (Table 15).

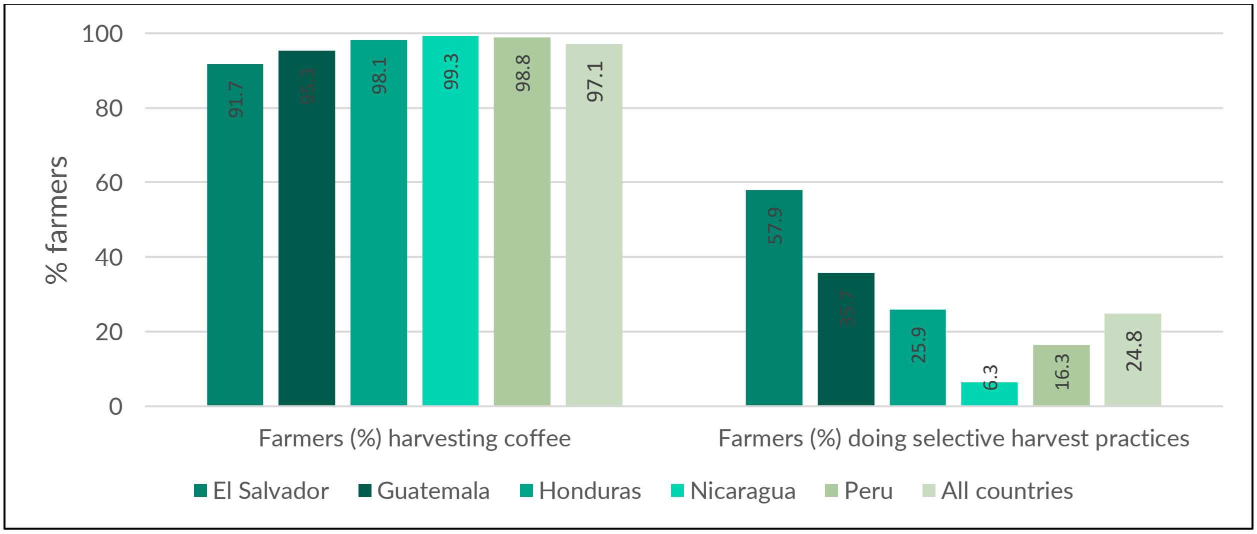


Figure 15. Coffee: harvest and selective harvest practices, by country

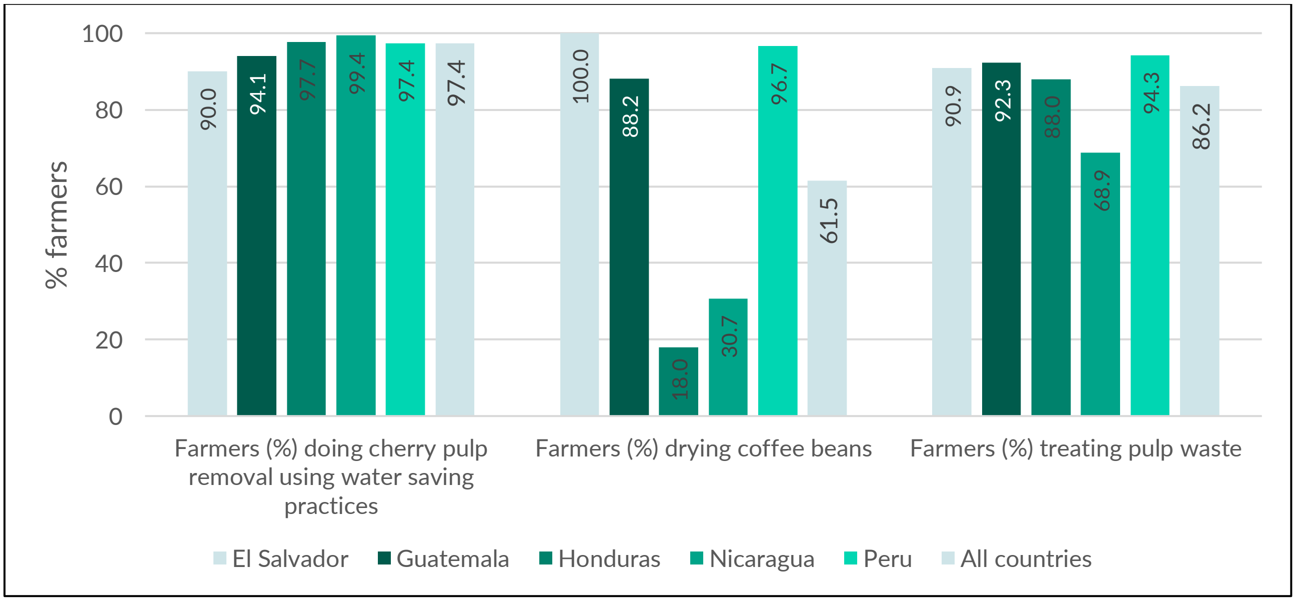


Figure 16. Coffee: post-harvest practices, by country

Table 15. Coffee: adoption of harvest, post-harvest and processing practices at baseline

Harvest, post-harvest and processing (HPHP) MOCCA-promoted practices*	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers harvesting	91.74	95.33	98.12	99.28	98.81	97.1
Of farmers harvesting, those doing so selectively	57.89	35.71	25.92	6.34	16.33	24.84
Of farmers doing selective harvest, % who conduct field sample indicating 75% of ripe cherries	62.12	70	57.14	76.92	63.26	65.02
Of farmers doing selective harvest, % who conduct field sample indicating 85% of ripe cherries AND *repela* and *pepena* to reduce risk of berry borer	37.87	30	42.85	23.07	36.73	34.97
Of farmers harvesting, those classifying coffee cherries after the harvest	74.82	53.61	58.71	40.81	63.07	57.74
Of farmers classifying coffee, % who do so optimally -- coffee was sorted from inert materials: (separated from leaves, stones, sticks).	100.00	100.00	100.00	100.00	100.00	100.00
Farmers (%) milling coffee in the farm	11.70	46.59	31.85	81.99	9.32	55.2
Of farmers milling coffee:						
Of farmers harvesting, those removing coffee cherry pulp using water saving practices	90.00	94.08	97.65	99.41	97.41	97.43
Of farmers conducting cherry pulp removal, % doing so at good level of adoption -- Removed pulp same day it was harvested	66.66	98.85	96.80	82.64	100.00	94.22
Of farmers conducting cherry pulp removal, % doing so optimally -- removed and transported pulp without water (i.e., dry method)	33.33	1.14	3.20	17.35	0.00	5.77
Of farmers harvesting, those Fermenting coffee beans	100.00	100.00	100.00	100.00	100.00	100.00
Of farmers fermenting coffee, % who fermented for <12 hrs	88.88	24.19	58.46	66.08	19.18	38.03
Of farmers fermenting coffee, % who fermented for more than 12 hrs	11.11	75.80	41.53	33.91	80.81	61.96
Of farmers harvesting, those drying coffee beans	100.00	88.17	17.98	30.72	96.69	61.52
Of farmers drying coffee, % who dried in a patio (no infrastructure)	33.33	70.12	45.61	25.47	4.37	22.50

Of farmers drying coffee, % who dried using an infrastructure	66.66	29.87	54.38	74.52	95.62	77.49
Of farmers harvesting, those verifying coffee bean moisture	77.77	65.40	64.91	33.33	97.79	74.38
Of farmers measuring moisture, % who measured using touch and visual methods up to 12%	57.14	7.43	35.13	16.27	10.31	12.11
Of farmers measuring moisture, % who measured using touch an instrument up to 12%	42.85	92.56	64.86	83.72	89.68	87.88
Of farmers harvesting, those treating any other waste water	n.a.	93.54	100.00	99.11	92.30	95.73
Of farmers treating waste water, % who does any waste water treatment	n.a.	95.4	76.34	66.66	71.07	76.43
Of farmers treating waste water, % who do so optimally -- has protocol to treat waste water	n.a.	4.59	23.65	33.33	28.92	23.56
Of farmers harvesting, those treating pulp waste	90.9	92.26	87.95	68.85	94.27	86.17
Of farmers treating pulp waste, % who do so at good level of adoption -- manages the pulp	70.00	67.59	54.79	43.65	43.92	49.17
Of farmers treating pulp waste, % who do so optimally -- has infrastructure to make pulp compost	30.00	32.40	45.20	56.34	56.07	50.82
Of farmers harvesting, those treating waste water from wet milling	25.00	42.47	72.09	51.74	69.44	60.23
Of farmers treating waste water from wer milling, % who do so at a good level of adoption -- manages the water from wet milling	100.00	53.16	76.34	88.2	73.86	75.51
Of farmers treating waste water from wer milling, % who do so optimally --Has a protocol to manage waste water AND has infrastructure on farm for this	0.00	46.83	23.65	11.79	26.13	24.48
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**
*Levels well or optimally as defined by MOCCA's criteria (see training curriculum for details)						

3.3.9 Quality, certifications, business management and high-value markets

Regarding farmers' knowledge of their coffee quality, few (17.87%) knew what the concept of physical yield factor was (Figure 17), and farmers knowing this reported an average physical yield factor of 64.54[22] with only 15.12% of farmers reporting receiving a higher price due to this factor (Table 16). Similarly, only 21.68% of farmers knew their cup grade ('taza') (Figure 17), and the average cup grade was 82.95, with few farmers (11.75%) reporting receiving a premium due to their cup grade (Table 16). The latter could be because farmers may receive a premium embedded in the price they receive, without knowing it, which would highlight the need to help them understand what is included (or not) in the price they receive. In Peru, a higher share of farmers knew their physical yield factor and cup grade, and three or more physical characteristics that determine the coffee quality, compared to other countries.

38.33% of the farms were certified (Figure 18), and the most common certifications were Organic (67.49%), UTZ/Rainforest Alliance (38.95%) and Fair Trade (37.71%), and this varied by country (Table 16). El Salvador and Guatemala are the countries where practically no farms are certified, and Peru is where most farms (83.7%) are certified. Systematically registering production costs was not common, as only 37.15% of farmers did this, and this number was highest in Peru, and lowest in El Salvador (Figure 18).

We asked farmers to state who their main two buyers were.[23] Almost one-half (48.51%) of farmers reported their main buyers were intermediaries, followed by an anchor firm collaborating in MOCCA (38.83%), a cooperative or farmer organization (27.19%), among others. This varied by country: while selling to intermediaries was more common in Guatemala, El Salvador and Honduras, selling to an anchor firm was more common in Nicaragua and Peru (Figure 19).

[22] We suggest using this value with caution, as the physical yield factor highlights the kg of dry parchment coffee needed to obtain 70 kg of Excelso (which is a grading term for exportable coffee from Colombia, not related to variety or cupping profile). Thus, one would expect minimum values higher than 70, and farmers reported minimum values of 2.0, 1.25, 0.8, 1.0 and 55.0 in El Salvador, Guatemala, Honduras, Nicaragua and Peru, respectively.

[23] Farmers could have reported several buyers, and we only collected information for the main two buyers, which is the reason why the sum of responses do not add to 100%.

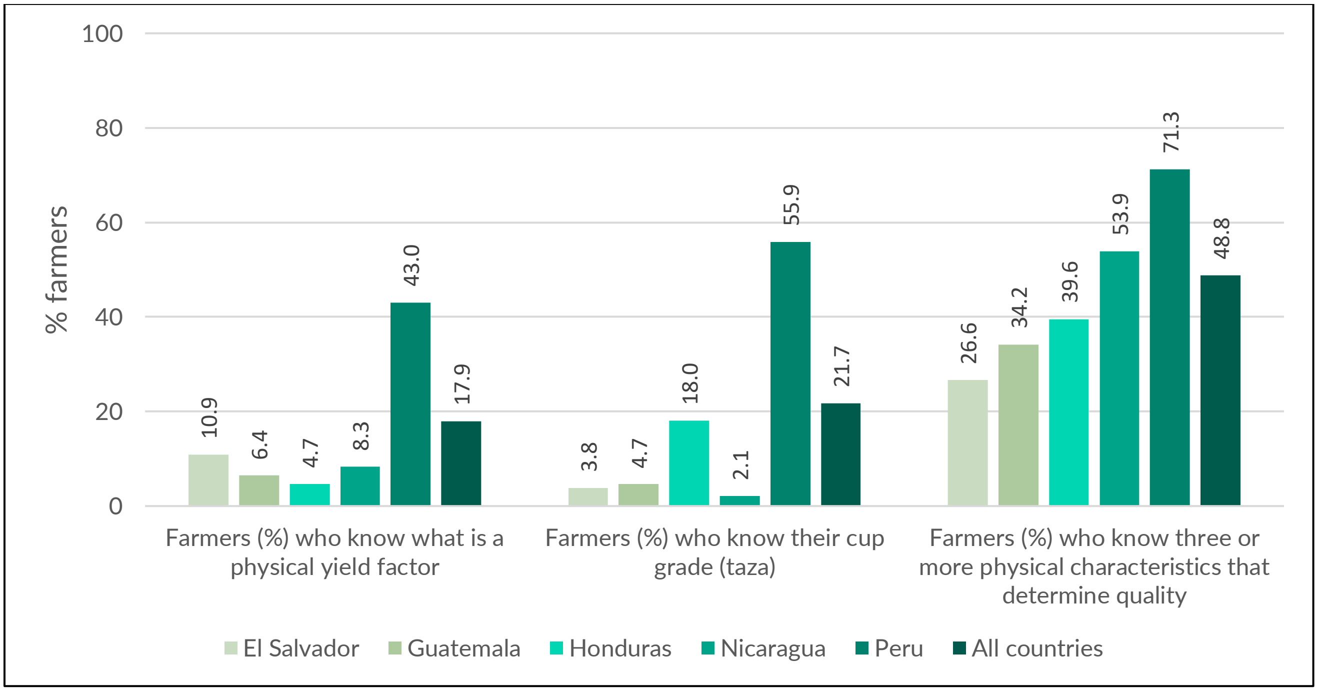


Figure 17. Coffee quality knowledge, by country

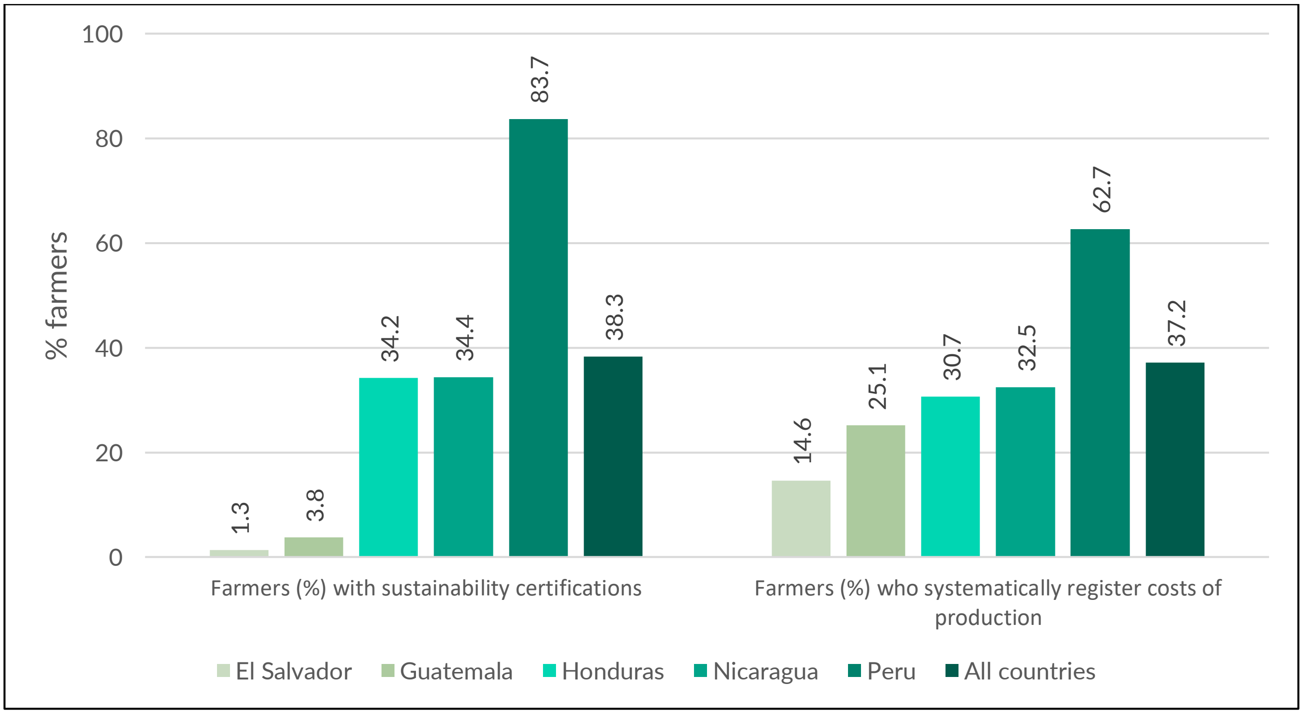


Figure 18. Coffee sustainability certifications and record keeping, by country

As one would expect, farmers could sell their coffee in one or several forms or presentation, which include coffee cherry, wet parchment, dry parchment or other. Most (95.9%) sold coffee. The most common presentation how farmers sold their coffee was dry parchment (51.94% of farmers selling coffee), followed by wet parchment (23.51% of sellers), cherry (19.62% of sellers) and far behind green beans (8.80%), but the main presentation varied by country. In Peru, practically all farmers sold dry parchment coffee beans, while in Nicaragua most farmers sold wet parchment coffee. In contrast, in El Salvador and Guatemala, selling coffee in cherry was as common as selling green coffee or dry parchment, respectively. However, we find this result for El Salvador surprising, as roughly 11% of the farmers who harvested reported milling coffee in their farm. Thus, we consider that farmers in El Salvador may have reported the form in which they received the payment (for example, they could have delivered cherry but were paid in green-equivalent) instead of the form in which they delivered the coffee, which would explain this unexpected finding. In Honduras, selling wet and dry parchment coffee was almost equally common (Figure 20).

While the characteristics of the market relationships of farmers is heavily determined by the buyers they are selling to, in this case intermediaries and the MOCCA anchor firms, it is interesting to note how the variation across countries maps onto the overall country characteristics found in the market system level analysis. For example the high level of certifications over all is not reflective of average certification rates in countries, but the variation across countries with high certification in Peru for example and lower certification rates in El Salvador and Guatemala somewhat reflect the differences at country level. Similarly whether coffee is sold as cherries, wet or dry parchment, or through cooperatives or intermediaries also varies across country in line with the overall existing country markets systems. While further analysis at the mid term and final evaluation stages will help further explore these questions, the baseline situation seems to suggest that farmer incomes are determined partially by specific anchor firm relationships as well as by the larger market system at the country level (which also influences how anchor firms behave in each context as well). This lends support to the MOCCA hypothesis that in order to influence outcomes for farmers, investments are needed to increase farmer participation in inclusive business relationships with anchor firms as well as to improve benefits to farmers in the overall market system serving farmers in these countries.

Table 16. Coffee: cup quality, farm certifications and buyers at baseline

Cup quality, certifications and buyers	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) who know what is a physical yield factor, and for those who know:	10.86	6.44	4.68	8.29	43.04	17.87
Of those farmers who know what is a yield factor, average physical yield factor	4.38	90.99	39.63	60.57	72.42	64.54
% who have received a higher price due to this factor	0.00	13.33	4.76	37.14	15.17	15.12
Average premium received (US$/100-lb sack)	n.a.	9.94	4.08	7.82	5.85	6.49
Farmers (%) who know their cup grade (taza)	3.83	4.66	18.03	2.13	55.85	21.68
Of farmers who know their cup grade, average cup grade	79.32	81.8	83.25	79.5	83.15	82.95
Of farmers who know their cup grade, % who have received a premium due to this quality	16.66	0.88	26.92	0	21.69	11.75
Average premium received (US$/100-lb sack)	n.a.	6.96	51.28	n.a.	46.92	46.33
Farmers (%) who know three or more physical characteristics that determine quality	26.6	34.15	39.57	53.91	71.25	48.75
Farmers (%) with farm certifications, and % farmers with...:	1.27	3.77	34.19	34.36	83.70	38.33
Organic certification	0.00	5.88	67.56	6.12	85.71	67.49
Fair trade certification	0.00	11.76	38.51	40.13	37.91	37.71
FLO certification	0.00	0.00	2.02	0.00	10.58	7.13
FLO-organic certification	0.00	0.00	8.78	0.68	16.04	11.89
UTZ/Rainforest Alliance certification	75.00	64.70	50.67	55.1	30.68	38.95
CLAC certification	0.00	0.00	0.00	0.00	0.00	0.00
Other certifications	25.00	23.52	12.16	12.95	5.11	8.04
Farmers (%) who systematically register costs of production	14.64	25.11	30.67	32.46	62.66	37.15
Farmers (%) whose main coffee buyer is...:						
MOCCA anchor firm	n.a.	13.52	25.89	76.06	56.29	38.83
Intermediary	71.79	73.91	60.07	15.51	30.38	48.51
Local market	2.56	4.34	1.41	1.37	4.94	3.13
Cooperative or farmer organization	2.56	3.14	22.96	51.72	44.87	27.19
Other buyers	23.07	4.34	3.18	15.17	2.82	6.72
Farmers (%) selling coffee, and of those, % selling:						
Cherry	52.94	48.79	17.06	1.20	0.29	19.62
Wet parchment	0.00	1.69	45.67	76.38	0.59	23.51
Dry parchment	2.07	50.48	40.14	22.89	99.55	51.94
Other	46.71	1.69	0.48	6.02	3.73	8.80
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**
*Levels well or optimally as defined by MOCCA's criteria (see training curriculum for details)						

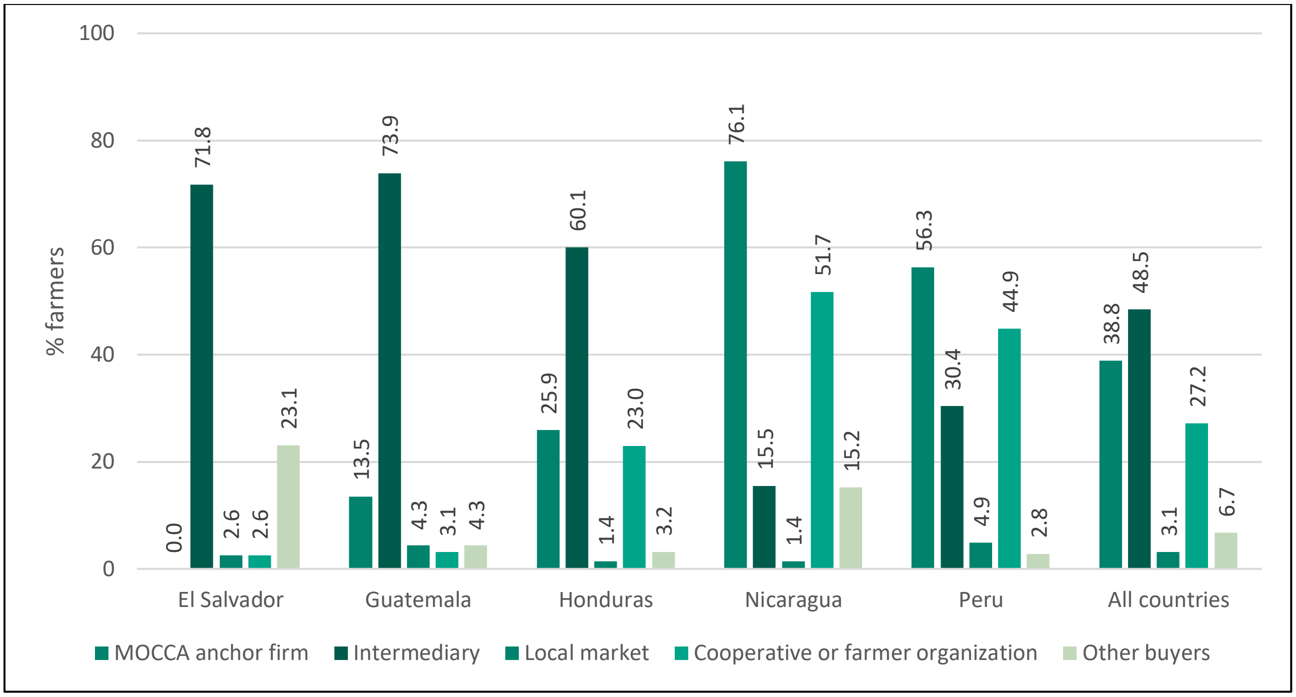


Figure 19. Coffee: major buyers, by country

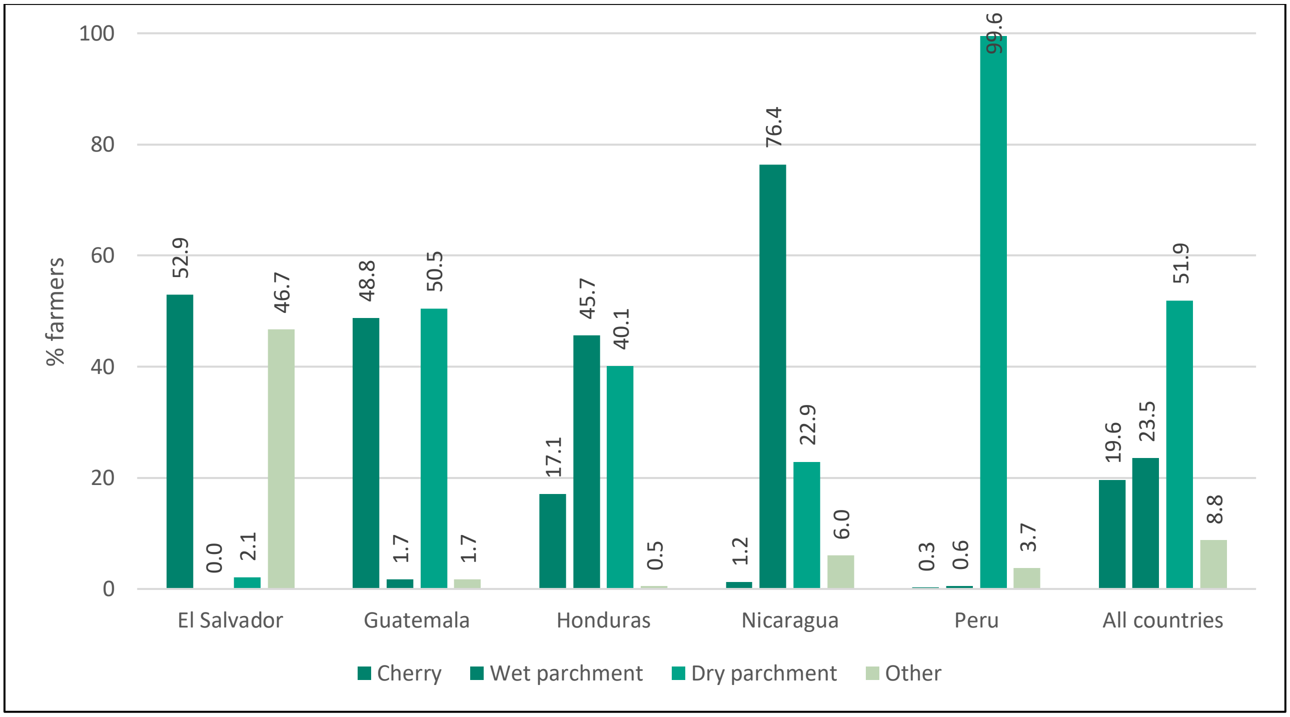


Figure 20. Form/presentation how coffee was sold, by country

3.4 Farm characteristics

3.4.1 Land use

We present details about land use in Table A 11. In the agricultural year of reference, farmers reported a total land area of 4.03 ha, and farmers in Nicaragua reported managing the largest land area (7.56 ha), followed by farmers in El Salvador (4.23 ha), Honduras (3.82 ha), Peru (3.51 ha) and Guatemala (1.59 ha) (Table A 11). As Figure 21 illustrates, farmers dedicated most of their land (2.74 ha) to the coffee crop, followed by cacao and temporary crops.

Surprisingly, 32.69% of farmers reported having more than one farm, and the average number of plots planted with crops was 1.82 (Table A 11). Regarding coffee, while 62.88% of farmers reported having only one plot with this crop, a little more than one in five farmers reported having two coffee plots and only 14.52% had three or more coffee plots. Overall, only 37.99% of farmers did not prune their coffee trees, and this was more common in Central America. The main reason given for not pruning coffee was that their trees did not need this practice.

3.4.2 Land tenure

Not surprisingly, it was rare for coffee farmers not to own land (11.7% only). Among farmers owning at least one of their plots, most reported they owned their land with deed. While the latter was true for the four Central American countries, owning land without a deed was more common in Peru. The differences by gender of household head were small and not statistically significant (Table 17).

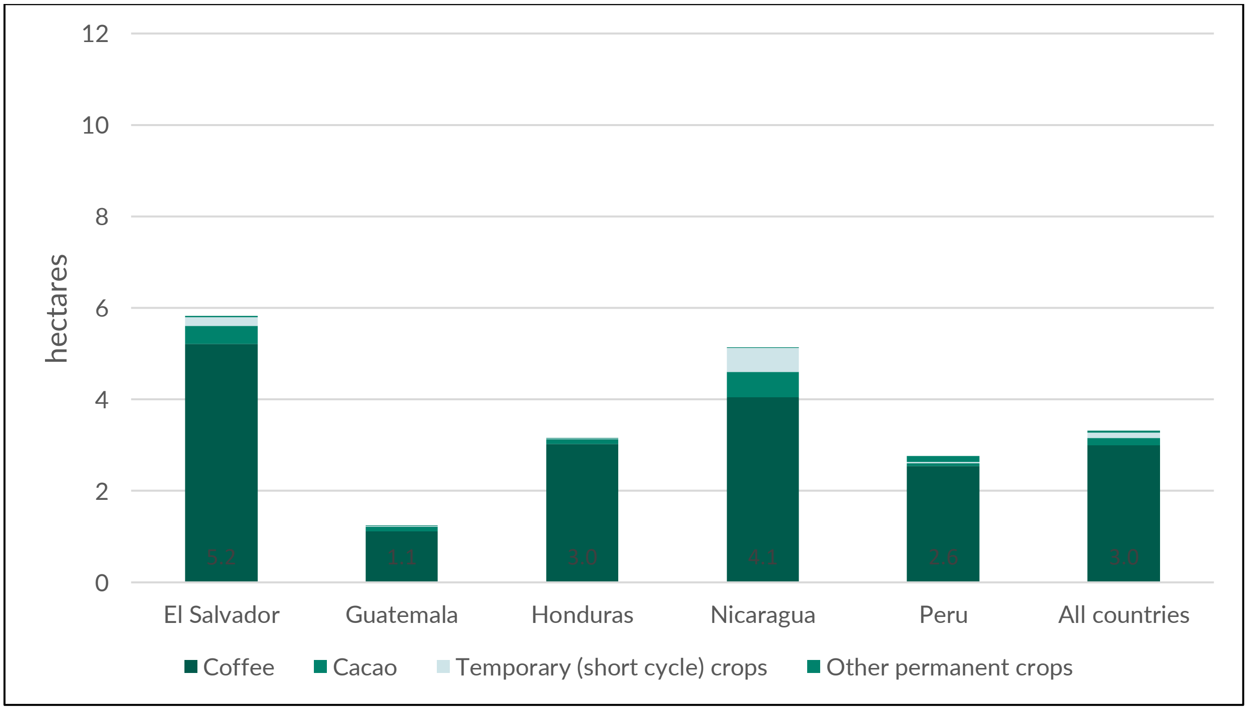


Figure 21. Coffee: land use, by country

Table 17. Coffee: land tenure, by sex of household head

Land tenure (% HH)	El Salvador			Guatemala			Honduras			Nicaragua			Peru			All countries		
	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
Owning land with deed	76.27	71.42	73.33	71.29	71.47	71.42	66.52	68.95	68.95	71.18	69.36	69.64	16.66	20.71	19.78	55.93	55.37	55.51
Owning land without deed	25.42	30.76	28.66	12.96	18.09	16.82	30.2	34.66	33.64	15.25	19.81	19.13	62.00	65.87	64.99	32.95	37.51	36.41
Not owning land	0.00	1.09	0.66	16.66	12.26	13.36	8.33	2.14	3.55	13.55	12.61	12.75	25.33	18.73	20.24	13.55	11.11	11.70
Number of households	**118**	**182**	**300**	**108**	**326**	**434**	**96**	**326**	**422**	**59**	**333**	**392**	**150**	**507**	**657**	**531**	**1674**	**2205**
*1 ha (hectare) = 10,000 square meters																		

3.5 Access to and use of inputs and services during the crop cycle

3.5.1 Access to inputs

We inquired farmers about the main place (town, city) where they usually travel to purchase agricultural inputs for their coffee crop. The most common transportation method used to reach this place was car/truck (56.84%), followed by bus, motorcycle and other means of transportation (Table 18). Using a car/truck was the most common transportation vehicle in all countries except Nicaragua, where using a bus was most common. On average, it took farmers a little over one hour (64.57 min) to reach this place using the most common transportation method, ranging from 38.12 min in Honduras to 95.45 min in Peru.

When asked whether they purchased chemical fertilizers, pesticides, herbicides, coffee seedlings and coffee seed at this place, most farmers reported they did buy fertilizers (79.07%), pesticides (52.16%) and herbicides (45.78%). However, buying coffee planting materials was not common. Although buying fertilizers, pesticides and herbicides in this place was common in Central America, the only inputs Peruvian farmers usually buy in the closest town are chemical fertilizers (Table 18).

Table 18. Coffee: access to market places where farmers can buy inputs

Access to inputs	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) using the following transportation means to reach the closest town where they usually buy inputs for coffee:						
Mean 1	Car/truck (50.63)	Car/truck (65.33)	Car/truck (70.96)	Bus (46.92)	Car/truck (74.18)	Car/truck (56.84)
Mean 2	Bus (38.92)	Bus (17.33)	By foot (15.46)	Moto (33.41)	Moto (13.20)	Bus (18.30)
Mean 3	By foot (9.49)	By foot (12.0)	Moto (7.73)	Car/truck (10.43)	By foot (11.28)	By foot (12.49)
Other transportation mean	0.95	5.33	5.85	9.24	1.33	12.36
Time (min) to reach closest town where farmers buy inputs, using the most common transportation mean	67.99	40.34	38.12	83.16	95.45	64.57
Farmers (%) who usually buy the following inputs in the closest town:						
Chemical fertilizers	96.51	94.44	93.44	94.31	41.98	79.07
Pesticides	83.54	81.11	51.52	77.96	2.37	52.16
Herbicides	67.08	64.88	35.83	89.33	2.07	45.78
Coffee plants (seedlings)	11.39	14.88	3.98	3.31	4.45	7.16
Coffee seeds	3.48	5.77	2.10	2.60	5.04	3.97
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**

3.5.2 Use of fertilizers, pesticides, and herbicides

88.21% of farmers reported applying fertilizer to their coffee crop, and a higher share of farmers in Honduras (94.93%) reported this, followed by farmers in Guatemala (92.0%), El Salvador (90.48%), Nicaragua (86.54%) and far behind, Peru (77.09%) (Table A 12). While most farmers fertilizing in Central America only applied chemical fertilizers, in Peru, a considerable number of farmers used either organic fertilizers or a combination of chemical and organic fertilizers (Figure 22). The most commonly used fertilizer (according to the quantity applied) varied by country, and included applying Triple 15, 18-16-12, Nutricafe, 20-5-20, and Guano de la Isla in El Salvador, Guatemala, Honduras, Nicaragua and Peru, respectively (Table A 12). On average, these fertilizers were applied between 1 and 2 times during the year.

While 46.53% of farmers applied pesticides in the agricultural years of reference, this was extremely rare in Peru (1.07%) and extremely common in Guatemala (91.32%). In contrast, slightly over one in four farmers applied herbicides, ranging from 75.12% of farmers in Nicaragua to none in Peru (Table A 12). While 57.46% of farmers who applied herbicides did this focalized/using a screen, doing this was most common in Honduras and El Salvador, and least common in Guatemala.

Implementing additional weed control methods included using a weed-wacker (37.8%), scheduling weed control (34.47%) and making selective weed control (18.06%).

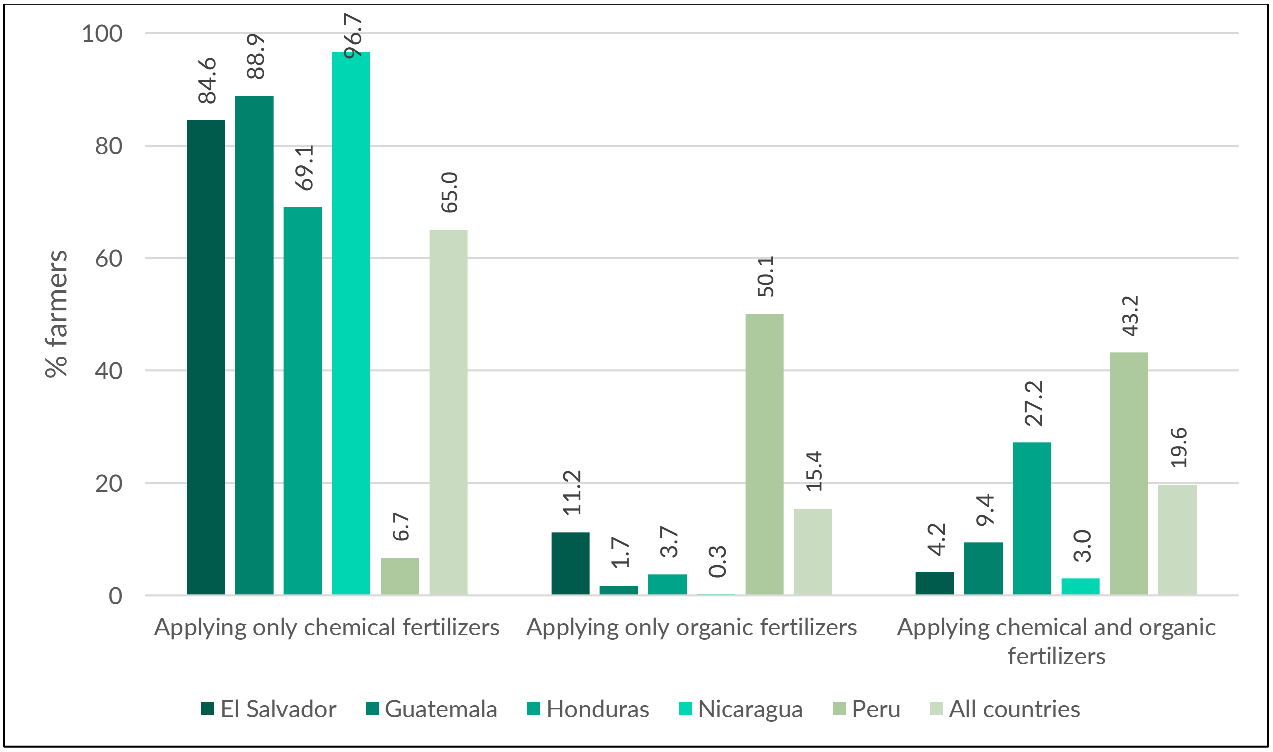


Figure 22. Coffee: types of fertilizers used, by country

The use of pesticides is understandable, as many farmers reported the incidence of insect pests and diseases in their crop.[24] While the two most common reported insect pests were berry borer (51.45%) and fumagina (ants, 2.73%) (Figure 23), the most common diseases were leaf rust (58.19%) and anthracnose (13.65%) (Figure 24). Reporting incidence of more than two diseases was more common than reporting incidence of more than two insect pests (Table A 12).

Regarding the first (main) insect pest that affected coffee, 47.03% of farmers did a field evaluation of this specific insect pest. However, most farmers reported <10% incidence, and this was the case in every country except in El Salvador Table A 12). For this insect pest, <15% of farmers said they did not control it, and among the ones who did control this insect, most used cultural control methods. Few farmers reported the incidence of a second insect pest.

Regarding the first (main) disease that affected coffee, 44.23% of farmers did a field evaluation of this specific disease. While one-half of farmers reported <10% incidence, 35.57% reported this disease affected 11-30% of their crop (Table A 12). As with insect pests, <15% of farmers said

[24] We asked farmers to name the main two pests (either insect or disease) affecting their crop in the year of reference. Thus, the information only provides details about the two main pests reported—some reported one disease and one insect, others two diseases or two insects.

they did not control this disease, and among the ones who did control it, most used chemicals control methods.

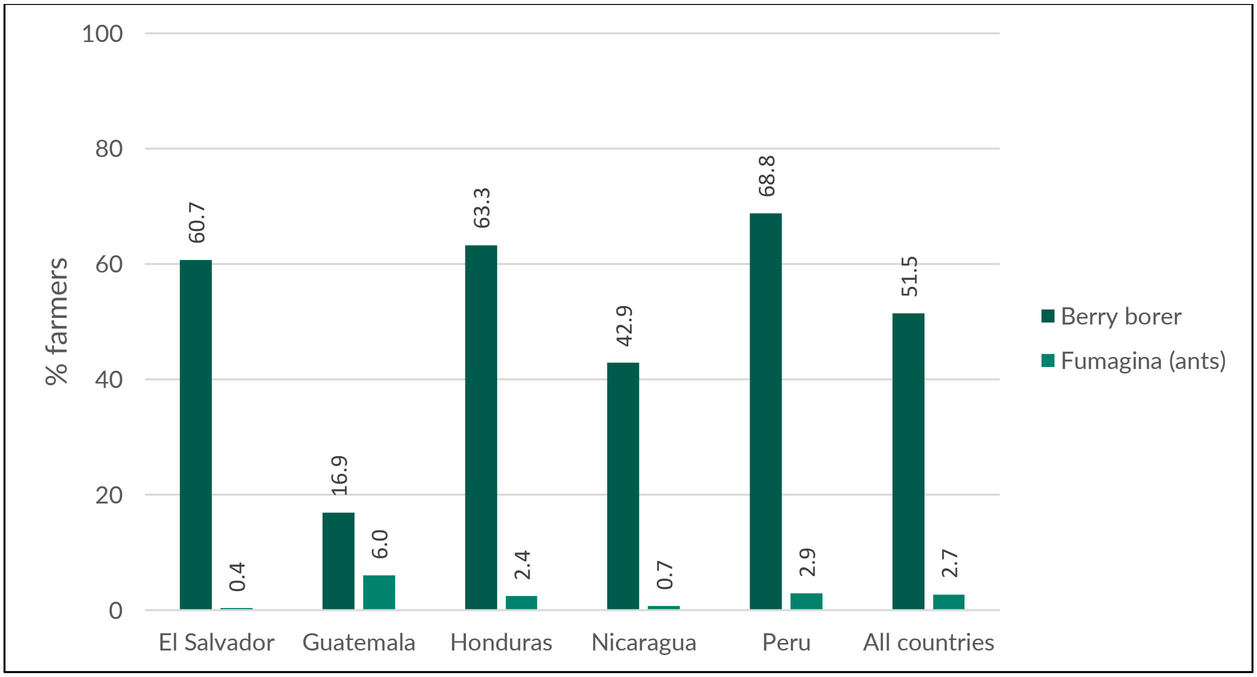


Figure 23. Coffee: main pests in the coffee crop, by country

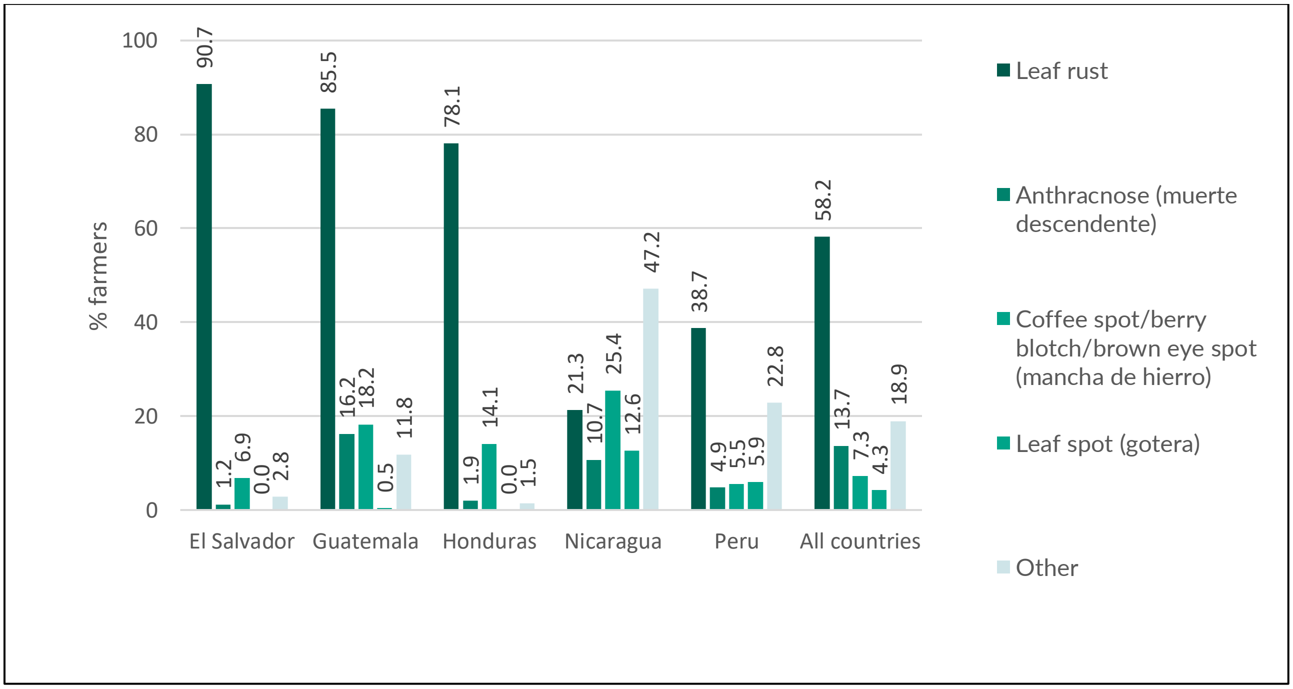


Figure 24. Coffee: main diseases in the coffee crop, by country

3.5.3 Financing and loan requirements

In the agricultural years of reference, few farmers (28.35%) requested a loan, except in Nicaragua, where 68.21% of farmers asked for a loan (Table 19).[25] Practically no farmer requesting a loan said the loan was denied. Farmers requesting a loan stated several sources for this loan, including micro-financing organizations (or "microfinancieras"; 26.05%), farmer cooperatives (15.97%), a bank (15.4%), MOCCA anchor firms (14.91%), rural banks and rarely, informal sources (prestamistas). Borrowing from MOCCA anchor firms was not reported in El Salvador and Guatemala, and extremely low in Honduras.

Since we wanted to learn more details about the largest loan obtained, we asked farmers whether they were willing to provide additional information, or at least the interest rate paid. In Peru, fewer farmers (28.95%) were willing to provide additional information, compared to Guatemala (56.6%), Honduras (69.11%), Nicaragua (66.07%) and El Salvador (90.9%). From the farmers willing to give us more information, we learned that while they did use part of the loan in the coffee crop, they also used it in other necessities (80.53% used part of the loan on coffee and 53.35% used it for necessities other than coffee). When using the loan on coffee, most farmers used part of the loan to purchase inputs and this was the case in all countries (Table 19).

The main collateral lenders requested to grant the loan was a guarantee over the coffee harvest, though this varied by country. On average, the loan was granted for 13 months. Farmers paid this loan in different ways. While in El Salvador, Guatemala, Nicaragua and Peru most farmers reported paying this loan primarily in cash, in Honduras, this loan was primarily directly deducted from the payment for coffee sales. Deducting the loan from the payment for coffee sales was also common in Nicaragua.

Knowing the interest rate was more common in El Salvador (72.72% of farmers knew this) than in Honduras (64.61%), Nicaragua (59.92%), Peru (52.84%) or Guatemala (50.94%). Most farmers in Central America reported the interest rate paid per year. In contrast, all farmers in Peru reported the monthly interest rate paid. The annual interest rate paid in Central America ranged from 8.78% in El Salvador to 21.28% in Nicaragua. The average monthly interest rate paid ranged from 2.32% in Guatemala to 12% in El Salvador, though we find this surprising, as in this country, the monthly interest is greater than the annual interest rate reported (Table 19).

[25] Values estimated as the difference of 100 minus the percent of farmers who did not request a loan.

Table 19. Coffee: access to financing and financing requirements at baseline

Financing details	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%):						
Not requesting a loan	95.52	86.38	84.43	31.79	69.99	71.65
Requesting a loan but was denied	0.95	1.78	0.23	1.21	2.82	1.38
Source of the loan (%):						
Bank	90.91	39.62	18.46	7.97	13.22	15.4
Rural bank	0	3.77	1.54	0.36	31.4	7.98
Micro-financing	0	7.55	12.31	45.29	0	26.05
Cooperative	9.9	15.09	16.92	6.88	37.19	15.97
MOCCA anchor firm	0	0	4	26.73	0.83	14.91
Informal source (“prestamista”)	0	26.41	0	0	0	2.75
Any other source	0	1.89	16	7.33	4.13	6.67
For farmers being denied a loan, main reason (%):						
Lack of collateral	33.33	37.5	10.00	40.00	9.09	28.57
Too indebted	0.00	0	0.00	0	0.00	0
Lack of deed for my farm	66.66	25	0.00	40.00	9.09	25.00
Other reason	0.00	0	0.00	0	0	0
Prefer not to respond	0.00	37.5	0.00	20.00	81.81	46.42
For farmers obtaining a loan, % willing to provide additional information	90.90	56.60	69.11	66.07	28.95	46.9
For the largest loan obtained						
Farmers (%) investing the loan in:						
Coffee renovation	30.00	34.78	18.75	16.96	15.18	18.44
Coffee rehabilitation	20.00	21.73	9.37	23.03	11.39	18.44
Inputs for coffee	40.00	60.87	78.12	79.39	39.24	66.34
Equipment/tools for coffee	20.00	13.04	12.5	17.57	7.59	14.23
Infrastructure (milling, drying, etc.) for coffee	0.00	4.35	6.25	5.45	18.98	8.73
Other uses	90.00	43.48	59.37	40.60	82.27	55.01
Farmers (%) investing the loan on coffee	50.00	65.21	93.75	90.30	60.29	80.53
Farmers (%) investing the loan on necessities other than coffee	90.00	43.47	59.37	40.60	79.47	53.35
For this loan, % farmers required to provide…:						
No collateral	60.00	17.39	27.27	49.01	35.44	37.29
Mortgage on the farm	30.00	65.22	4.54	11.76	31.64	27.02
Guarantee over coffee harvest	1.00	13.04	59.09	31.37	29.11	30.27
Other collateral	0.00	4.35	9.09	7.84	3.79	5.40
Length of the loan (months)	26.44	15.22	17.12	12.46	9.92	12.91
Loan paid/being paid (% farmers) in…:						
Cash	90.09	95.65	18.18	70.00	79.74	72.43
Deducted from coffee harvest payment	9.09	4.35	81.81	30.00	15.18	25.04

Other payment mode	0.00	0	0	0	5.06	2.16

Table 19. Continued

Financing details	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) knowing the interest rate paid, and:	72.72	50.94	64.61	59.92	52.84	58.22
Farmers (%) that report annual interest	87.50	55.56	80.95	61.44	0.00	51.29
Interest rate paid (% per year)	8.78	17.47	13.44	21.28	n.a.	18.68
Farmers (%) that report monthly interest	12.50	44.44	19.07	38.55	100.00	48.70
Interest rate paid (% per month)	12.00	2.32	8.96	3.14	5.45	4.45
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**

3.5.4 Access to research products

Few farmers reported receiving information about coffee research, although receiving this was slightly more common in El Salvador. In general, the main source of information about coffee research products was thru non-governmental organizations (NGOs, 46.8%) or the government (25%). However, this varied greatly by country—while using the internet to obtain information about coffee was the most common source in Honduras, the government or an extensionist was the most common source in Peru, and NGOs were the most common source in El Salvador, Guatemala and Nicaragua (Table A 13).

We asked farmers whether they needed to pay to obtain information of coffee research products.[26] In general, accessing such information did not cost farmers. Most farmers said they were able to use the information to make farming decisions and the ones who were not able to use the information, said they did not consider it useful.

Although one out of four farmers needing technical advice with their coffee crop generally do not seek anyone for advice (possibly, because they do not know where to get it, or how to get it), when they do, they consult with an NGO technician, a relative or a neighbor who also grows coffee, and this varied by country (Table A 13). Further, farmers needing technical advice rarely seek the assistance of a government technician, except in El Salvador. When contacting a technician for advice, farmers usually do it over a cell phone.

These results are consistent with the market system level assessment, which suggested farmers in Peru to have reported lower access to and utility for coffee research outputs, with somewhat higher reports for all other countries. Within the farmer group surveyed, Peru stands out with the lowest (7.1%) percent of farmers who reported receiving any kind of research products for coffee with a high dependence on government extensionist, or the use of internet as a source of research

[26] Like when one pays to get a copy of a document, or to have access to the full content of a document, for example.

information for coffee. Given the relatively few number of indicators collected on farmers access to research outputs in coffee, this may be a topic to explore further in the evaluation. Further, we expected (from the market system assessment) Nicaraguan farmers to report lower percentages for access to technical assistance and lower reliance on extension agents from institutions vs neighbors and relatives, which the farmer-level results confirmed.

3.5.5 Varieties grown, tree density and crop age

While most farmers in Nicaragua and Peru reported growing only one coffee variety, farmers in all other countries reported growing more than one variety (Table 20 and illustrated in Figure 25). On average, the coffee plantations (all varieties) had an average age of 6.39 years, and coffee trees in Guatemala were the oldest (8.27 years) and in Nicaragua were the youngest (4.73 years). While in Table 20 we provide details for up to seven varieties grown, in most of the table we only discuss information for the three most commonly grown varieties. In El Salvador, the three most commonly grown varieties were Catimor (which is a family of leaf rust tolerant varieties rather than a variety itself, though many farmers in several countries utilize this term when naming their variety), Sarchimor and Salvadoreño. In Guatemala, the most common varieties were Caturra, Catimor and Catuaí. In Honduras, the most common varieties were Catimores including Lempira and IHCAFE 90. Catimor was the most grown 'variety' in Nicaragua and Peru. Among all countries, Catimor, Caturra and Lempira were planted the most.

Table 20. Coffee: varieties most commonly grown at baseline

Details of coffee varieties	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) growing:						
Only 1 variety	61.39	55.6	49.18	77.01	38.4	54.07
2 varieties	27.85	26.37	29.04	18.48	28.06	26.12
3 varieties	5.70	9.89	13.58	3.55	20.24	11.89
More than 3 varieties	5.06	3.96	7.73	0.71	13.15	6.92
Age (yr) of coffee trees at the farm level (all varieties)	6.88	8.27	6.78	4.73	5.73	6.39
Name (and % coffee area) of the most commonly planted varieties:						
Variety 1	Other (33.54)	Caturra (27.99)	Lempira (39.98)	Catimor (81.43)	Catimor (72.12)	Catimor (45.90)
Variety 2	Catimor (18.48)	Catimor (20.25)	IHCAFE (27.72)	Other (7.35)	Caturra (9.90)	Other (10.28)
Variety 3	Sarchimor (15.92)	Catuí (15.18)	Catimor (14.16)	Catuí (3.24)	IHCAFE (6.43)	Caturra (8.71)
Variety 4	Salvadoreño (14.51)	Bourbon (11.89)	Parainema (5.72)	Parainema (2.25)	Bourbon (3.21)	Lempira (8.37)
Variety 5	Bourbon (9.97)	Other (9.57)	Pacamara (3.12)	Caturra (2.19)	Tipica (2.89)	IHCAFE (6.08)
Variety 6	Lempira (2.56)	IHCAFE (4.41)	Other (3.10)	Pacamara (1.32)	Catuaí (2.81)	Catuaí (4.77)
Variety 7	Anacafe (1.40)	Sarchirmor (2.51)	Catuí (2.21)	Lempira (1.15)	Castillo Colombia (1.14)	Bourbon (4.58)
Other varieties	3.59	8.16	3.96	1.04	1.46	11.28
For the main 3 coffee varieties…						
# of trees planted:						
Variety 1	2988	4971	7640	15314	8925	9540
Variety 2	2750	2484	6974	10161	2959	4072
Variety 3	2684	3759	6898	12268	2859	4386
# of trees planted/ha:						
Variety 1	1958	6290	3475	4580	4892	4620
Variety 2	2800	5980	3533	4844	4491	4216
Variety 3	1634	5210	3619	4892	4862	5487
% of productive trees:						
Variety 1	93.39	92.03	95.94	81.36	89.56	85.60
Variety 2	100.00	74.78	92.57	77.70	85.55	86.52
Variety 3	92.87	70.94	93.61	71.43	88.46	88.25

Table 20. Continued

Details of coffee varieties	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Age (yr) of coffee trees:						
Variety 1	8.25	16.46	9.27	21.25	16.66	23.22
Variety 2	6.50	7.28	10.85	8.31	6.69	10.09
Variety 3	4.32	10.91	8.73	6.75	7.81	10.65
Distance (m x m) between trees:						
Variety 1	1x1	1.5x1	2x1	2x1.5	1.5x1.5	1.5x1.5
Variety 2	1.2x2.15	1x1.5	2x1	1x2	1.2x1.5	1.2x1.5
Variety 3	1.5x1.5	1.5x1	2x1	2x1.5	1.2x1.5	1.5x1.5
% trees that were renovated in the 2019-2020 ag. year:						
Variety 1	2.80	2.11	1.12	3.86	3.00	3.09
Variety 2	0.00	3.18	0.94	3.01	5.48	2.43
Variety 3	1.31	1.47	1.88	7.19	1.82	4.02
% trees that need to be renovated:						
Variety 1	0.00	9.18	5.40	7.28	4.56	5.46
Variety 2	0.00	9.41	5.84	8.94	5.88	4.72
Variety 3	0.00	9.17	3.66	5.24	5.55	7.78
% farmers who pruned trees in the 2019-2020 ag. year:						
Variety 1	26.43	56.96	33.85	41.69	43.45	39.64
Variety 2	0.00	28.97	25.25	30.77	33.95	31.93
Variety 3	34.57	35.64	33.03	34.78	36.52	43-11
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**
*1 ha (hectare) = 10,000 square meters						

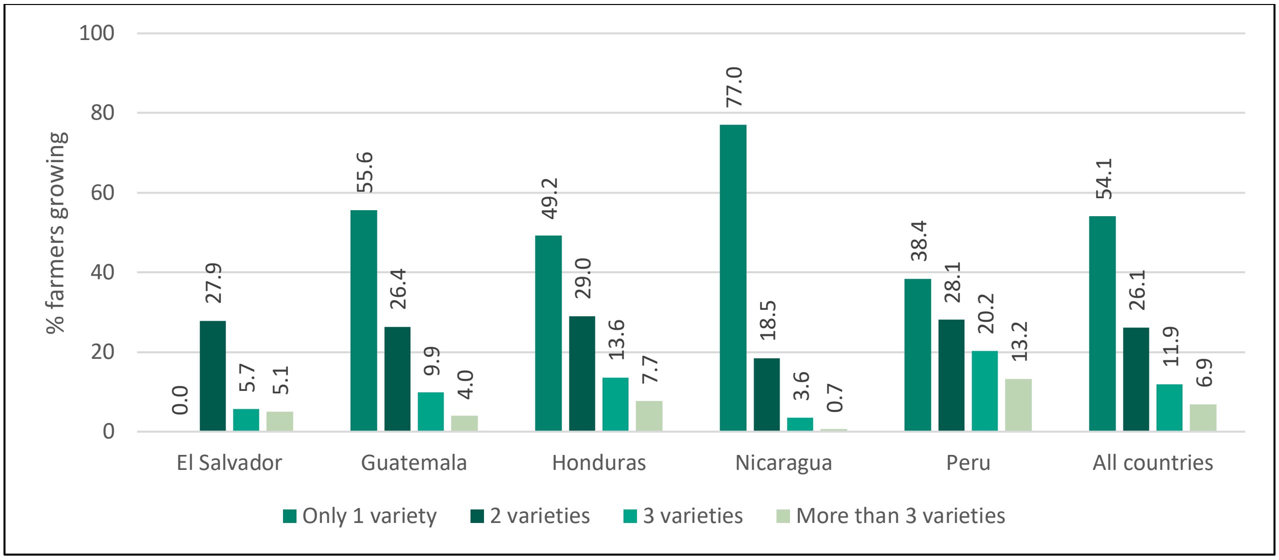
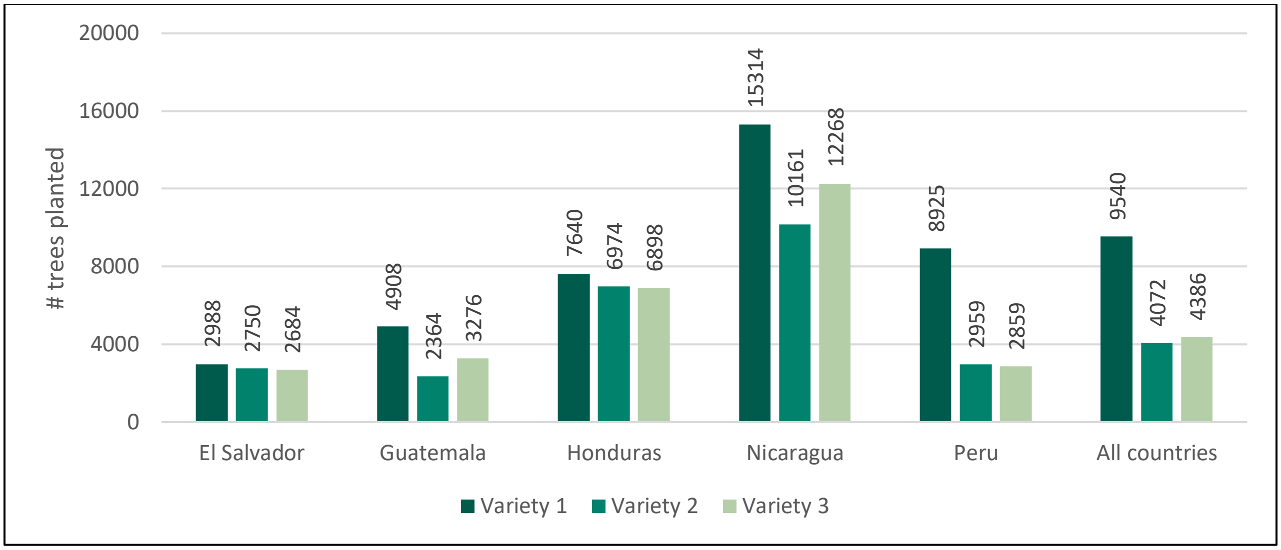


Figure 25. Number of coffee varieties grown, by country

As Figure 26 illustrates, for the most common variety, the number of trees planted ranged from 2,988 in El Salvador to 15,314 in Nicaragua (Table A 11). For the second and third most planted varieties, the number of trees planted were much lower, but similar between them. The planting rate in the evaluated countries was higher for the third variety than the first and second varieties (5,487 trees/ha vs. 4,620 trees/ha and 4,216 trees/ha, respectively). For comparison, we include MOCCA-recommended planting densities in Table 21.

Table 21. Coffee: planting densities recommended by MOCCA according to variety or planting system

Variety	Between rows (m)	Between plants (m)	Total plants/mz
Sarchimores & Catimores, Paché, Lempira, Anacafe-14, Starmaya, IHCAFE- 90, Maragogype, Maracaturra, T-5296, T-5175	2	1,50	2300
	2,5	1	2800
Caturra, Catuaí, Villa Sarchí, Laurina	2	1	3500
Plantations with the following characteristics: mechanized management system and the variety is resistant to rust	3	0,80	2900
	2,5	0,80	3500
	2,5	0,67	4210
Typica, Bourbon, Geisha	2	2	1750
*1 mz (manzana) = 7,000 square meters			



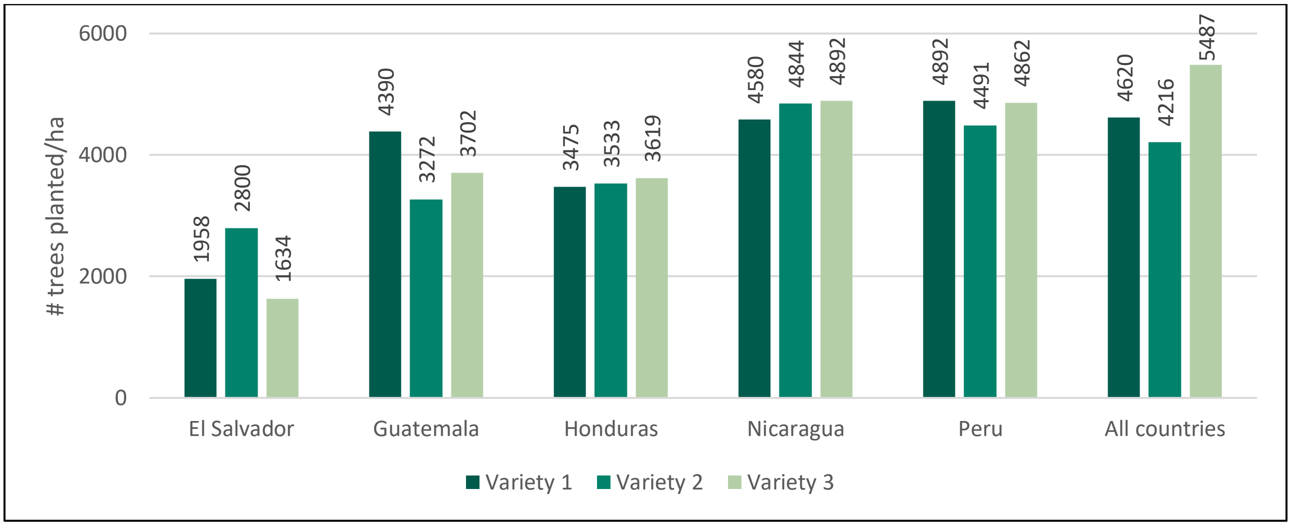
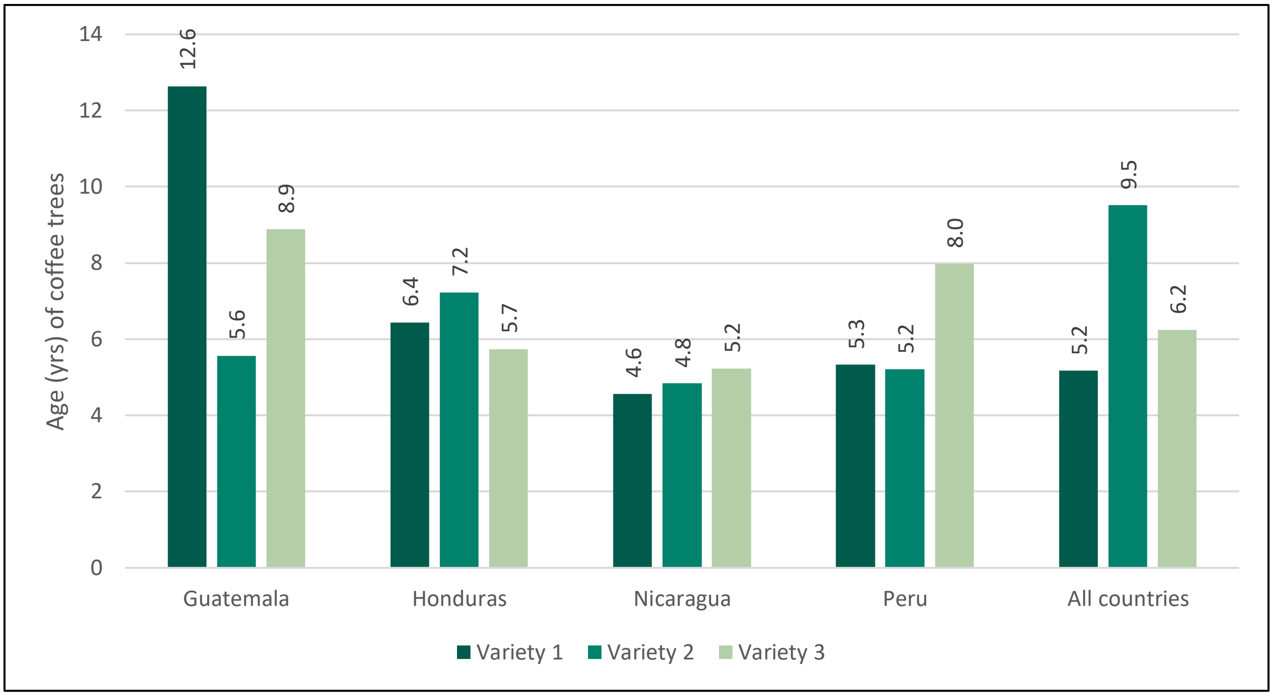


Figure 26. Coffee trees (top) and trees/ha (bottom) planted with the three most common varieties, by country

Farmers reported that for all three varieties, most trees were productive, ranging from 85.6% for the first variety to 88.25% for the third variety (Table 20). Although the coffee trees of variety 1 were the oldest, this varied by country (Figure 27). Farmers reported that for the most grown variety, they pruned almost 40% of the trees in the agricultural years of reference, and a higher share of coffee trees of this variety were pruned in Guatemala (Figure 28).

In general, farmers renovated few trees of the three most grown varieties in the agricultural years of reference (Figure 29), perhaps because coffee plantations are not too old. However, farmers reported that between 5.46% and 7.78% of the trees of the variety 1 and variety 3, respectively, needed renovation.



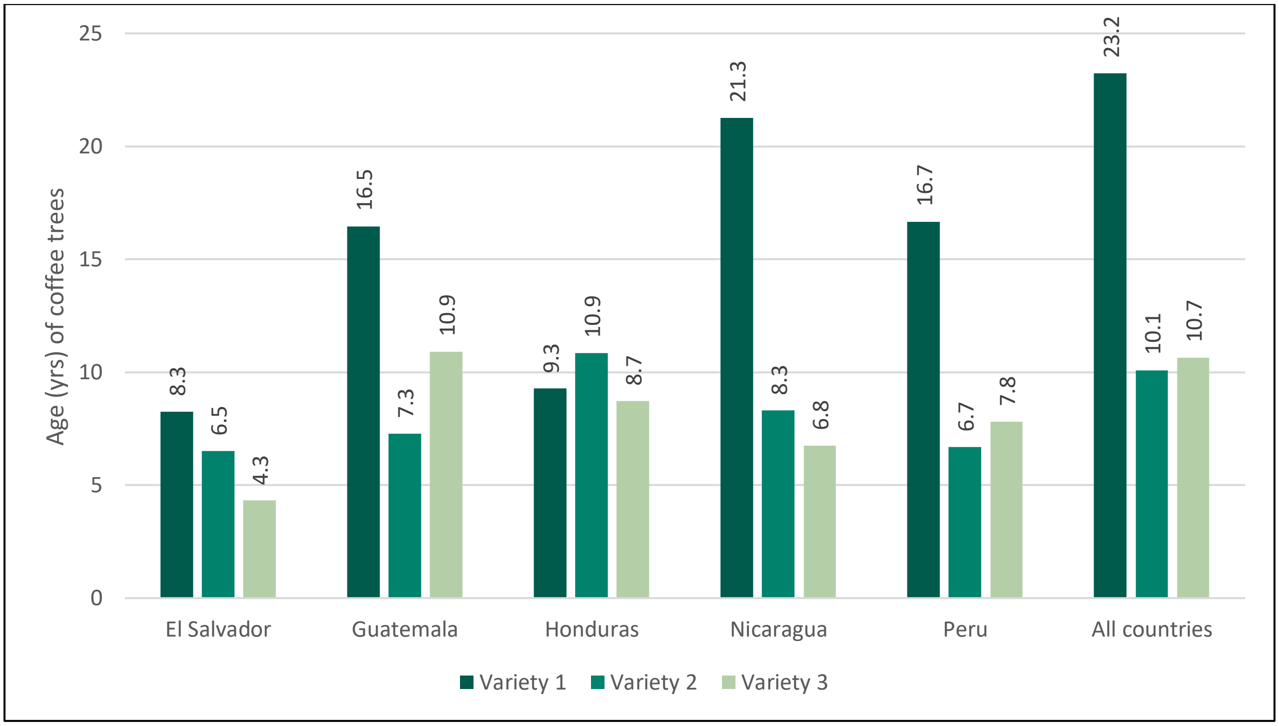


Figure 27. Age of coffee trees of the three most common varieties, by country

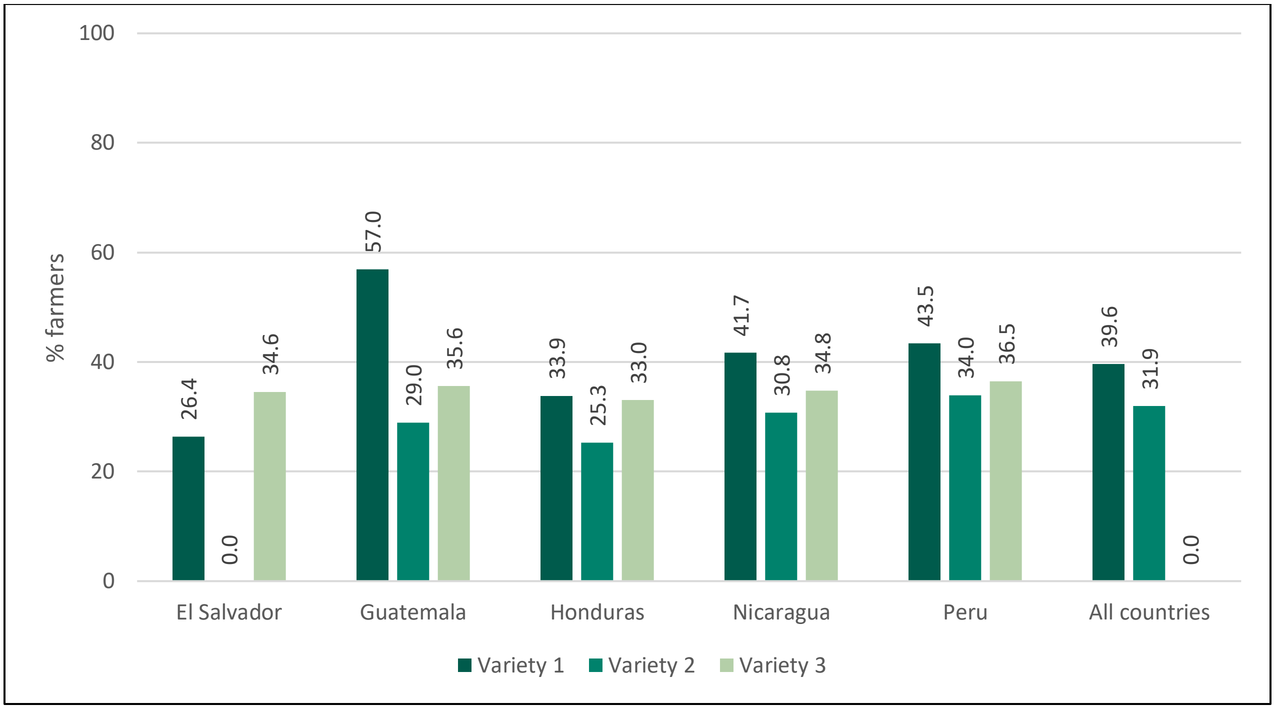
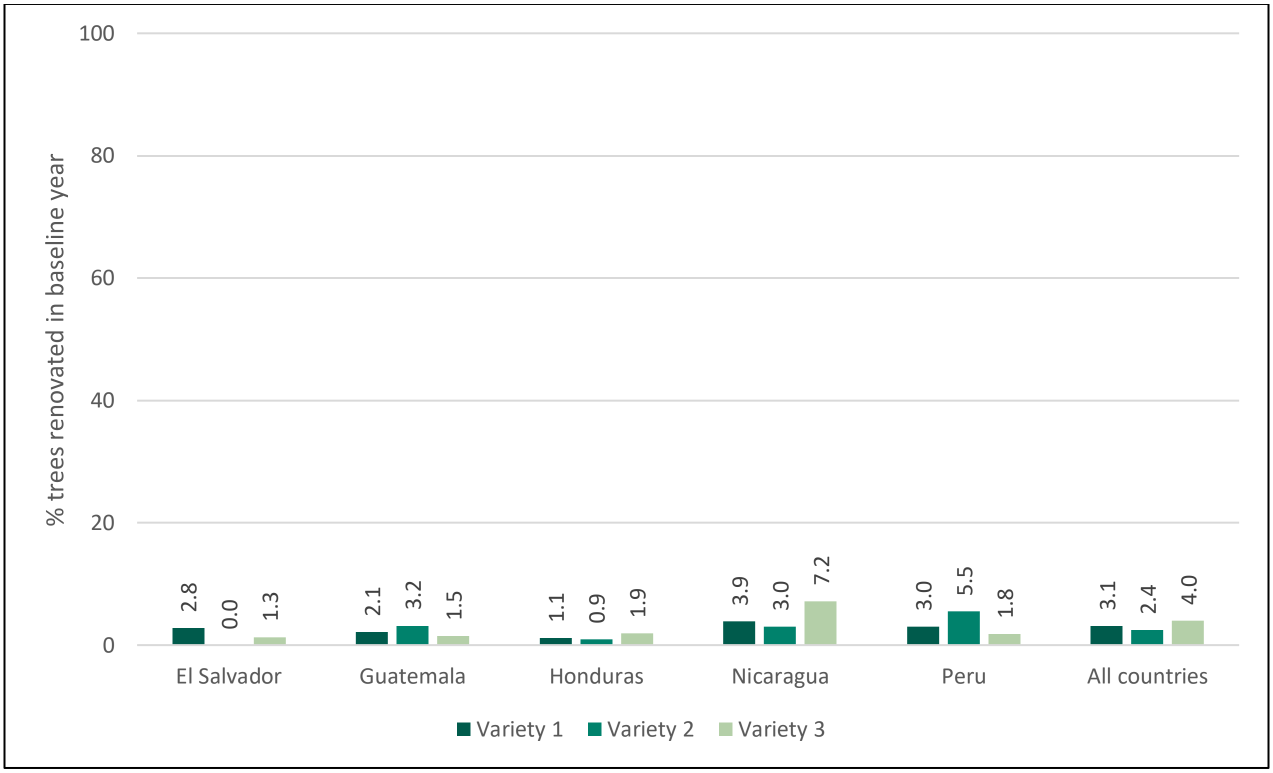


Figure 28. Farmers pruning coffee trees of the three most common varieties, by country



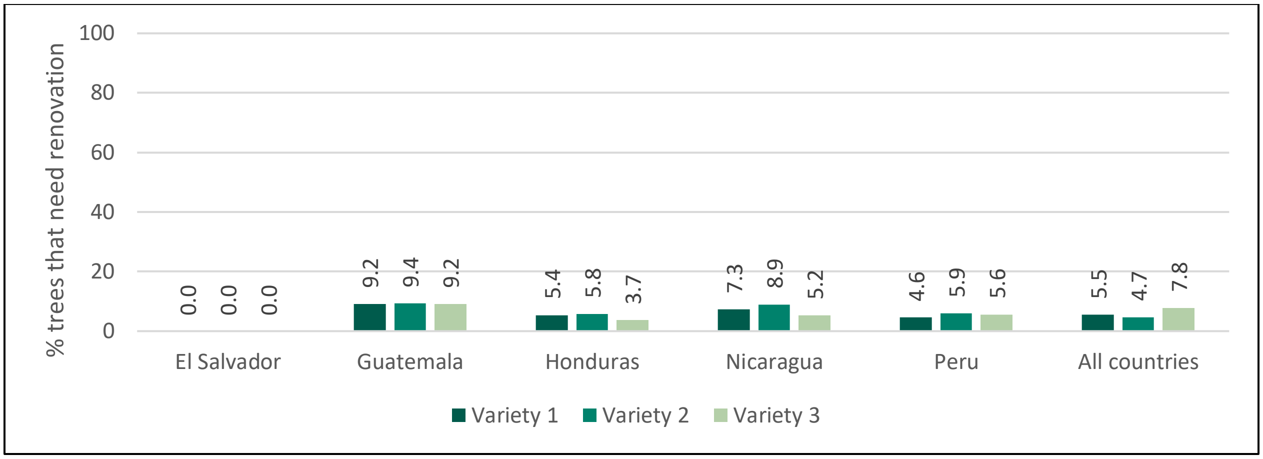


Figure 29. Coffee trees renovated (top) and in need of renovation (bottom) of the three most common varieties, by country

3.5.6 Coffee shade

Most of the coffee plots had 5%-24% shade (35.78% of coffee plots) or 25-39% shade (31.07% of coffee plots), and few plots had <5% or >40% shade (Table 22). We observed the same trend in all countries. In almost one out of four plots, farmers reported planting shade trees within the two years prior to the interview date and in a little over one-half of the plots, farmers pruned the shade trees in the baseline year.

For each coffee plot, we wanted to know about the use of cover crops or dead cover (mulch, crop residues) While having dead cover was common (59.49% of plots had this), using cover crops was less common (only 25.99% of plots had this). The use of dead cover was highest in Peru and El Salvador (Table 22).

Table 22. Coffee: shade in coffee plots at baseline

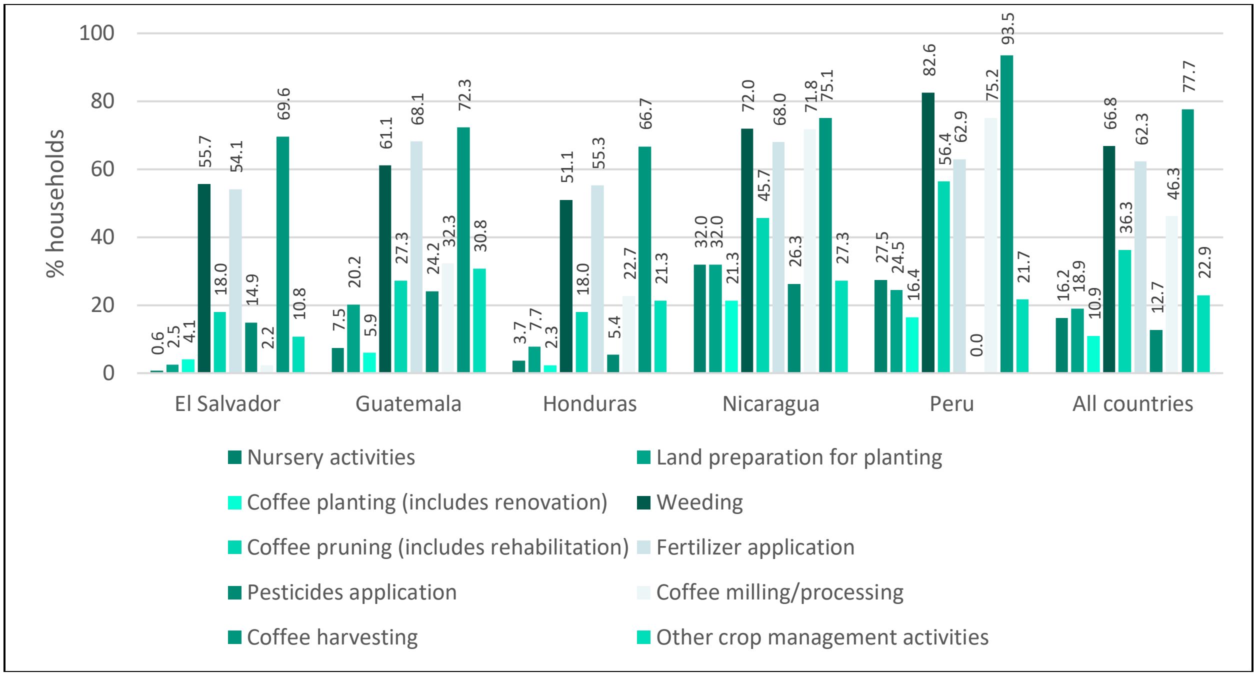
Details	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Share (%) of plots...:						
Without shade trees	1.11	5.27	2.51	1.80	2.79	2.80
With <5% shade	4.92	13.15	14.44	10.84	15.86	12.63
With 5-24% shade	23.96	33.23	36.67	31.39	45.13	35.78
With 25-39% shade	32.91	34.14	29.79	40.09	23.39	31.07
With >40% shade	37.4	13.76	16.42	16.14	12.56	17.60
Plots (%) where shade trees were:						
Planted in the past 2 years	14.6	24.84	28.82	36.44	17.51	24.13
Pruned in the 2019-2020 ag. Year	58.88	52.53	40.08	55.35	53.07	51.77
Plots (%) with:						
Dead cover (mulch, residues)	63.33	45.76	57.37	53.73	71.61	59.49
Cover crops	12.85	15.96	37.99	26.56	30.81	25.99
Number of coffee plots	**347**	**663**	**710**	**800**	**1135**	**3655**

3.5.7 Use of labor

Collecting labor data (both family and hired labor) was challenging as farmers had difficulties recalling details about the use of labor in coffee activities. To facilitate data collection, we inquired about the use of labor for categories of activities instead of each possible activity, as detailed in Table A 14

Although family and hired labor participated in all ten categories of activities done in coffee plots, the main activities where household members participated were the harvest (77.66% of households reported their members participated in this activity), weeding (66.82%), fertilizer application (62.25%) and coffee milling/processing (46.27%). While the participation of household members in milling/processing activities was more relevant in Nicaragua and Peru, the participation in fertilizer application was less common in El Salvador and Honduras. We observed something similar for hired labor. Hiring labor was more common for the harvest (77.53%), weeding (59.07%) and fertilizer application (50.15%) (Figure 30).

In the coffee harvest, between four and five household members participated an average of 18.31 days/ha, and farmers hired almost seven people to work an average of 29.51 days/ha in this activity (Figure 31). There were differences between countries in the number of people (family or hired) and days worked on this activity. In Guatemala, the number of family members who harvested coffee was highest compared to other countries, and in Peru and Guatemala these members worked the highest number of days. In contrast, few people were hired in El Salvador to harvest coffee, and they worked the fewest days on this activity.



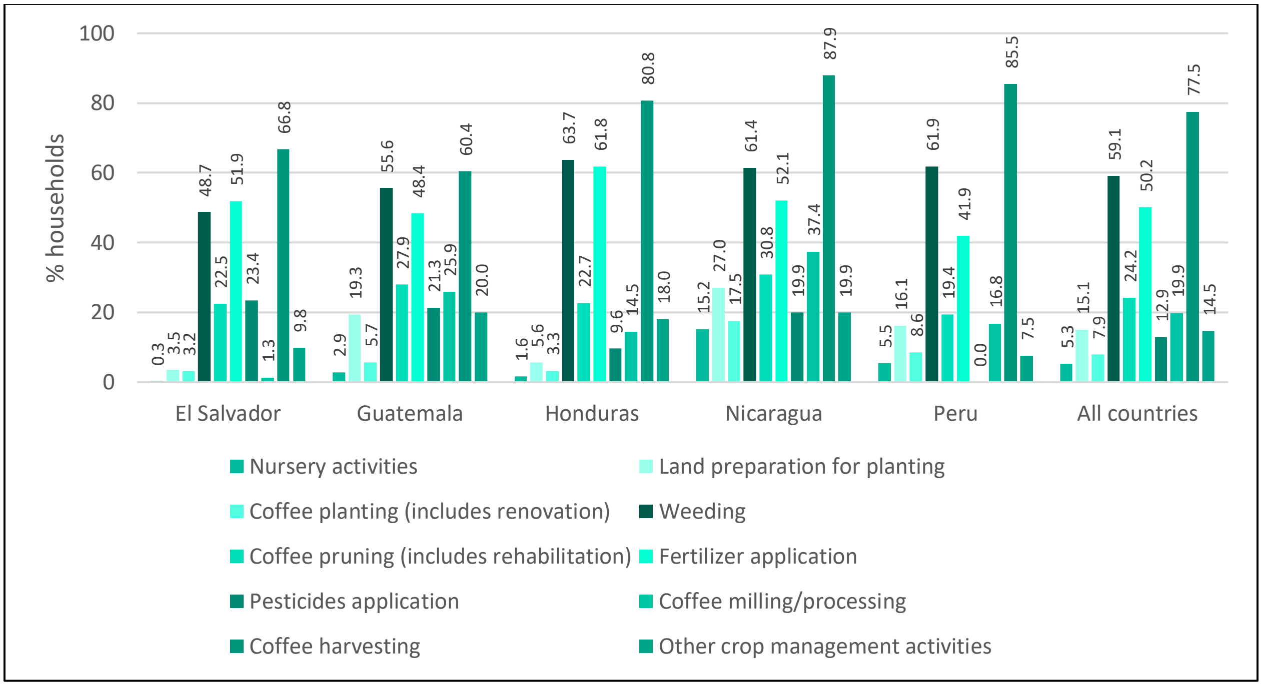


Figure 30. Use of family (top) and hired (bottom) labor on coffee activities, by country

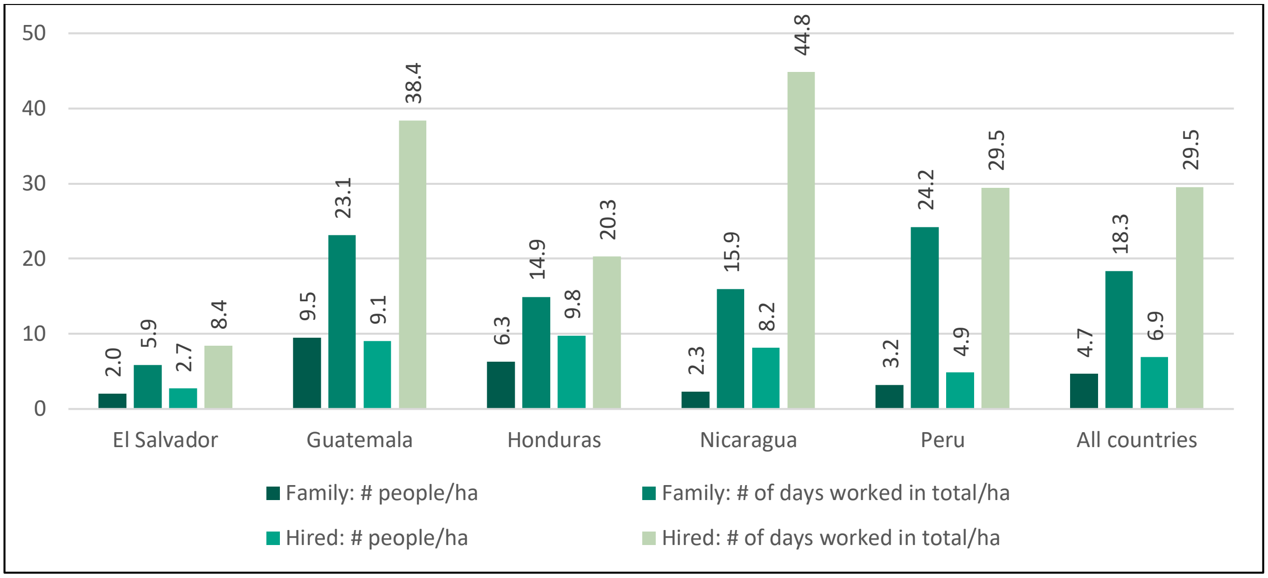


Figure 31. Use of family and hired labor on coffee harvest, by country

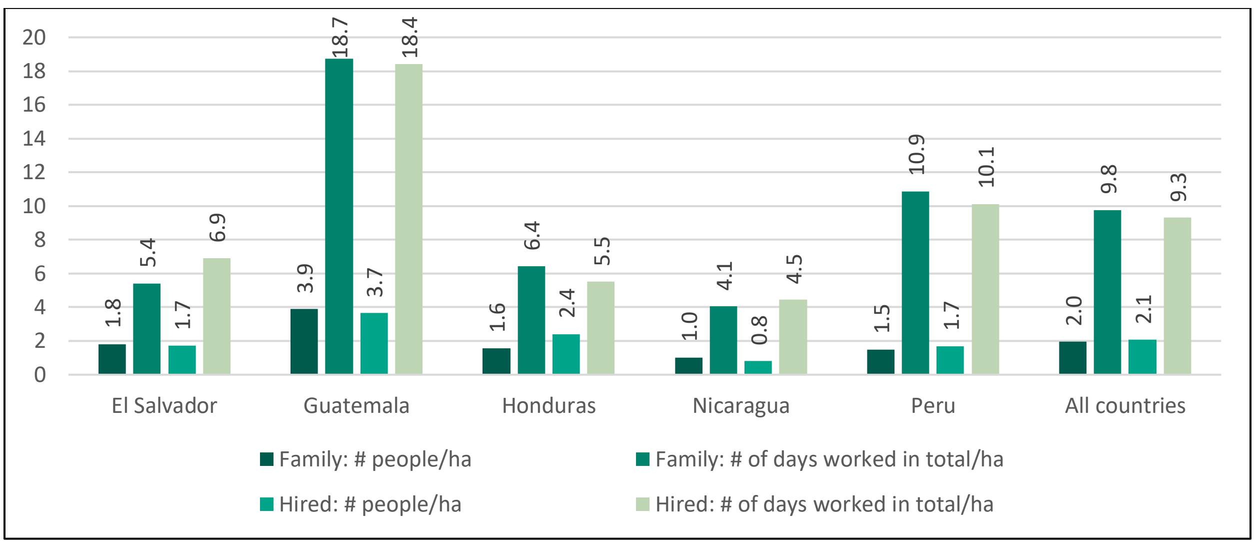


Figure 32. Use of family and hired labor on weeding coffee plots, by country

Regarding the work done to control weeds in the coffee plots, approximately two people (household members or hired labor) participated an average of 9-10 days/ha on this activity (Figure 32). While the differences across countries in the number of people that worked on this activity were small, the differences in the number of days/ha they worked on this activity were large. In Guatemala, the number of people (family or hired) that worked on this activity was higher than in all other countries. Similarly, it was in this country where the number of days both family and hired labor worked on this activity was the highest.

The application of fertilizers in coffee plots required two household members and between one and two hired people (Figure 33). The average number of days/ha worked on this activity was the same (roughly 6 days) for family and hired labor. While there were small differences between countries in the number of people (family or hired) that worked on this activity, the differences in the number of days/ha they worked were large. In Guatemala, the number of days household members and hired people worked on this activity was much higher than in all other countries. When asked about the daily wage ("jornal" in Spanish), farmers reported an average of US$6.69/day, and this cost was lowest in Nicaragua (US$4.32/day) and highest in Peru (US$8.80/day). Additional details about labor in coffee activities are in Table A 14

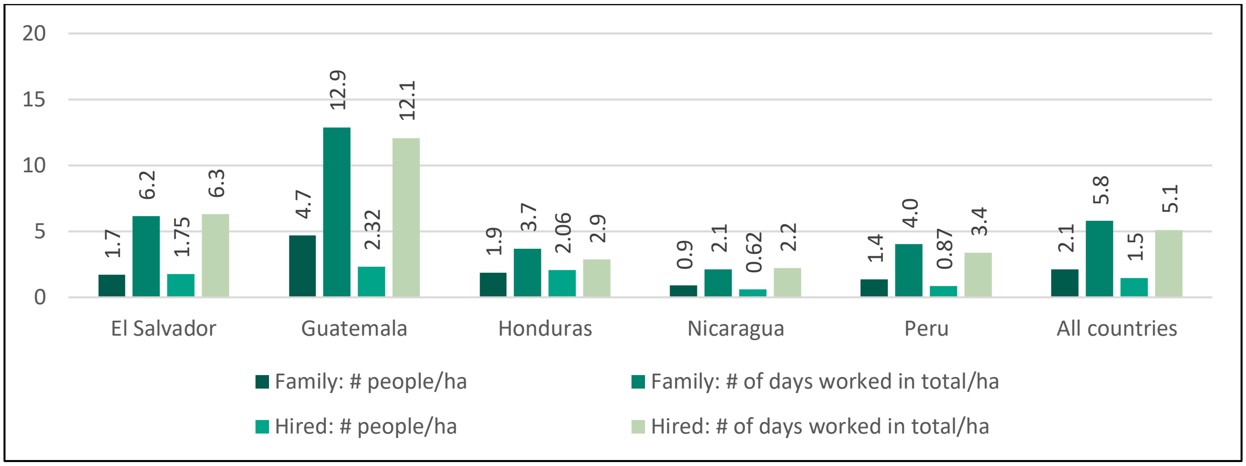


Figure 33. Use of family and hired labor on coffee fertilization, by country

3.6 Evaluation of coffee trees in the main plot

Previous experiences have shown us that in some cases, farmers' self-reported information about land (coffee) area can be inaccurate. To be able to correct this potential bias, enumerators visited (together with the farmer) the main coffee plot, as determined by the plot where farmers dedicate most time implementing agricultural practices. The objective of this visit was to measure the coffee area and make a diagnosis of the coffee trees, following Aguilar and Guharay (2002). With this diagnosis, we were able to determine the share of productive trees, trees in need of pruning, in need of stumping, that need to be removed, recently renovated/stumped and physical failures (i.e., missing trees). The result of this field visit are in Table 23, and we interpret next.

The main coffee plot had an average of 2.25 ha, and this area was smallest in Guatemala (0.84 ha) and largest in El Salvador (3.68 ha). There were approximately 7,720 coffee trees in this plot (roughly 3,431 trees/ha), ranging from 4,809 trees in El Salvador to 11,437 trees in Nicaragua. We also present median values in Table 23. A little over 82% of the trees were productive (range: 72.61% in Nicaragua to 87.75% in Peru), 13.18% needed pruning (range: 8.12% in Nicaragua to 17.89% in El Salvador), 6.2% needed stumping (or rehabilitation), 3.42% need to be removed (or renovated), 5.97% were recently renovated or stumped, and 4.14% were missing. These suggest that roughly 19.38% of the trees need rehabilitation (sum of the ones that need pruning + stumping) and 7.56% need renovation (sum of the ones that need to be removed + physical failures). Details about the differences between countries are in Table 23.

Table 23. Coffee: technician's evaluation of the main coffee plot, at baseline

Evaluation details	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Area (ha) of the main coffee plot	3.68	0.85	2.20	2.86	2.16	2.25
# coffee trees (median) in this plot	2,500	2,012	4,400	8,000	6,200	5,000
# coffee trees (mean) in this plot	4,809	4,816	9,064	11,436	7,836	7,720
Percent of:						
Productive trees	81.75	81.42	85.23	72.61	87.75	82.38
Trees in need of pruning	17.89	14.97	12.84	8.12	13.24	13.18
Trees in need of stumping (recepo)	5.95	9.24	5.28	6.45	4.75	6.20
Trees that need to be removed	3.64	6.51	1.95	3.04	2.43	3.42
Trees recently renovated or stumped	6.10	6.68	4.32	7.82	5.28	5.97
Physical failures (missing trees)	4.89	4.73	2.71	5.36	3.51	4.14
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**
*1 ha (hectare) = 10,000 square meters						

3.7 Coffee harvesting and income from coffee sales

36.74% of farmers reported the harvest evaluated in the year of reference corresponded to a high-production year.[27] On average, farmers harvested 665 kg of green coffee/ha, ranging from 187 kg green coffee/ha in El Salvador to 827 kg green coffee/ha in Honduras (Table 24). Farmers sold an average of 1,706 kg of green coffee (range: 369 kg green coffee in El Salvador to 2,907 kg green coffee in Nicaragua), which is proportional to the coffee area in all countries except El Salvador. The amount sold is equivalent to selling 683 kg of green coffee/ha, and this was lowest in El Salvador (133 kg green coffee/ha) and highest in Guatemala (821 kg green coffee/ha).[28] Selling coffee generated an average gross annual income of US$4,940, equivalent to US$2,079/ha. In El Salvador, the gross annual income generated per hectare of coffee was the lowest—US$765/ha. Finally, most farmers sold dry parchment coffee, followed by wet parchment and cherry, and the Table 24 includes the average price reported by farmers selling in each of these presentations. In all countries except El Salvador and Peru, the average prices were as expected—highest for dry parchment, and lowest for cherry coffee.[29]

[27] In coffee, usually the plants have one year of high productivity, followed by a year of low productivity.
[28] The inconsistencies in the average values of harvested green coffee/ha and amount sold of green coffee/ha are, as TNS stated, due to the fact that farmers many times do not report in their harvest, amounts that they keep for own consumption (roughly 90 kg). However, they sometimes report it in the sales, particularly when this is sold as low-quality coffee (but even then they do not report it in the amount harvested).
[29] This may be driven by farmers miss-reporting the unit price (i.e., too low for wet parchment and too high for green coffee). After cleaning data, we could not further fix these issues.

Table 24. Coffee: harvest and income from sales at baseline

Details	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) reporting the baseline year was a high-production year	24.45	40.61	30.75	46.81	36.78	36.74
Coffee area (ha)**	3.34	1.11	3.03	4.05	2.55	2.74
Coffee yields:**						
Kg harvested/ha (green coffee)	187	699	827	746	682	665
Kg sold/ha (green coffee)	133	821	802	794	685	683
Amount of coffee sold (kg green coffee)**	369	951	1,969	2,907	1,839	1706
Income from coffee sales:**						
US$	1,601	2,417	5,298	7,685	6,170	4,940
US$/ha	765	2,298	2,237	1,940	2,496	2,079
% farmers who sold coffee, and of those…:**	91.13	90.98	96.95	98.34	99.26	95.90
% selling cherry coffee	52.94	46.62	16.94	1.19	0.29	19.37
And price of cherry coffee (US$/kg)	3.69	0.91	1.07	0.70	3.68	1.99
% selling wet parchment	n.a	1.63	45.34	75.65	0.59	23.28
And price of wet parchment (US$/kg)	n.a	1.97	1.93	1.05	2.86	1.38
% selling dry parchment	2.07	48.71	40.09	22.67	99.55	51.41
And price of dry parchment (US$/kg)	2.55	2.82	1.86	1.11	2.69	2.46
Number of plots	**316**	**455**	**427**	**422**	**677**	**2297**

*1 ha (hectare) = 10,000 square meters

** A total of 68 observations (18, 16, 19, 11 and 4 in El Salvador, Guatemala, Honduras, Nicaragua and Peru, respectively) were excluded for these variables because presented extreme values (much larger than 3 standard deviations above the mean, when estimating income from coffee sales/ha)

3.8 Other crops grown

Roughly, 13% of farmers reported growing other crops in addition to coffee, ranging from 6.94 in Peru to 23.33% in Nicaragua (Table A 15). On average, these farmers grew one additional crop at the most. For farmers growing more than two crops, we asked them to identify the main two crops according the quantity produced, as we wanted to focus only on the two most important crops. For these other crops (up to two), we asked questions about the area planted, quantity produced and use of the harvest. Although we expected complete information about these other crops, only 34.5% of farmers provided enough information to include in the analysis.

While in Central America the two main crops grown in addition to coffee were maize and plantains (except in Guatemala where they were maize and peanuts), in Peru they were plantains and cassava. On average, farmers planted 0.46 ha with both these crops, and this area ranged from 0.10 ha in Honduras to 0.91 ha in Nicaragua (Table A 15). Roughly, 46% of farmers reported selling approximately 34% of their harvest. The number of farmers reporting selling part of these crops and the share of the production sold was lowest in Peru and highest in Nicaragua and El Salvador. The latter suggests that, as one would expect (given the crops reported), farmers left part of this production for household consumption. Finally, farmers who sold part of these crops reported a gross annual income of US$335 from these sales.

3.9 Socioeconomic characteristics of farmers and their households

3.9.1 Characteristics of interviewed farmers

We sampled farmers using a sampling frame provided by TNS. While we attempted to interview the sampled farmers, in few cases (5.51%) this was not possible (Table 25). In 94.32% of the households, the interviewed farmer was in charge of coffee plots. The interviewed farmers were mostly male (75.64%), most were married or lived in free union with a spouse (78.82%), and were almost 47 years old. While there were differences in these indicators between countries, these were small. Finally, given that 75.8% of the sampled farmers were male (practically the same share as the interviewed farmers), we deduct that in the few households where we had to interview a person different from the sampled farmer; the interviewed person had the same sex as the sampled farmer.

Table 25. Coffee: demographic characteristics of beneficiary farmers at baseline

Characteristics of farmers	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Characteristics of interviewed person (% yes)						
Is the person in charge of coffee plots	94.93	94	94.35	89.57	97.18	94.32
Sex of interviewed person (% male)	62.54	75.41	77.34	81.75	76.96	75.64
Is married/free union Age (years)	62.02 51.87	83.11 49.04	83.05 45.80	85.07 43.29	77.25 45.75	78.82 46.78
Does any crop activity in the farm, and type of activity (% yes):	92.97	75.58	78.98	90.99	94.27	86.83
Coffee activities (crop management, harvest, marketing)	77.06	75.76	62.99	30.56	25.86	49.49
Activities in crops other than coffee	7.88	7.97	16.51	22.78	22.39	16.79
Activities in small animals	1.43	4.29	1.52	1.87	13.36	5.68
Other activities	13.62	11.96	18.96	44.77	38.36	28.01
Is the person from sampling list	94.62	93.33	95.29	92.18	96.15	94.49
Characteristics of farmer from sampling list						
Sex (% male)	60.13	75.12	77.25	84.94	77.16	75.80
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**

3.9.2 Household and home characteristics, and household income

In 51.75% of households, there were two household heads, and households with two heads were more common in Peru and Nicaragua, and least common in Guatemala (Table A 16). The average head of both heads was 47 years. Though we wanted to estimate household size and the rate of dependents, we could not do it, as many enumerators did not collect detailed information about other household members.[30]

In less than 10% of households, a household member had migrated within six months prior to the interview. In households where at least one member migrated, farmers reported that 1-2 members had left the household and in 57.46% of these households, at least one member migrated to another country. Not surprisingly, the share of households reporting the latter was highest in El Salvador, Guatemala, and Honduras, all countries in the so called Northern Triangle in Central America, a region characterized by high migration rates, a social problem driven by many factors, and affecting agriculture in general. Despite this, few households (9.31%) reported receiving remittances in the 12 months preceding the interview date. Also, receiving subsidies from the government or NGOs was more common in Peru and rare in Nicaragua (Table A 16).

When asked about how the pandemic caused by COVID-19 had affected them, we had to separate the analysis for each cohort of farmers, as the way the question was structured changed. Roughly one of every two cohort 1 farmers reported that they had not been affected, though this greatly varied by country. This was expected, as when baseline data collection started for this cohort, the COVID pandemic was starting, and the year of reference was pre-pandemic. In contrast, only 23.44% of cohort 2 farmers reported the pandemic had no effect on their household (the year of reference was the first year of the pandemic). For households affected by the pandemic, the main effect for cohort 1 households was a reduced income, followed by the shortage of labor for crop activities. In contrast, for cohort 2 households, the main effect was the high input costs, followed by labor shortages for coffee harvest.

Regarding the characteristics of the homes, most had access to water and in the households with no direct access to water, farmers reported they needed to walk roughly 12 minutes to get water. We estimated three indices for the assets owned by the household,[31] and these are the only variables estimated using the combined data of all countries. As explained above, by construction, the average value of the index is zero and we can compare the values for each country against each other. Households in Honduras (first) and El Salvador (second) are better off than households in Guatemala (third), Peru (fourth) and Nicaragua (fifth), according to the home assets index. In contrast, households in Guatemala (first) and Honduras (second) are better off than households in other countries according to the transportation assets index, and households in Peru (first) and Nicaragua (second) were better off than households in the other three countries according to the index of productive assets.

Finally, the average gross annual household income was US$5,246, ranging from US$2,490 in El Salvador to US$7,921 in Nicaragua. As we can see at the bottom of Table A 16, most of the household income came from agricultural activities, and within agriculture, coffee sales were the main source of income (Table 24).

[30] Using MOCCA's farmer registration database, TNS estimated average household sizes of 5 for Guatemala (from 6,598 farmers) and Nicaragua (1,793 farmers), and 4 members for Honduras (3,876 farmers) and Peru (769 farmers), which can be used as reference.
[31] We use these as proxy for wealth as when households become wealthier they invest more in assets.

3.10 Determinants of adoption of renovation and rehabilitation, and factors affecting coffee yields

In the three regressions (renovation, rehabilitation and yields) we considered variables that would affect the adoption of R&R practices and yields, that were conceptually appropriate and with high quality data, and that were exogenous. Given that the processes that determine adoption of R&R practices are similar, we used the same variables in these two regressions. However, for yields, some of the variables were different as we consider the factors that affect yields are different.

In R&R regressions, we included the sex and age of the household head, whether decisions about what inputs to purchase for coffee were taken jointly (between the two heads), the coffee area, number of coffee trees, number of MOCCA practices implemented, whether farmers sold thru MOCCA's anchor firms, whether a household member had migrated within six months prior to the interview, whether anyone in the household received remittances within 12 months prior to the interview, the number of coffee varieties, the distance between the farm and the closest town where farmers could purchase inputs, altitude, whether farmers obtained information of coffee research products from NGOs or the Government, the age of the coffee trees, if anyone in the household had access to credit, the share of coffee trees planted under a variety susceptible to leaf rust, whether the coffee had a shade crop, and an index of productive assets.

In the yields regression, we included the sex and age of the household head, whether decisions about what inputs to purchase for coffee were taken jointly (between the two heads), number of coffee trees/ha, number of family members working in all coffee activities, whether a household member had migrated within six months prior to the interview, whether anyone in the household received remittances within 12 months prior to the interview, the number of MOCCA practices implemented, the number of coffee varieties, the share of coffee trees planted under a variety susceptible to leaf rust, the distance between the farm and the closest town where farmers could purchase inputs, the number of farm certifications, altitude, whether the coffee had a shade crop, the age of the coffee trees, if anyone in the household had access to credit, whether farmers obtained information of coffee research products from NGOs or the Government, and an index of productive assets.

In all three regressions, the combined analysis (for all countries) included variables to control for country-specific effects (i.e., dummy variables for countries) and included a few interaction terms. Further, in all regressions we estimated standard errors considering municipality fixed effects. Next we discuss the regression results.

3.10.1 Renovation

The factors affecting the likelihood of implementing renovation practices in the coffee farm vary by country. Table 26 presents the Probit regression results (marginal effects) for each country separately, and for all countries combined, and Table A 17 presents descriptive statistics of the variables included in this regression. We interpret the main (statistically significant) results for each country.

In El Salvador, only one of the evaluated factors had a statistically significant influence in the probability of implementing renovation practices: the distance between the farm and the closest town (negative effect). As the time required to reach the closest town increases, farmers are less likely to implement renovation practices. This is understandable as the farther farmers are located, the more difficult it becomes for them to have access to inputs and services (including technical assistance to gain knowledge, planting material, etc.), which could make it more difficult for them to renovate their plantations.

In Guatemala, five[32] of the evaluated factors had a statistically significant influence in the probability of implementing renovation practices: making joint decisions about purchasing coffee inputs (negative effect), the number of coffee trees (positive effect at a decreasing rate), altitude (positive effect at a decreasing rate), obtaining information of coffee research products from NGOs or Government (negative effect), and the age of coffee trees (negative effect). Household heads making joint decisions about which inputs to purchase for coffee are less likely to do renovation in their farm. We suspect that this finding may be influenced by the low number of households reporting this (Table A 17) as is rare to make joint decisions (only 4.4% of farmers reported this). As the number of coffee trees increase, farmers are more likely to do renovation up to certain number of trees,[33] after which farmers are less likely to renovate.[34] As the altitude where the coffee is located increases, the probability of adopting renovation practices increases, up to 3,169 m.a.s.l., after which the probability of adoption starts to decrease, most likely because coffee is seldom grown at such altitude.[35] Surprisingly, when farmers seek for information about coffee research products from NGOs or Government sources, the likelihood of renovating coffee decreases. This is difficult to explain and requires further analysis, but could be driven by the low number of farmers who reported doing this (8.5%). Finally, as the coffee trees become older, farmers in Guatemala are less likely to renovate, which contradicts our prior belief about this (as one would expect them to be more likely to renovate). However, given that coffee plantations are on average 9.5 years old (Table A 17), it is possible that farmers have not faced the need to renovate their plantations, thus explaining this finding.

In Honduras, only two factors affected the probability of doing renovation: making joint decisions about purchasing coffee inputs (negative effect) and the index of productive assets (positive effect). We only interpret variables that have not been interpreted before (as the explanation is the same), or that have the opposite effect. As farmers invest more in productive assets (i.e., have more of such assets), they are more likely to renovate, possibly because, as explained above, this is an indicative of wealth and farmers have more resources to invest in this activity.

In Nicaragua, four factors had a statistically significant effect on the likelihood of renovating coffee: selling coffee to MOCCA's anchor firms (positive effect), the number of coffee varieties grown (positive effect), having shade in the coffee plots (negative effect), and obtaining information of coffee research products from NGOs or Government (positive effect). Farmers selling coffee thru MOCCA's anchor firms are more likely to implement renovation practices,

[32] This does not include quadratic variables.
[33] This inflection point is 56,862 trees, which makes this decreasing effect not relevant in practice for this sample.
[34] In this and any other variable that is shown with zeros (in any regression), we estimated the inflection points using the values in the table, but containing 10 decimals, which we do not show.
[35] Coffee farms in Guatemala were located at an average elevation of 1,540 m.a.s.l., the highest of all Central American countries.

possibly because they receive additional benefits (e.g., technical assistance, financing, a guaranteed market) derived from this business relationship that allows/motivates them to renovate their crop. We can explain the positive effect of having more varieties because this is most likely an indicative that farmers are renovating their plantations to change the varieties they grow, or diversify the coffee crop (with other varieties, which requires renovation). Having a shade crop associated with coffee decreases the probability of renovating coffee, perhaps because the coffee trees last longer with the appropriate shade. Finally, contrary to what we observed in Guatemala, when farmers seek information about coffee research products from NGOs or Government sources, the likelihood of renovating coffee increases, most likely because these farmers benefit from using the information they obtain and if in need, learn how to properly renovate their coffee.

Finally, in Peru, five factors had a statistically significant effect on the probability of implementing renovation practices: the number of coffee trees planted (negative effect), the distance between the farm and the closest town (positive effect), the altitude (positive effect), the sex of the household head (negative effect), and the index of productive assets (negative effect). Contrary to Guatemala, as the number of coffee trees increase, farmers are less likely to renovate. We found the opposite of what we found for El Salvador, as when the time taken to reach the closest town where farmers can purchase inputs increases, the likelihood of renovating coffee increases. This is surprising, though it could be an indicative of farm expansions in distant places, which requires planting new trees, which farmers may have reported as if they renovated coffee. It is not surprising that altitude has an effect on renovation in both Peru and Guatemala, the only countries in the sample with highlands. For Peru, as the altitude increases, farmers are more likely to renovate. Surprisingly, male-headed households are less likely to renovate coffee, and as the index of productive assets increase (suggesting households become wealthier as they invest more on productive assets) farmers are less likely to renovate. The latter may happen because these farmers have the tools (and probably the knowledge) to maintain their plantations better, hence reducing the need to renovate.

3.10.2 Rehabilitation

The factors affecting the likelihood of implementing rehabilitation practices in the coffee farm vary by country. Table 27 presents the Probit regression results (marginal effects) for each country separately, and for all countries combined, and Table A 17 presents descriptive statistics of the variables included in this regression. As for renovation, we only interpret statistically significant variables for each country.

In El Salvador, only two variables had a significant effect on the likelihood of rehabilitating coffee: the coffee area (positive effect) and the time it takes to get from the farm to the closest market where farmers can buy inputs (negative effect). As farms become larger, farmers are more likely to rehabilitate coffee, which can be explained because larger farms require more management, including pruning to maintain a healthy and productive crop. Although the positive effect of area will most likely start to decrease at some point (which one would expect, as it becomes more difficult to manage larger plantations), we cannot estimate this inflection point because the quadratic term in the regression was not statistically significant (though it had the correct sign). As the time required to reach the closest town increases, farmers are less likely to implement rehabilitation practices because the farther they are located, the more difficult it becomes for them to have access to inputs and services that could facilitate implementing such practices, or because the economic benefits derived from this investment may not offset its costs.

In Guatemala, six factors had a statistically significant influence in the probability of implementing rehabilitation practices: making joint decisions (both heads) about which inputs to purchase for coffee (negative effect), the number of MOCCA practices implemented (positive effect), if a household member migrated six months prior to the interview (negative effect), receiving remittances (positive effect), obtaining information of coffee research products from NGOs or Government (positive effect), and the age of the coffee trees (positive effect at a decreasing rate). Household heads making joint decisions about which inputs to purchase for coffee are less likely to implement rehabilitation practices in their farm. Like for renovation decisions in this country, we suspect that this finding for rehabilitation may also be influenced by the low number of households reporting this (Table A 16), as is rare to make joint decisions. As the number of MOCCA practices implemented increases, the likelihood of rehabilitating coffee increases possibly because farmers have better knowledge about how to manage the crop, care more about the crop, and value the benefits given by rehabilitating their coffee trees. However, although the squared term of this variable is not statistically significant (hence we cannot estimate a valid inflection point where this effect becomes negative), we can assume that this is true up to certain number of practices, after which the effect will change. Migration of household members negatively affect the probability of rehabilitating coffee, most likely because fewer member means fewer family labor available to work on farm, which could only be offset by hiring labor. Receiving remittances had a positive effect on the likelihood of implementing rehabilitation practices most likely because these remittances allow farmers to have cash at hand that they can invest in the crop (like to hire labor, or purchase tools, etc.), and to rehabilitate coffee. The positive effect of obtaining information of coffee research products from NGOs or Government is self-explanatory as farmers gain knowledge, which they can use to manage coffee better. As coffee trees become older, the likelihood of implementing rehabilitation practices increase, which is understandably as when trees become older, they demand more pruning and other practices to maintain them health and productive. However, after the coffee reaches 36.96 years of age, farmers are less likely to rehabilitate, possibly because it becomes too expensive to do this, or it is not worth doing it.

In Honduras, seven factors had a statistically significant effect on the probability of implementing rehabilitation practices: the number of MOCCA practices implemented (positive effect), selling coffee thru MOCCA's anchor firms (positive effect), the number of coffee varieties grown (positive effect), the distance to the nearest town where farmers can buy inputs for coffee (negative effect), having shade with coffee (positive effect), the age of the coffee trees (positive effect at a decreasing rate), and the index of productive assets (negative effect). We can explain the effect of the number of MOCCA practices implemented with the same reasons as for Guatemala. Farmers selling coffee thru MOCCA's anchor firms are more likely to implement rehabilitation practices, possibly because of the same reasons previously explained for renovation in Nicaragua: farmers may receive additional benefits (e.g., technical assistance, financing, a guaranteed market) derived from this business relationship that allows/motivates them to rehabilitate their crop. As the number of varieties grown increases, farmers are more likely to implement rehabilitation, perhaps because they need to care for varieties requiring different management. As the time required to reach the closest town increases, farmers are less likely to implement rehabilitation practices because the farther they are located, the more difficult it becomes for them to have access to inputs and services that could facilitate implementing such practices, or because the economic benefits derived from this investment may not offset its costs, as previously explained for El Salvador. Farmers who have shade with coffee are more likely to rehabilitate, as when properly managed, the shade has a positive effect on the growth of the coffee trees, hence demanding more pruning (and better management) to maintain the trees healthy and productive. We can explain the effect of the age of the coffee trees with the same reasons as the ones previously explained for Guatemala, with the difference that in Honduras, after the coffee trees reach 27.1 years, farmers are less likely to rehabilitate their coffee trees (suggesting they may perceive it is not worth doing this). Finally, as the index of productive assets increase farmers are less likely to rehabilitate. This effect is unexpected, as one may assume that as productive assets become available, farmers can maintain their plantations better (either because they have the right tools, of have more resources). Given that only one of the 11 assets considered in this index relate to owning pruning tools, it is likely that this is driving this effect.

Six factors affect the likelihood if implementing rehabilitation practices in Nicaragua: making joint decisions (both heads) about which inputs to purchase for coffee (negative effect), the number of MOCCA practices implemented (positive effect), having shade with coffee (negative effect), obtaining information of coffee research products from NGOs or Government (positive effect), the age of coffee trees (positive effect), and the index of productive assets (negative effect). Since we have explained above the effect of many of these factors, we only interpret variables that have not been interpreted before (as the explanation is the same), or that have the opposite effect. Having a shade crop associated with coffee decreases the probability of rehabilitating it, perhaps because the shade helps to regulate the coffee growth, hence the need to prune more often. As coffee trees become older, farmers are more likely to rehabilitate, which is understandable, as the trees require more pruning. However, contrary to what we found for Guatemala and Honduras, we cannot estimate an inflection age after which this effects negative, because the quadratic term is not statistically significant.

In Peru, seven factors had a statistically significant effect on the probability of implementing rehabilitation practices: the number of MOCCA practices implemented (positive effect), selling coffee thru MOCCA's anchor firms (negative effect), the distance to the nearest town where farmers can buy inputs for coffee (negative effect), the age of the coffee trees (positive effect at a decreasing rate), having shade with the coffee crop (negative effect), the index of productive assets (positive effect), and obtaining information of coffee research products from NGOs or Government (positive effect). Like before, we will only discuss variables that have not been discussed before (as the explanation is the same), or that have the opposite effect. Similar to all other countries except El Salvador, as the number of MOCCA practices implemented increases, the likelihood of rehabilitating coffee increases. In contrast to what we found in Honduras, selling thru MOCCA's anchor firms in Peru had a negative effect on the likelihood of implementing rehabilitation practices, suggesting that famers may not be benefiting from this business relationship as much as in Central America, which is surprising as 44.6% of farmers reported selling thru a MOCCA anchor firm, the second highest share among all countries. Further analysis is required to understand better the existing relationship between anchor firms and farmers, to determine how this can change to benefit farmers more. As trees become older, farmers are more likely to rehabilitate, but after they reach 24.8 years of age, this likelihood start to decrease, most likely because of the factors explained above. The positive effect of having more productive assets is self-explanatory, as when farmers are better off, they can purchase tools to use for rehabilitation, and implement in this practice. All other variables can be explained with the same reasons as discussed for the other countries.

Table 26. Coffee renovation regression results: marginal effects

Variables	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Sex of HH head (1=male)	0.054	-0.037	0.032	-0.043	**-0.112****	**-0.046***
	(0.058)	(0.052)	(0.049)	(0.064)	(0.047)	(0.025)
HH head age (years)	-0.002	0.007	0.005	0.007	-0.013	0.001
	(0.014)	(0.008)	(0.009)	(0.011)	(0.008)	(0.001)
HH head age squared	0.000	-0.000	-0.000	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Joint decision (spouses) on purchase of coffee inputs (1=yes)	-0.080	**-0.122*****	**-0.098****	-0.090	0.007	**-0.040***
	(0.052)	(0.045)	(0.048)	(0.064)	(0.038)	(0.024)
Coffee area (Ha)	0.013	-0.065	-0.006	-0.017	0.062	0.010
	(0.013)	(0.055)	(0.017)	(0.033)	(0.047)	(0.009)
Coffee area squared	-0.000	**0.012***	0.000	0.001	-0.003	-0.000
	(0.001)	(0.007)	(0.001)	(0.002)	(0.004)	(0.000)
Number of coffee trees	0.000	**0.000****	0.000	0.000	**-0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of coffee trees squared	-0.000	**-0.000****	-0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number MOCCA practices implemented	0.009	0.014	-0.003	0.074	-0.029	0.011
	(0.038)	(0.017)	(0.019)	(0.055)	(0.025)	(0.012)
Number MOCCA practices squared	-0.001	-0.000	0.000	-0.000	**0.001***	0.000
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.000)
Sold thru MOCCA's anchor firms (1=yes)	n.a.	-0.059	0.049	**0.092***	0.064	**0.060*****
		(0.050)	(0.061)	(0.049)	(0.039)	(0.022)
HH member migrated within last 6 months (1=yes)	-0.106	0.045	0.061	0.133	-0.009	0.011
	(0.069)	(0.069)	(0.076)	(0.083)	(0.060)	(0.033)
Received remittances (1=yes)	0.240	-0.075	0.054	0.034	0.075	**0.067***
	(0.226)	(0.048)	(0.071)	(0.108)	(0.073)	(0.038)
Number of coffee varieties	0.065	-0.015	0.018	**0.076***	0.003	**0.019***
	(0.049)	(0.022)	(0.017)	(0.041)	(0.019)	(0.011)
Distance to closest town (hours)	**-0.086****	-0.061	-0.048	0.006	**0.035****	-0.002
	(0.040)	(0.045)	(0.051)	(0.030)	(0.017)	(0.011)
Altitude (m.a.s.l.)	-0.000	**0.001***	0.001	-0.001	**0.002***	**0.000*****
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)
Altitude squared	0.000	**-0.000***	-0.000	0.000	-0.000*	**-0.000*****
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Obtained information of coffee research products from NGOs or government (1=yes)	0.069	**-0.084***	0.150	**0.146***	0.161	**0.091****
	(0.075)	(0.046)	(0.096)	(0.081)	(0.103)	(0.039)
Coffee age	-0.016	**-0.027*****	-0.044	-0.045	-0.011	**-0.019***
	(0.032)	(0.006)	(0.027)	(0.035)	(0.016)	(0.008)
Coffee age squared	0.000	0.001	0.001	0.004	0.001	0.000
	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)	(0.000)
Access to credit (1=yes)	n.a.	-0.022	0.043	0.005	0.070	0.017
		(0.078)	(0.087)	(0.048)	(0.060)	(0.028)
% of coffee trees under a variety susceptible to leaf rust	-0.002	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.002)	(0.000)	(0.002)	(0.001)	(0.001)	(0.000)
Has shade crop with coffee (1=yes)	0.018	0.007	0.026	**-0.197*****	0.007	-0.030
	(0.065)	(0.038)	(0.046)	(0.053)	(0.039)	(0.021)
Index of productive assets	0.010	0.020	**0.031****	-0.029	**-0.043*****	-0.013

	(0.050)	(0.015)	(0.014)	(0.019)	(0.016)	(0.008)
Country dummies	No	No	No	No	No	Yes
Observations	**132**	**339**	**307**	**353**	**567**	**1,699**
Probit regression marginal effects. Standard errors in brackets; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$						

Table 27. Coffee rehabilitation regression results: marginal effects

Variables	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Sex of HH head (1=male)	0.012	0.010	0.082	0.049	-0.044	0.008
	(0.060)	(0.053)	(0.062)	(0.068)	(0.034)	(0.024)
HH head age (years)	0.009	-0.011	0.007	0.012	0.004	0.001
	(0.015)	(0.010)	(0.009)	(0.010)	(0.006)	(0.001)
HH head age squared	-0.000	0.000	-0.000	-0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Joint decision (spouses) on purchase of coffee inputs (1=yes)	-0.037	**-0.202***	-0.025	**-0.137***	-0.000	-0.012
	(0.061)	(0.118)	(0.075)	(0.072)	(0.030)	(0.026)
Coffee area (Ha)	**0.024***	-0.011	0.039	0.021	0.041	**0.019****
	(0.014)	(0.058)	(0.024)	(0.037)	(0.044)	(0.009)
Coffee area squared	-0.001	-0.001	0.000	0.001	-0.001	-0.000
	(0.001)	(0.006)	(0.001)	(0.003)	(0.005)	(0.000)
Number of coffee trees	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of coffee trees squared	0.000	0.000	-0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number MOCCA practices implemented	-0.052	**0.061*****	**0.062*****	**0.067***	**0.053****	**0.054*****
	(0.058)	(0.026)	(0.024)	(0.039)	(0.021)	(0.012)
Number MOCCA practices squared	0.005	-0.001	-0.001	-0.000	-0.001	-0.001
	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Sold thru MOCCA's anchor firms (1=yes)	n.a.	-0.075	**0.151***	0.061	**-0.072****	0.009
		(0.075)	(0.078)	(0.048)	(0.032)	(0.023)
HH member migrated within last 6 months (1=yes)	-0.073	**-0.132***	0.067	0.098	-0.017	0.007
	(0.114)	(0.079)	(0.080)	(0.072)	(0.054)	(0.034)
Received remittances (1=yes)	0.050	**0.163****	0.062	0.028	0.017	0.047
	(0.124)	(0.083)	(0.072)	(0.103)	(0.055)	(0.036)
Number of coffee varieties	0.051	0.038	**0.058****	0.049	0.024	**0.050*****
	(0.046)	(0.030)	(0.024)	(0.042)	(0.016)	(0.012)
Distance to closest town (hours)	**-0.068***	-0.022	**-0.191*****	0.009	**-0.044*****	**-0.041*****
	(0.039)	(0.043)	(0.057)	(0.029)	(0.013)	(0.011)
Altitude (m.a.s.l.)	-0.001	0.000	-0.000	-0.000	0.000	0.000
	(0.002)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
Altitude squared	0.000	-0.000	0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Obtained information of coffee research products from NGOs or government (1=yes)	0.106	**0.200*****	-0.038	**0.173*****	**0.142*****	**0.138*****
	(0.084)	(0.058)	(0.090)	(0.061)	(0.056)	(0.028)
Coffee age	0.020	**0.046*****	**0.119*****	**0.081****	**0.065*****	**0.063****
	(0.028)	(0.014)	(0.023)	(0.036)	(0.012)	(0.008)
Coffee age squared	-0.000	**-0.001*****	**-0.004*****	-0.005	**-0.003*****	**-0.002****
	(0.000)	(0.000)	(0.001)	(0.003)	(0.000)	(0.000)
Access to credit (1=yes)	n.a.	0.132	0.108	-0.002	-0.036	0.044
		(0.117)	(0.095)	(0.049)	(0.054)	(0.029)
% of coffee trees under a variety susceptible to leaf rust	-0.001	0.001	0.001	-0.001	0.000	**0.001****
	(0.001)	(0.000)	(0.002)	(0.001)	(0.001)	(0.000)

Has shade crop with coffee (1=yes)	-0.018	-0.053	**0.093***	**-0.099****	**-0.053***	**-0.039***
	(0.054)	(0.042)	(0.055)	(0.049)	(0.029)	(0.020)
Index of productive assets	-0.016	-0.029	**-0.028***	**-0.042****	**0.023***	-0.012
	(0.053)	(0.021)	(0.017)	(0.019)	(0.013)	(0.008)
Country dummies	No	No	No	No	No	Yes
Observations	**132**	**339**	**307**	**353**	**567**	**1,699**
Probit regression marginal effects. Standard errors in brackets; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$						

3.10.3 Yields

The factors affecting coffee yields (kg green coffee/ha) are diverse and differ by country (Table 28). We include descriptive statistics of the variables included in this regression in Table A 18. Next, we discuss in detail the factors affecting yields for each country.

In El Salvador, eight variables showed a statistically significant effect on yields: age of household head (positive effect at a decreasing rate), the number of coffee trees/ha (positive effect at a decreasing rate), the number of MOCCA soon-to-be promoted practices implemented (negative effect at an increasing rate), obtaining information of coffee research products from NGOs or Government (positive effect), the altitude (negative effect at an increasing rate), having access to agricultural credit (positive effect), receiving remittances (positive effect), and the interaction between migration and receiving remittances (negative effect). As household heads become older, they obtain higher yields. However, after farmers reach 56 years of age, the yields they obtain start to decrease. While the positive effect of age is explained by the experience they gain with age, the decreasing effect after certain age is most likely because farmers physically cannot perform as well as in their youth, highlighting the importance of having generational relay to maintain or increase coffee yields. As one would expect, as the planting density (i.e., # trees/ha) increases, yields increase up to certain density, after which yields decrease (because of competition for nutrients, water, sun, etc., between trees).[36] Although the number of MOCCA-promoted practices has a negative effect on yields, after farmers implement 10 of these practices, their yields start to increase. This suggests that in El Salvador, MOCCA should promote more than 10 practices to have a positive effect on yields, as fewer practices will not have the intended effect (this result also suggests the plantations may be poor, because they require many practices to perform well). The positive effect of obtaining information of coffee research products from NGOs or Government is self-explanatory as farmers gain knowledge, which, together with experience, they can use to manage coffee better and obtain higher yields. As the altitude where coffee is grown increases, yields decrease up to 777 m.a.s.l., after which, yields start to increase. This suggests that in El Salvador, coffee should be grown roughly above 770 m.a.s.l. to obtain better yields, which is understandable as in lower altitudes that may also be affected by high temperatures, the crop does not perform well. The positive effect of having access to cash (either from loans or remittances) is self-explanatory, as with more cash, farmers can invest (inputs, labor) in the crop. Finally, yields were lower in households receiving remittances but where a family member recently migrated, highlighting the fact that the cash received (from remittances) may not be enough to offset the lost family labor.

[36] This threshold is estimated at 73,377 trees/ha, which in practice means that at current planting rates (i.e., 2,882 trees/ha; Table A 18), yields are only positively affected by the planting rate; thus, making this threshold not relevant (as we should not expect to have such high planting rates). Thus, while the effect is important, its magnitude is not, and we strongly recommend not using this value.

In Guatemala, six factors affected yields: sex of household head being male (positive effect), the number of coffee trees per hectare (positive effect at a decreasing rate), the number of MOCCA practices implemented (positive effect at a decreasing rate), receiving remittances (positive effect), the age of coffee trees (positive effect), and obtaining information of coffee research products from NGOs or Government (negative effect). We only interpret coefficients that we have not interpreted before, or that have the opposite effect. Male-headed households obtained higher yields, highlighting the need of assistance to female-headed households to help them increase their productivity. As the number of trees per hectare increase, yields increase up to certain number of trees,[37] after which yields start to decrease. The number of MOCCA practices implemented have a positive effect on yields, up to 19 practices, after which implementing more practices becomes detrimental, most likely because farmers have less time and resources to properly implement these additional practices and this has a direct (or indirect) negative effect on yields. Thus, MOCCA should prioritize which practices to promote, and perhaps exclude less important ones. Age positively affected yields, and though one should expect this to be true up to certain age, we could not statistically estimate this inflection point. However, given that the average coffee age was 8.55 years (Table A 18), this most likely explain why this coefficient was not statistically significant, as coffee plantations are relatively young. Finally, farmers who obtained information of coffee research products from NGOs or Government obtained lower yields. While the latter suggest that the information farmers can access may be too complex for them to understand and/or use to make farming decisions that affect yields, we suspect this result is also driven by the fact that few farmers (8.6%; Table A 18) reported obtaining such information from these sources.

In Honduras, five factors affected yields: the number of MOCCA practices implemented (positive effect at a decreasing rate), having at least one household member migrating within the previous six months (negative effect), having access to credit (negative effect), making joint decisions (both heads) about which inputs to purchase for coffee (positive effect), and male headed households making joint decisions (with the spouse) about which inputs to purchase for coffee (negative effect). We will only discuss variables that have not been discussed before (as the explanation is the same), or that have the opposite effect. As in Guatemala, the number of MOCCA practices implemented have a positive effect on yields, up to 14 practices, after which implementing more practices becomes detrimental. Thus, the same recommendation is valid: prioritize which practices to promote (based on farmers' needs), to avoid promoting too many practices. The negative effect of the migration of household members is possibly because the reduced family labor available to work on the coffee crop. Contrary to El Salvador, farmers with access to financing obtained lower yields, which could have happened because these farmers did not use part of this loan on coffee (59.37% of farmers with a loan said they used it for other purposes; Table 19). In households where both heads jointly decide on coffee inputs, yields were higher, highlighting the positive effects of making consulted decisions. However, the latter appears to be more true for female-headed households, as when male heads jointly decide with their spouse on coffee inputs, yields were lower.

[37] This threshold is estimated at 28,960 trees/ha, which in practice means that at current planting rates (5,792 trees/ha), yields are only positively affected by the planting rate; thus, making this threshold not relevant (as we should not expect to have such high planting rates). Thus, while the effect is important, its magnitude is not, and we strongly recommend not using this value.

In Nicaragua, only the number of coffee trees/ha had a statistically significant effect (positive at decreasing rate) on yields. As the number of trees per hectare increase, yields increase up to certain number of trees,[38] after which yields start to decrease.

In Peru, six factors affected yields: the age of the household head (positive effect at a decreasing rate), the number of coffee varieties grown (negative effect), the share of coffee trees susceptible to leaf rust (negative effect), the number of farm certifications (positive effect), the age of coffee trees (positive effect at a decreasing rate), and the index of productive assets (positive effect). As household heads become older, they obtain higher yields. However, after farmers reach 46 years of age, the yields they obtain start to decrease. While the positive effect of age is explained by the experience they gain with age, the decreasing effect after certain age in this country may be related to the need to be open to new technologies and management practices (as older farmers are less likely to try new technologies, compared to younger farmers). As the number of varieties grown increase, yields decrease, most likely because farmers need to manage these varieties differently, for which they need knowledge and resources which they may not have. The results highlight the importance of promoting and planting rust-resistant varieties as when the number of coffee trees of a variety susceptible to leaf rust increases, yields decrease. As the number of farm certifications increase, yields increase, most likely because many certifications require the implementation of good agricultural practices, which have a positive effect on yields. As coffee trees become older, yields increase. However, after trees reach 9.4 years, yields start to decrease, which is surprising, as this is an extremely young age for coffee yields to start decreasing. Finally, as the index of productive assets increase, coffee yields increase, most likely because farmers who invest in such assets are better off and may invest more in the crop.

[38] This threshold is estimated at 15,500 trees/ha, which in practice means that at current planting rates (4,652 trees/ha), yields are only positively affected by the planting rate; thus, making this threshold not relevant (as we should not expect to have such high planting rates). Thus, while the effect is important, its magnitude is not, and we strongly recommend not using this value.

Table 28. Coffee yield (kg green/ha) regression results

Variables	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Sex of HH head (1=male)	70.712	**126.359*** **	97.658	123.249	-317.042	-11.723
	(54.050)	(35.717)	(79.706)	(102.762)	(229.345)	(83.539)
HH head age (years)	**15.243** **	-9.138	21.179	-35.043	**18.113* **	4.149
	(5.681)	(8.737)	(13.031)	(20.775)	(9.534)	(7.780)
HH head age squared	**-0.135** **	0.051	**-0.281** **	0.290	**-0.203** **	-0.075
	(0.058)	(0.085)	(0.119)	(0.191)	(0.096)	(0.074)
Joint decision (spouses) on purchase of coffee inputs (1=yes)	-39.324	171.207	**358.412** **	-10.691	-354.215	-66.087
	(33.239)	(162.125)	(148.233)	(206.087)	(252.078)	(105.687)
HH head male x Joint decision on purchase of inputs	69.726	-46.283	**-289.208* **	275.928	392.790	93.246
	(122.244)	(112.837)	(158.750)	(278.420)	(266.256)	(105.021)
Number of coffee trees/ha	**0.049*** **	**0.045*** **	-0.002	**0.174** **	0.033	**0.044*** **
	(0.007)	(0.011)	(0.021)	(0.062)	(0.049)	(0.011)
Number of coffee trees/ha squared	**-0.000*** **	**-0.000*** **	**0.000** **	**-0.000* **	-0.000	**-0.000*** **
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Family labor: # members in all coffee activities	-12.857	15.083	3.859	37.843	-1.234	12.470
	(22.125)	(10.707)	(39.697)	(42.296)	(8.770)	(14.529)
HH member migrated within last 6 months (1=yes)	-8.035	-52.906	- **341.589*** **	75.503	-95.016	**-88.933** **
	(45.562)	(115.489)	(68.048)	(119.950)	(69.489)	(40.021)
Received remittances (1=yes)	**315.684** **	**124.113* **	47.634	-38.187	555.392	259.902
	(112.609)	(72.015)	(271.443)	(95.537)	(459.971)	(196.796)
HH member migrated x Received remittances	**-304.791*** **	-166.133	338.692	-286.102	-759.840	-304.624
	(94.786)	(166.975)	(236.929)	(195.810)	(592.873)	(231.799)
Number MOCCA practices implemented	**-104.764*** **	**99.893*** **	**68.342** **	7.302	48.061	**74.642*** **
	(20.475)	(22.334)	(26.920)	(58.265)	(35.064)	(14.583)
Number MOCCA practices squared	**5.188*** **	**-2.729*** **	**-2.396** **	-0.117	-1.896	**-2.378*** **
	(0.779)	(0.750)	(1.076)	(1.955)	(1.234)	(0.550)
Number of coffee varieties	-41.348	8.118	-15.621	-22.126	**-61.878** **	**-60.340*** **
	(29.231)	(27.649)	(50.744)	(96.255)	(22.813)	(21.013)
Share of total coffee trees under a variety susceptible to leaf rust	0.479	-0.799	-2.165	-2.361	**-1.680** **	**-1.059** **
	(1.187)	(0.648)	(1.493)	(1.504)	(0.634)	(0.514)
Distance to closest town (hours)	-12.149	55.355	-113.370	-7.332	31.591	1.216
	(41.034)	(71.607)	(66.981)	(45.187)	(37.218)	(17.656)
Number of certifications	n.a.	4.489	78.898	97.386	**75.664** **	**82.016*** **
		(42.902)	(50.536)	(76.775)	(27.691)	(28.049)
Altitude (m.a.s.l.)	**-0.665* **	0.055	-1.266	-0.318	0.253	**0.241* **
	(0.335)	(0.076)	(1.590)	(0.720)	(0.441)	(0.130)
Altitude squared	**0.000** **	0.000	0.001	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Has shade crop with coffee (1=yes)	48.788	-34.776	15.752	-149.908	-17.443	-28.820
	(44.450)	(52.280)	(71.973)	(149.298)	(61.852)	(44.591)
Coffee age	-1.196	**52.191** **	7.834	55.250	**89.034** **	**48.142*** **
	(28.553)	(20.872)	(31.317)	(55.273)	(32.610)	(14.098)
Coffee age squared	-0.100	-1.826**	-0.274	-1.808	**-4.725** **	**-2.054*** **
	(1.275)	(0.738)	(1.512)	(3.561)	(1.727)	(0.633)
Access to credit (1=yes)	**430.841*** **	41.117	**-187.447** **	123.956	-63.988	41.193
	(67.449)	(121.197)	(69.667)	(99.105)	(64.360)	(54.552)
Obtained information of coffee research products from NGOs or government (1=yes)	**99.110** **	**-171.711** **	134.914	22.579	-132.406	-25.388
	(43.861)	(74.673)	(299.899)	(203.771)	(108.842)	(81.683)
Index of productive assets	11.229	-6.972	-16.223	35.042	**89.453** **	**35.721*** **
	(18.876)	(12.789)	(17.249)	(30.400)	(40.179)	(12.509)
Constant	**415.589* **	**-451.203* **	644.092	468.476	-365.454	**576.116*** **

	(197.314)	(264.945)	(1,130.609)	(586.769)	(497.020)	(205.478)
Country dummies	No	No	No	No	No	Yes
Observations	**111**	**335**	**301**	**348**	**563**	**1,658**
Adjusted R^2	**0.643**	**0.356**	**0.191**	**0.202**	**0.090**	**0.115**
Standard errors in brackets; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$						

3.11 Summary of coffee results

The coffee results highlight that making joint decisions about which inputs to purchase for coffee was rare, and that in most male-headed households, this decision was not consulted with anyone, suggesting female-heads make this process more consultative. Further, in the few households where this process was consultative, it was more common to consult with another household member.

Farmers dedicated most of their land to the coffee crop and it was rare for coffee farmers not to own land. While most farmers reported owning their land with deed in the Central American countries, owning land without a deed was more common in Peru.

The analysis of key MOCCA indicators show that intended beneficiary farmers grew 2.74 ha with coffee, ranging from 1.11 ha in Guatemala to 4.05 ha in Nicaragua. These farmers harvested 665 kg of green coffee per hectare (equivalent to 10.24 qq/mz), with the highest yields found in Honduras (827 kg green coffee/ha; 12.74 qq/mz) and the lowest in El Salvador (187 kg green coffee/ha; 2.88 qq/mz). Roughly, 30% of farmers reported selling coffee to MOCCA's anchor firms, and this was more common in Nicaragua, followed by Peru, Honduras and far behind Guatemala, which suggests that the project could greatly benefit farmers by providing them access to improved markets.

When we disaggregated key MOCCA indicators by sex, we observed statistically significant differences for most indicators in the combined analysis (i.e., all countries), but these differences varied by country. For example, in Guatemala, male-headed households planted more area with coffee, obtained higher yields, had more access to financing for agriculture and obtained a much higher value of annual coffee sales, compared to female-headed households. In contrast, in Peru a higher share of female-headed households had access to improved markets thru MOCCA's anchor firms. In El Salvador, male-headed households obtained higher yields, and none of the differences in these indicators were statistically significant in Honduras.

When we disaggregated some of the key MOCCA indicators by age of the household head, we found statistically significant differences in the above four indicators in the combined analysis. Younger farmers obtained higher yields and had more access to financing for agriculture, but planted less area with coffee and obtained smaller income from annual coffee sales. As one would expect, these differences varied by country. When we disaggregated three of the key MOCCA indicators by the size of the coffee area we found statistically significant differences all indicators: farmers with larger coffee areas planted more coffee, reported a higher value of annual coffee sales but obtained lower yields.

In general, most farmers reported they had adopted >10-19 of the basic soon-to-be-promoted MOCCA practices, with an average of 14 practices (of up to 33 practices evaluated). Thus, there is an opportunity for MOCCA not only to increase the number of practices farmers implement in their farms, but also to lift the number of practices implemented at optimal levels (according to its curriculum). However, econometric regression results suggest that MOCCA should prioritize practices, as in many countries, after a certain number of practices, the likelihood of implementing rehabilitation practices and the yields decrease.

Regarding renovation and rehabilitation, it was more common to implement rehabilitation practices than renovation practices, which is understandable given the different requirements of implementing each of them. While rehabilitation was more common in Peru and Nicaragua, renovating coffee was more common in Nicaragua. As one would expect, the share of farmers reporting limitations to adopt renovation practices was slightly higher than the ones reporting the same for rehabilitation practices, and in both cases, the main limitation was having the economic resources to implement them.

Most farmers reported they already implement soil conservation practices and that they applied fertilizer in the agricultural years of reference. Further, almost three out of four farmers said they implement cost-saving practices to control weeds. While fertilizing based on nutritional deficiencies was not common (only one of every five farmers did this), applying the MOCCA-recommended nutritional formulas was rare, except in Peru, where most farmers were not only already implementing this practice, but they also did it optimally, suggesting making an impact on this practice in this country will be more challenging. Similarly, in this country, MOCCA should not dedicate much effort to train farmers on fertilizer application forms, as almost every farmer in Peru reported doing this, and doing it optimally. Despite this, given that only 50.42% of farmers said they used methods to reduce fertilization costs, and almost everyone did this well, MOCCA could benefit farmers by training them on how to do this, and how to do it optimally.

Implementing integrated pest management was not common, as only 31% of farmers reported they implemented a pest & disease monitoring system in the agricultural years of reference. In these years, the two most common diseases were leaf rust (58.19%) and anthracnose (13.65%), and the most common insect pest was the berry borer (51.45%).

Roughly, 31% of farmers with seed beds and nurseries prepared their substrate mix for their seed germinators, and everyone was doing this well. Thus, MOCCA can increase the share of farmers who make this in situ, and who do it optimally. Although almost three out of four farmers reported disinfecting the substrate mix they prepare, there is an opportunity to teach many how to do this optimally, as most did this well, except in Peru and El Salvador (though in El Salvador, <1% of farmers reported managing seed beds or nurseries).

Knowing where to acquire certified or verified planting material for seed beds was not common (only 22% of farmers reported knowing this). Further, buying seedlings from certified nurseries was rare, especially in Nicaragua where none of the interviewed farmers reported doing this. Despite this lack of knowledge on this topic, 49.16% of farmers were willing to pay more for a certified or verified genetic material.

On average, it took farmers a little over one hour to reach the closest town where they could buy inputs for coffee, using the most common transportation method. While it was common for farmers to purchase fertilizers, pesticides and herbicides at this place, buying coffee planting materials was not common (many reported purchasing this from neighbors). While using fertilizer was extremely common (the type of fertilizer applied varied by country), using pesticides was less common and applying herbicides was even less common.

Most farmers reported growing only one coffee variety and it was not common to grow more than three varieties. In El Salvador, the three most commonly grown varieties were Catimor, Sarchimor and Salvadoreño. In Guatemala, the three most commonly grown varieties were Caturra, Catimor and Catuaí. In Honduras, the three most common varieties were Lempira, IHCAFE 90 and Catimor. While Catimor was the first most grown variety in Nicaragua and Peru.

Although family and hired labor participated in all activities done in coffee plots, the main activities where household members and hired labor participated the most were the harvest, weeding, fertilizer application. Further, roughly 38% of the farms were certified.

In general, few farmers (28.35%) requested a loan, except in Nicaragua (68.21%). Farmers reported the formal system was the main source for the loan. While farmers used part of the loan for coffee (especially to purchase inputs), they also used it in other necessities. While in most countries, the loan was paid back mostly in cash, in Honduras was common for lenders to directly deduct it from the payment for coffee sales, perhaps highlighting mature business relationship between these two actors.

Few farmers reported obtaining information about coffee research, and among the ones who obtained information, the main source was thru non-governmental organizations. Most farmers said they were able to use this information to make farming decisions.

A diagnostic of the main coffee plot showed that a little over 80% of the trees in this plot were productive, 13.18% needed pruning and 6.2% needed stumping. Overall, roughly 7.56% of trees in the main plot needed renovation (i.e., need to be removed and physical failures) and 19.38% needed rehabilitation. Few farmers said they were not able to harvest coffee in the year of reference. Among the farmers who did it, 55.2% milled coffee in the farm, and from them, most removed the cherry pulp using water saving practices and treated the pulp waste. However, treating waste water from wet milling was less common. Farmers harvested an average of 665 kg of green coffee/ha and sold an average of 1,706 kg of green coffee, which generated a gross annual income of US$4,940, equivalent to US$2,079/ha.

Farmers' main coffee buyers were intermediaries, followed by an anchor firm collaborating in MOCCA (though this varied by country). Knowledge about coffee quality was low as few farmers (17.87%) knew what a physical yield factor was and a similar share (21.68%) knew their cup grade.

Only 13.36% of farmers reported growing other crops in addition to coffee. The main two additional crops grown (according to the quantity produced) included maize and plantains (in this order) and this varied by country. Roughly, 46% of farmers reported selling approximately 34% of the harvest of these other crops, generating a gross annual income of US$335. When combining all sources of income, we estimated that the average gross annual household income was US$5,246, ranging from US$2,490 in El Salvador to US$7,921 in Nicaragua, most of which came from agricultural activities, especially coffee sales.

The multivariate regression results for the adoption of renovation practices show that in El Salvador, only the distance between the farm and the closest town (negative effect) statistically affected the probability of implementing renovation practices. In Guatemala, this probability was affected by making joint decisions about purchasing coffee inputs (negative effect), the number of coffee trees (positive effect at a decreasing rate), altitude (positive effect at a decreasing rate), obtaining information of coffee research products from NGOs or Government (negative effect), and the age of coffee trees (negative effect). In Honduras, only making joint decisions about purchasing coffee inputs (negative effect) and the index of productive assets (positive effect) had an effect on the probability of implementing renovation practices.

Meanwhile, in Nicaragua, selling coffee to MOCCA's anchor firms (positive effect), the number of coffee varieties grown (positive effect), having shade in the coffee plots (negative effect), and obtaining information of coffee research products from NGOs or Government (positive effect) affected the likelihood of adopting renovation practices. Finally, in Peru, adopting renovation practices was influenced by the number of coffee trees planted (negative effect), the distance between the farm and the closest town (positive effect), the altitude (positive effect), the sex of the household head (negative effect), and the index of productive assets (negative effect).

The multivariate regression results for the adoption of rehabilitation practices show that in El Salvador, the coffee area (positive effect) and the time it takes to get from the farm to the closest market where farmers can buy inputs (negative effect) statistically significantly affected the adoption of rehabilitation practices. In Guatemala, this was affected by making joint decisions (both heads) about which inputs to purchase for coffee (negative effect), the number of MOCCA practices implemented (positive effect), if a household member migrated six months prior to the interview (negative effect), receiving remittances (positive effect), obtaining information of coffee research products from NGOs or Government (positive effect), and the age of the coffee trees (positive effect at a decreasing rate).

This was quite different in Honduras, where the number of MOCCA practices implemented (positive effect), selling coffee thru MOCCA's anchor firms (positive effect), the number of coffee varieties grown (positive effect), the distance to the nearest town where farmers can buy inputs for coffee (negative effect), having shade with coffee (positive effect), the age of the coffee trees (positive effect at a decreasing rate), and the index of productive assets (negative effect) had a significant effect on this likelihood.

In Nicaragua, making joint decisions (both heads) about which inputs to purchase for coffee (negative effect), the number of MOCCA practices implemented (positive effect), having shade with coffee (negative effect), obtaining information of coffee research products from NGOs or Government (positive effect), the age of coffee trees (positive effect), and the index of productive assets (negative effect) all affected the probability of adopting rehabilitation practices.

Finally in Peru, the likelihood of implementing rehabilitation practices was determined by the number of MOCCA practices implemented (positive effect), selling coffee thru MOCCA's anchor firms (negative effect), the distance to the nearest town where farmers can buy inputs for coffee (negative effect), the age of the coffee trees (positive effect at a decreasing rate), having shade with the coffee crop (negative effect), the index of productive assets (positive effect), and obtaining information of coffee research products from NGOs or Government (positive effect).

The regression results for coffee yields show that in El Salvador, age of household head (positive effect at a decreasing rate), the number of coffee trees/ha (positive effect at a decreasing rate), the number of MOCCA soon-to-be promoted practices implemented (negative effect at an increasing rate), obtaining information of coffee research products from NGOs or Government (positive effect), the altitude (negative effect at an increasing rate), having access to agricultural credit (positive effect), receiving remittances (positive effect), and the interaction between migration and receiving remittances (negative effect) all had an effect on coffee yields.

In Guatemala, sex of household head being male (positive effect), the number of coffee trees per hectare (positive effect at a decreasing rate), the number of MOCCA practices implemented (positive effect at a decreasing rate), receiving remittances (positive effect), the age of coffee trees (positive effect), and obtaining information of coffee research products from NGOs or Government (negative effect) statistically affected this outcome variable. In Honduras, yields were affected by the number of MOCCA practices implemented (positive effect at a decreasing rate), having at least one household member migrating within the previous six months (negative effect), having access to credit (negative effect), making joint decisions (both heads) about which inputs to purchase for coffee (positive effect), and male headed households making joint decisions (with the spouse) about which inputs to purchase for coffee (negative effect).

In Nicaragua, only the number of coffee trees/ha had a statistically significant effect (positive at decreasing rate) on yields. Finally, in Peru, the following factors affected yields: the age of the household head (positive effect at a decreasing rate), the number of coffee varieties grown (negative effect), the share of coffee trees susceptible to leaf rust (negative effect), the number of farm certifications (positive effect), the age of coffee trees (positive effect at a decreasing rate), and the index of productive assets (positive effect).

IV. RESULTS FOR CACAO FARMERS

4 Results for cacao farmers

This section describes the cacao production system, harvest process, and the characteristics of producer households in Ecuador, El Salvador, Guatemala, Honduras, Nicaragua and Peru. While we discuss the results for main variables (or indicators), we encourage the readers to see the tables and annex tables for more details.

4.1 Decision making in the household

We asked about how household heads took decisions and whether the process was consultative. In general, the decision about which farm inputs to purchase and how to use cacao sales income is made only by men (59.95 % and 60.5%). These percentages are higher than 65% in Ecuador, El Salvador, Honduras and Nicaragua (66.32%, 71.3%, 70% and 79.16%). In very few households were decisions made only by women or by both spouses. In most countries, these numbers are below 25% except for El Salvador (25% only by women).

The farmers consult different sources to make decisions about which farm inputs to purchase, including other household members (24.39%), extension agents (20.78%), and input suppliers (2.18%). However, for decisions about spending cacao income, *my spouse* was the only answer. *Head of household* was mostly responsible for decisions about where to use the farm inputs and cacao income (69.36%), and it is exceptionally high in El Salvador (93.47%) and Guatemala (84.37%) (Table 29).

4.2 Key MOCCA indicators

In this section, we first present key MOCCA indicators for each country, and then disaggregate these indicators by sex of household head, age category and size of the cacao area. For both coffee and cacao, USDA requests key indicators disaggregated by these variables using the following groups: (1) sex of household head: male vs. female headed households; (2) age of household head: 15-29 years vs. >30 years old; and (3) size of cacao area: <5 ha vs. >5 ha.

4.2.1 By country

Peru has a yield of 451.84 kg dry/ha, followed by Guatemala (350.96kg dry/ha)[39]. Cacao in El Salvador is a young sector (most farmers are still waiting for their first harvest). This situation is reflected in the low yields (88.87 kg dry/ha), small production areas (1.58 ha), and low annual sales (US 233) for El Salvador[40]. In Ecuador, the crop situation is different. It is the most important cacao origin for fine and flavor cacao (Wiegel et al, 2020). The country has the largest production area per producer (3.58 ha), generating annual cacao sales of US$3,398.27 (among farmers who sold, and US$3,189 among all sampled farmers). In Central America, the numbers are significantly lower. In Guatemala, Nicaragua and Honduras annual sales[41] are US$502, US$687 and US$509 (full sample), respectively (Table 30).

[39] The equivalence for manzanas/quintales is 0.0154

[40] The annual amount of cacao includes the producers that effectively sold during the harvest and the average of the total sample.

[41] The annual sales were calculated using price (wet or dry) per cacao quantity (wet or dry) and their sum.

Table 29. Cacao: household decisions at baseline

Household (HH) decisions	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Decisions about which farm inputs to purchase (%):							
Male HH head only	66.32	71.73	64.06	70.00	79.16	56.26	59.95
Female HH head only	12.95	25.00	20.31	14.28	13.33	23.20	17.61
Both spouses	7.25	2.17	1.56	7.14	1.66	12.80	7.87
With whom did you consult to make decisions about which farm inputs to purchase? (%):							
No one, male headed HH	37.82	18.47	57.81	28.57	65.00	15.73	29.21
No one, female headed HH	7.77	1.08	21.87	8.57	12.50	5.06	7.54
Other HH member	36.78	14.13	6.25	42.85	15.83	26.40	24.39
Agricultural technician	3.10	70.65	1.56	30.00	3.33	42.13	20.78
Input supplier	1.55	0.00	0.00	0.00	1.66	4.00	2.18
Other	0.00	21.73	1.56	20.00	0.00	2.13	2.51
Who decided how to use the income from cacao sales (%)?:							
Male HH head only	62.69	68.47	73.43	60.00	66.66	52.80	60.5
Female HH head only	16.58	25.00	20.31	15.71	9.16	22.40	19.25
Both spouses	16.58	3.26	1.56	15.71	16.66	11.73	12.14
Farms (%) where inputs and cacao income use decided by:							
Household head only	71.50	93.47	84.37	64.28	74.16	73.86	69.36
Both heads	6.73	2.17	1.56	4.28	1.66	8.00	5.57
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	**1061**

Table 30. Cacao: MOCCA key indicators by country, at baseline

Key USDA indicators	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Yield (kg dry/ha)	329.32	88.87	350.96	190.91	250.92	451.84	352.80
Area cacao (ha)	3.58	1.58	1.02	1.56	2.16	2.34	2.40
Farmers (%) accessing financing for agriculture	5.28	0.97	2.73	0.45	4.22	9.09	5.93
Value of annual cacao sales (US$) - includes only farmers who sold	3,398.27	232.53	530.85	681.35	750.22	2,534.88	2,099.68
Value of annual cacao sales (US$)	3,189	93	502	509	686.82	2,387	1824.6
Annual amount of cacao sold (kg dry)	1,123	69	417	335	1,385.89	1,220	1047.25
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	**1,061**
*1 ha (hectare) = 10,000 square meters							

Access to financial services for cocoa farmers across countries is deficient (5.93%). Peru has the highest percentage (9%), while in El Salvador and Honduras it is practically null (<1%). The higher percent of cacao farmers with access to finance in Peru (9%) and Ecuador (5%) as compared with Central American countries (0.5 to 4%) aligns well with both the much higher annual cacao sales and the relatively more developed cacao sectors with a much longer history as a cacao origin as seen in the market system level assessment. While the results of the market system level assessment might suggest that farmers in Honduras, Nicaragua, Ecuador and Peru would have an easier time accessing credit for cacao than either El Salvador or Guatemala, this assessment focused on availability of financial services for the sector while the farmer level assessment is providing complementary data on whether MOCCA beneficiaries are able to access those services. In particular it will be interesting to understand how farmers in Guatemala are accessing financing for cacao and why so few in Honduras receive credit when the mechanisms at least have been created for the sector.

4.2.2 By sex of the household head

In all countries, the average yields of women farmers are lower than men's, except for Peru, but the difference is not statistically significant. Only Honduras has a significant difference of more than 78 kg dry/ha. In terms of sales and access to financial services, the results are similar, with no statistical difference except for Nicaragua (annual sales) but a tendency for male farmers to perform better on those indicators (Table 31)

The MOCCA indicators disaggregated by anchor firms per country and sex of household head are included in Table A 19, Table A 20, Table A 21, Table A 22, Table A 23 and Table A 24. No significant differences were found in these indicators between male and female headed households. This could mean heterogeneous groups in some variables such as farmers with certifications or access to financial services. However, for indicators such as household income or yield, the internal variability (standard deviation) could be very high.

Table 31. Cacao: MOCCA indicators by sex of household head, at baseline

Key USDA indicators	Ecuador			El Salvador			Guatemala		
	Female	Male	p-value	Female	Male	p-value	Female	Male	p-value
Yield (kg dry/ha)	302.78	337.25	0.419	69.42	96.25	0.457	299.32	370.59	0.323
Area cacao (ha)	3.07	3.72	0.361	1.33	1.67	0.527	0.77	1.12	0.122
Farmers (%) with access to financing for agriculture	4.25	5.55	0.724	0.00	1.31	0.554	0.00	3.84	0.369
Value of annual cacao sales (US$) only includes farmers who sold	2,666.34	3,594.59	0.344	146.06	264.24	0.323	391.80	583.69	0.380
Value of annual cacao sales (US$)	2,551.92	3,354.95	0.392	59.50	104.30	0.410	354.49	561.24	0.316
Number of households	**47**	**180**		**27**	**76**		**21**	**54**	

Key USDA indicators	Honduras			Nicaragua			Peru			All countries		
	Female	Male	p-value	Female	Male	p-value	Female	Male	p-value	Female	Male	p-value
Yield (kg dry/ha)	130.52	209.03	0.049**	109.14	281.04	0.2544	493.24	434.75	0.242	357.14	351.35	0.8607
Area cacao (ha)	1.28	1.67	0.243	1.27	2.35	0.0560*	2.15	2.42	0.604	2.00	2.54	0.0699*
Farmers (%) with access to financing for agriculture	0.00	6.34	0.211	0	5.12	0.2504	7.25	9.83	0.401	4.10	6.55	0.1421
Value of annual cacao sales (US$) only includes farmers who sold	395.83	767.01	0.256	245.3	858.76	0.0153**	2,522.4	2,534.9	0.9751	1897.0	2167.42	0.4376
Value of annual cacao sales (US$)	247.39	608.74	0.132	225.67	785.36	0.0180**	2,400.4	2,381.8	0.973	1635.1	1888.6	0.3851
Number of households	**24**	**63**		**25**	**117**	**142**	**124**	**305**		**268**	**793**	

Note: differences in means between groups are significant at the 10% level (*), 5% level (**) or 1% level (***)

4.2.3 By age category

If we segregate farmers by age (15-29 and ≥30 years), we find no significant differences in yields, access to finance or annual cacao sales across countries, except for Guatemala where the annual value of cacao sales in the group of farmers older than 30 is significantly higher (US605.04 vs. US 139.66). In general, the senior group scores better on these indicators across countries (Table 32).

Table 32. Cacao: MOCCA indicators by age of household head, at baseline

Key USDA indicators	Ecuador			El Salvador			Guatemala		
	15-29 yrs	≥30 yrs	p-value	15-29 yrs	≥30 yrs	p-value	15-29 yrs	≥30 yrs	p-value
Yield (kg dry/ha)	316.31	330.26	0.9035	n.a.	88.87	n.a.	402.01	341.28	0.4908
Area cacao (ha)	2.19	3.61	0.468	n.a.	1.58	n.a.	0.67	1.08	0.146
Farmers (%) with access to financing for agriculture	20.00	4.95	0.138	n.a.	1.03	n.a.	0.00	3.22	0.552
Value of annual cacao sales (US$) only includes farmers who sold	1,754.80	3,437.78	0.525	n.a.	232.53	n.a.	139.66	605.04	0.079*
Value of annual cacao sales (US$)	1754.80	3220.98	0.5711	0.00	98.28	0.3358	139.66	566.01	0.099*
Number of households	**5**	**222**		**6**	**97**		**11**	**62**	

Key USDA indicators	Honduras			Nicaragua			Peru			All countries		
	15-29 yrs	≥30 yrs	p-value	15-29 yrs	≥30 yrs	p-value	15-29 yrs	≥30 yrs	p-value	15-29 yrs	≥30 yrs	p-value
Yield (kg dry)/ha)	173.34	192.06	0.7924	211.27	256.69	0.8058	435.91	453.25	0.8347	356.63	352.73	0.9433
Area cacao (ha)	0.92	1.63	0.171	1.38	2.25	0.2228	1.92	2.38	0.595	1.58	2.51	0.106
Farmers (%) with access to financing for agriculture	1.25	3.79	0.866	13.33	3.17	0.4419	5.55	9.41	0.442	6.06	6.21	0.961
Value of annual cacao sales (US$) only includes farmers who sold	413.98	698.89	0.371	536.1	782.75	0.434	2,016.89	2,580.96	0.548	1,189.75	2,063.13	0.138
Value of annual cacao sales (US$)	206.99	539.64	0.3714	500.36	714.42	0.4705	1848.81	2436.48	0.5036	1062.08	1889.55	0.098*
Number of households	**8**	**79**					**36**	**393**		**66**	**853**	
Note: p-value in parenthesis, and differences in means between groups are significant at the 10% level (*), 5% level (**) or 1% level (***)												
*1 ha (hectare) = 10,000 square meters												

4.2.4 By size of cacao area

In general, farmers with smaller farms (≤5 ha) obtained on average US 1,430.02 in annual cacao sales, much lower than the US 4,463.75 obtained by larger producers (> 5 ha). Only Guatemala and Honduras did not have differences in cacao sales across farm sizes. For Ecuador and Peru, the difference could be up to fivefold between. This income difference needs to be taken into account in the later impact study. In terms of yield, there are no significant differences by farm size (Table 33).

Table 33. Cacao: MOCCA indicators by size, at baseline

Key USDA indicators	Ecuador			El Salvador			Guatemala		
	<5 ha	>5 ha	p-value	<5 ha	>5 ha	p-value	<5 ha	>5 ha	p-value
Yield (kg dry)/ha)	340.29	291.51	0.253	90.96	7.4	n.a.	350.96	n.a.	n.a.
Area cacao (ha)	1.86	10.52	0.000***	1.44	7.00	n.a.	1.02	n.a.	n.a.
Value of annual cacao sales (US$) only includes farmers who sold	1,827.20	9,623.61	0.000***	235.22	125.00	0.000***	530.85	n.a.	n.a.
Value of annual cacao sales (US$)	1,695.96	9,062.22	0.000***	235.22	1.98	0.000***	501.76	n.a.	n.a.
Number of households	**183**	**44**		**40**	**63**		**71**	**2**	

Key USDA indicators	Honduras			Nicaragua			Peru			All countries		
	<5 ha	>5 ha	p-value	<5 ha	>5 ha	p-value	<5 ha	>5 ha	p-value	<5 ha	>5 ha	p-value
Yield (kg dry)/ha)	195.12	126.73	0.335	253.11	210.26	0.869	446.06	575.65	0.240	353.96	339.55	0.783
Area cacao (ha)	1.33	6.47	0.0000***	1.74	10.35	0.000***	1.89	12.61	0.0000***	1.72	10.74	0.000***
Value of annual cacao sales (US$) only includes farmers who sold	690.86	536.38	0.788	576.84	3796.86	0.000***	2,211.93	9,460.39	0.000***	1,558.30	8,213.30	0.000***
Value of annual cacao sales (US$)	507.74	536.38	0.956	525.56	3796.86	0.000***	2,077.39	9,460.39	0.000***	1,584.97	4,499.39	0.000***
Number of households	**84**	**3**		**135**	**7**		**411**	**18**		**788**	**131**	
Notes: ha = hectares; p-values in parenthesis, and differences in means between groups are significant at the 10% level (*), 5% level (**) or 1% level (***)												
*1 ha (hectare) = 10,000 square meters												

4.3 Adoption of MOCCA-promoted practices

MOCCA is promoting nine groups of practices: (a) Planting of new cacao plants, in new or renovated & rehabilitated cacao areas, (b) Production of cacao seedlings in greenhouses, (c) Fertility management (nutrition), (d) Cacao pruning and management of accompanying trees, (e) Integrated pest management (f) Cacao harvesting (g) Fermentation (h) Drying and (i) Commercialization. The list of practices and more details (curriculum) are described in Table A 25. For most of these practices, they provide a criteria to consider a farmer implementing a practice well vs. optimally. Although we attempt to provide information at these levels for most practices, given that this curriculum was not available when we prepared the instruments and started data collection, we can only provide such information for practices for which we had collected the information.[42]

To read all tables in the rest of this section, the values of variables not indented represent values at the sample level. However, values of variables indented represent a sub-group; hence, are not at the sample level (instead, they are at a sub-sample level determined by the variable immediately above it). For example, the information about the percent of farmers doing pruning in their farm, and the percent of these farmers doing it well vs. optimally (all countries, Table 35) should be interpreted as: 81.80% of farmers in all countries reported doing pruning, and of farmers who prune, 41.13% did it well and 58.87% did it optimally. To estimate the share of sampled farmers doing this well, you need to multiply both values (i.e., 81.80% * 41.13% = 33.63%).

4.3.1 All practices

At the baseline, farmers adopted an average of 3.1 practices good and 2.42practices optimally. There is not much variation across countries. Peru stands out for highest number of practices adopted at both well and optimally levels. Ecuador and El Salvador are at the lower end, with just two practices at the optimally level (Table 34).

Table 34. Cacao: overall adoption of MOCCA-promoted practices at baseline

MOCCA-promoted practices*	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
# of practices adopted, and…:							
# practices adopted good	2.84	2.79	2.91	2.82	3.11	3.39	3.10
# practices adopted optimally	2.03	2.03	2.43	2.71	2.07	2.76	2.42
Number of households	**227**	**103**	**73**	**87**	**429**	**429**	**1061**
*Levels well or optimally as defined by MOCCA's criteria (see training curriculum for details)							

[42] This is the reason why for many practices, we did not collect data: the curriculum was developed after data collection started.

4.3.2 Renovation and rehabilitation

The quality of adoption of renovation practices is assessed using two levels. For *re-planting cacao/compacting cacao areas*, the farmers were considered to be *doing the practice well* when they have 5 or fewer different cacao clones per hectare and/or do not know the name of the varieties, or have renovated with 50% grafted seedlings and 50% seedlings coming from seeds. Farmers were considered to be *replanting cacao/compacting cacao areas optimally* if they have 5 or more clones per hectare and know the name of the varieties, or have renovated with 80% grafted seedlings and 20% seedlings coming from seeds. Regarding *knowledge about the variety planted*, farmers who knew the variety planted in their plot were considered to *do this practice well*, while farmers who use genetic materials coming from elite trees or registered/identified from a trusted source of genetic material were considered to *do this practice optimally*. For the *cacao tree density*, farmers who used planting densities of 3.5m x 3.5m between cacao plants were considered to be *doing this practice well*, while farmers who planted at a density of 3.0m x 3.0m between cacao plants and planted accompanying trees according to distances recommended in the CACAO MOVIL guide under agroforestry systems were considered to be *doing this practice optimally*. Farmer who does at least 1 of the recommended *pruning* is considered to be *doing this practice well* and while farmers who implemented 3 of the recommended pruning based on a farm diagnosis of the pruning needs for cacao and shadow trees were considered to do this *practice optimally*. (Table A 25).

Governments and donors have financed renovation and rehabilitation activities in the cocoa sector mainly in Ecuador and Peru. Fertilization, pruning, and shade management are all critical, but the renovation of areas will also keep production volumes up and increase productivity and profitability. Few farmers are re-planting cacao (1.41%), all of them are doing this practice well. The percentages of farmers knowing the clone/varieties and density of cacao trees on their farm are 98.02% and 67.57%, respectively. Approximately 81.8% of farmers did pruning in their farm, and this was highest in Honduras (95.40%) and lowest in Ecuador (66.07%). Around 41% of the farmers that prune did it well and most of them did it optimally (58.87%). In Ecuador, for example, the government claims to have pruned 101 thousand hectares of cacao by 2014 (ref. report). This kind of prior investments in the sector may explain why some of these indicators are performing well at the baseline (Table 35).

Table 35. Cacao: adoption of Renovation & Rehabilitation practices at baseline

Renovation & Rehabilitation (R&R) MOCCA-promoted practices*	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) doing pruning in their farm	66.07	69.90	91.78	95.40	84.50	87.64	81.80
Of farmers who does at least 1 of the recommended pruning	49.33	45.83	38.81	19.28	31.67	45.21	41.13
Of farmers who implemented 3 of the recommended pruning based on a farm diagnosis of the pruning needs for cacao and shadow trees	50.67	54.17	61.19	80.72	68.33	54.79	58.87
Farmers (%) knowing the clone/variety planted	99.55	87.37	97.26	95.40	99.29	100.00	98.02
Of farmers who knew the variety planted in their plot	95.13	97.78	100.00	92.77	100.00	98.83	97.60
Of farmers who use genetic materials coming from elite trees or registered/identified from a trusted source of genetic material	4.87	2.22	0.00	7.23	0.00	1.17	2.40
Farmers (%) knowing the cacao tree density	55.50	59.22	47.94	78.16	35.21	87.87	67.57
Of farmers who used planting densities of 3.5m x 3.5m between cacao plants	1.59	0.00	5.71	94.12	20.00	1.86	11.85
Of farmers who planted at a density of 3.0m x 3.0m between cacao plants and planted accompanying trees according to distances recommended	98.41	100.00	94.29	5.88	80.00	98.14	88.15
Farmers (%) re-planting/compacting cacao area	0.44	0.00	4.10	1.14	2.11	1.63	1.41
Of farmers who have 5 or fewer different cacao clones per hectare and/or do not know the name of the varieties, or have renovated with 50% grafted seedlings and 50% seedlings coming from seeds	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Of farmers who have 5 or more clones per hectare and know the name of the varieties, or have renovated with 80% grafted seedlings and 20% seedlings coming from seeds	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Number of households	227	103	100	87	142	429	1061
*Levels well or optimally as defined by MOCCA's criteria (see training curriculum for details)							

During the 2019/2020 agricultural year, we found on average that just 17.62 % of farmers renovated cacao trees during the year (Figure 34). Peru and Honduras have the highest rates (21.44% and 20.68%), and El Salvador the lowest (11.65%). The main reason farmers gave for implementing this practice is low yields (70.63%) followed by dead plants (53.13%). Nicaragua has the highest percentage (92.31%). A very low percentage of farmers renovate cacao trees based on an assessment of the plantation (4.38%) and in El Salvador 57.14% of farmers report having insufficient knowledge about renovation. The main reasons among farmers who think is important cacao renovation are yield increase (91.5%) and quality of the harvest (25.51%) and the principal barriers are cost (15.58%) and lack of interest (13.33%). 40.69% of the cacao farmers reporting having limitations to adopting rehabilitation practices. The main reason is the lack of economic resources (35.50%). However, reasons varied by country, with lack of time being important in Peru (35.51%) and lack of knowledge being important in Guatemala (35.71%) (Table A 26).

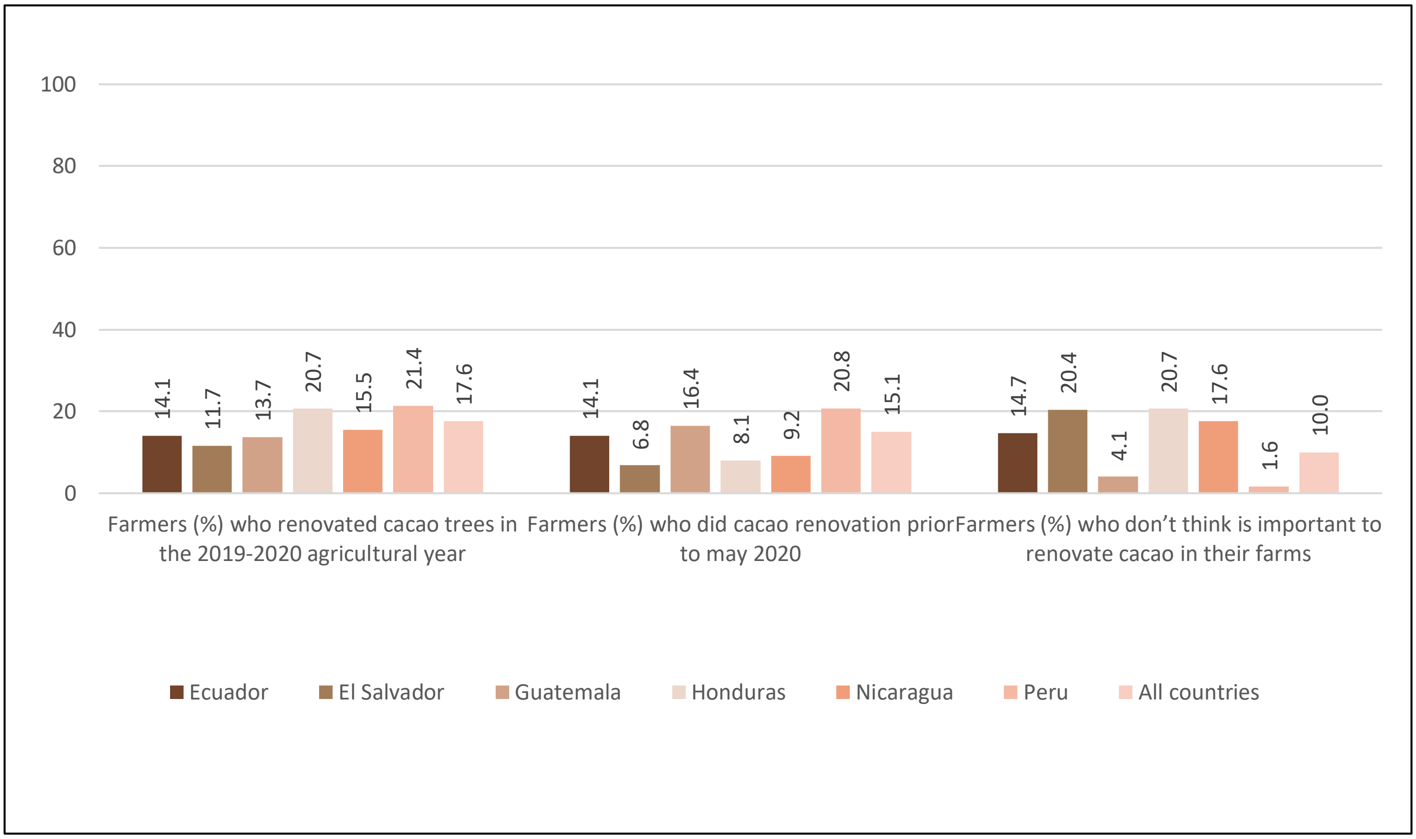


Figure 34. Farmers (%) renovating cacao and who do not think this is important, by country

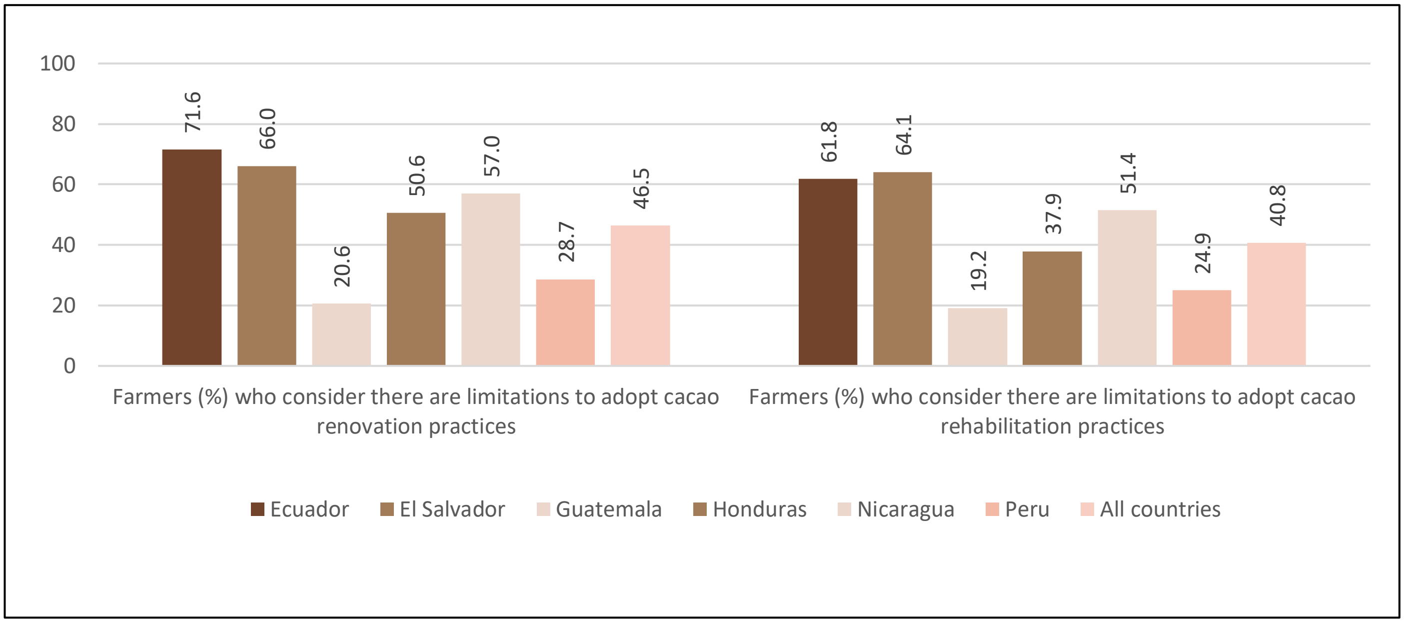


Figure 35. Cacao farmers (%) reporting limitations to implement R&R, by country

4.3.3 Crop nutrition

In El Salvador, 86.4% of farmers applying fertilizers in the baseline year, this percentage is more than double for all countries (37.9%)(Figure 36). Fertilization based on nutritional deficiencies (12.91%) and a fertilization plan (12.15%) are the lowest, especially in Nicaragua (2.1% and 7%). El Salvador has a different pattern of practice adoption with the adoption of fertilizer practices being higher than other countries.

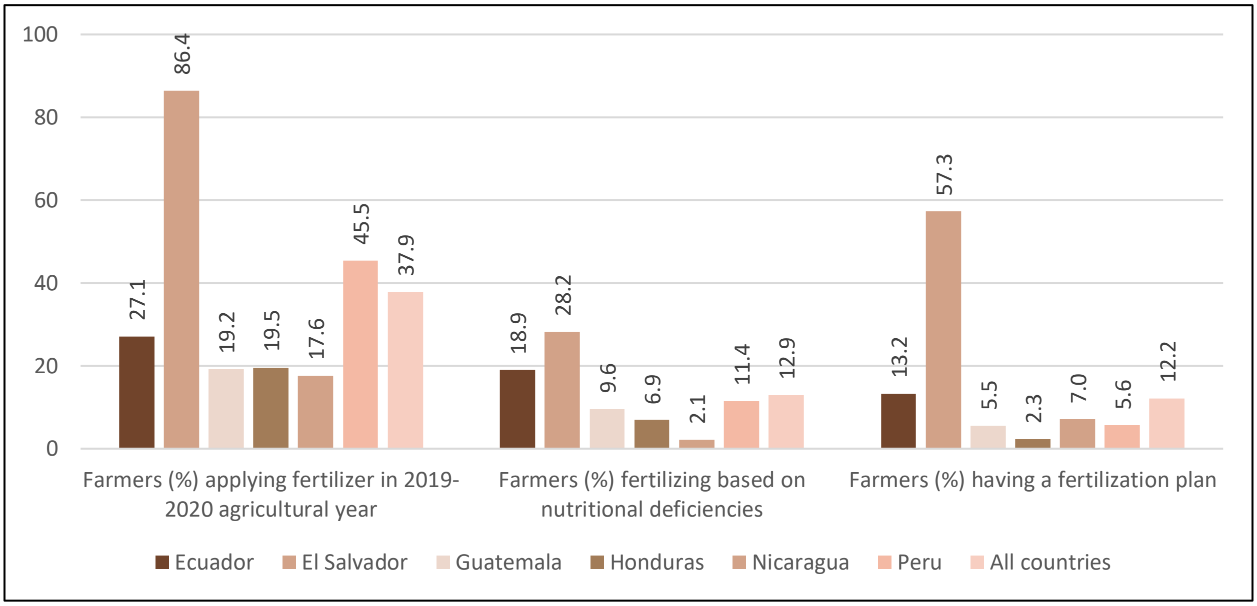


Figure 36. Cacao farmers (%) applying nutritional management practices at baseline, by country

The adoption of N&IPM practices were assessed by adoption level - well or optimally, according to the criteria described in the curriculum. Regarding *farmers fertilizing based on nutritional deficiencies*, those who did a visual evaluation of nutrient deficiencies in plant leaves and did a nutrient balance calculation based on actual and expected harvest (N, P, K) to determine fertilization needs were considered to be doing *this practice well*. Farmers who did a nutrient balance calculation based on expected harvest (N, P, K) and/or used soil analysis results to determine fertilization needs were considered to be *doing the practice optimally*. Adoption of a *Fertilization ("enmiendas") plan* was considered to be *done well* when farmers did at least 2 fertilizer applications (one every 6 months), and considered to be *done optimally*, if the farmer had a nutrition plan based on the production system, or did at least 4 fertilizer applications (one every 3 months) applying 150 gr/plant every time.

The majority of the farmers that implemented practices (> 90%) did them well[43]. This implies room for improving their implementation to optimal level. One exception is fertilization based on nutritional deficiencies, where more farmers doing the practice optimally, though overall adoptions is quite low (14.58%) (Figure 37). Of the 12.2% of farmers with a fertilization plan, most did this at level good (Figure 38). For more details, see Table A 27.

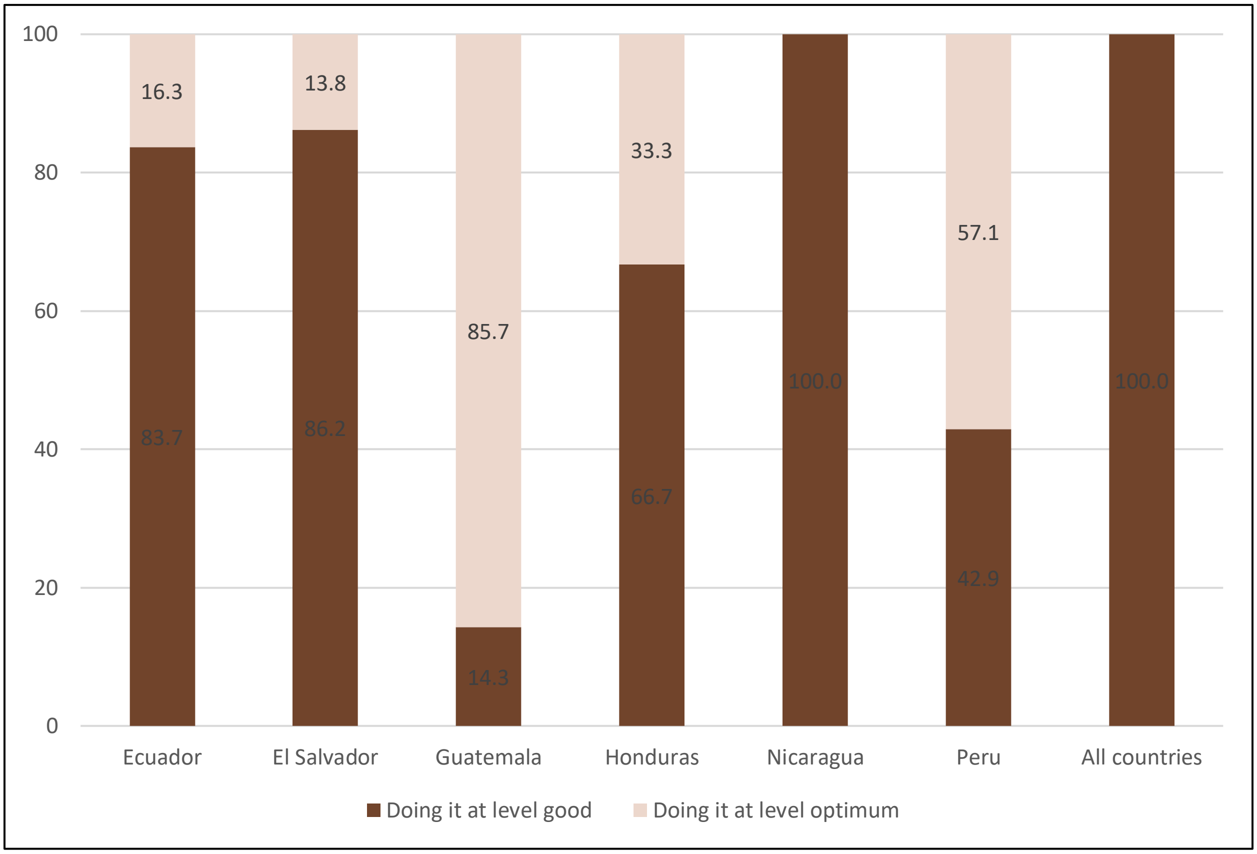


Figure 37. Cacao farmers (%) fertilizing based on nutritional deficiencies, by level

[43] The percentages are related to producers implementing the practices.

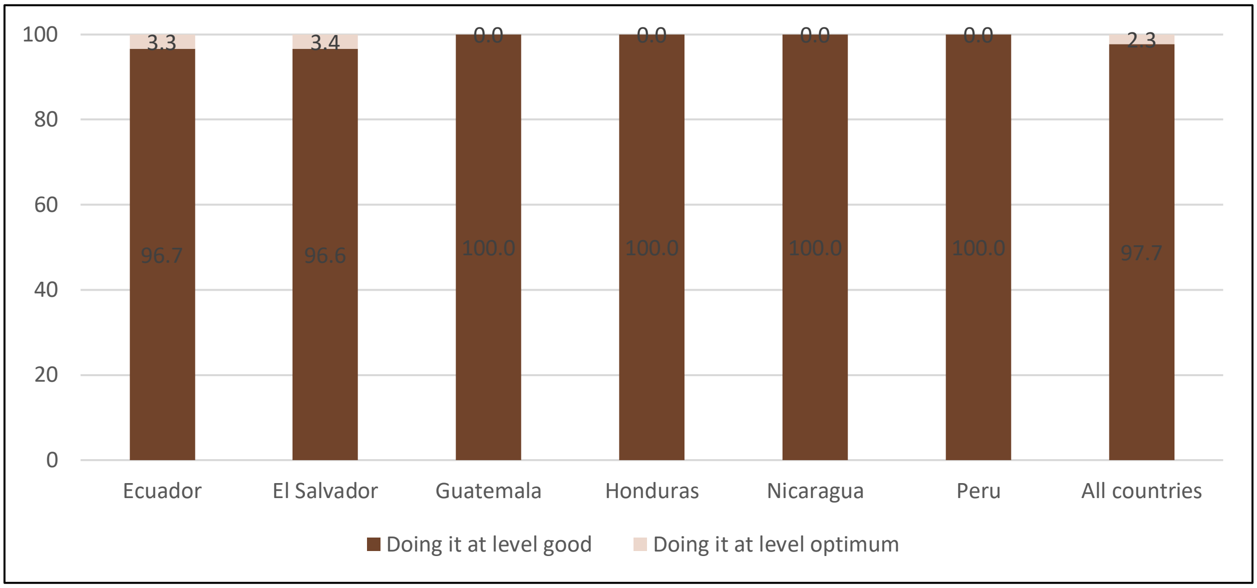
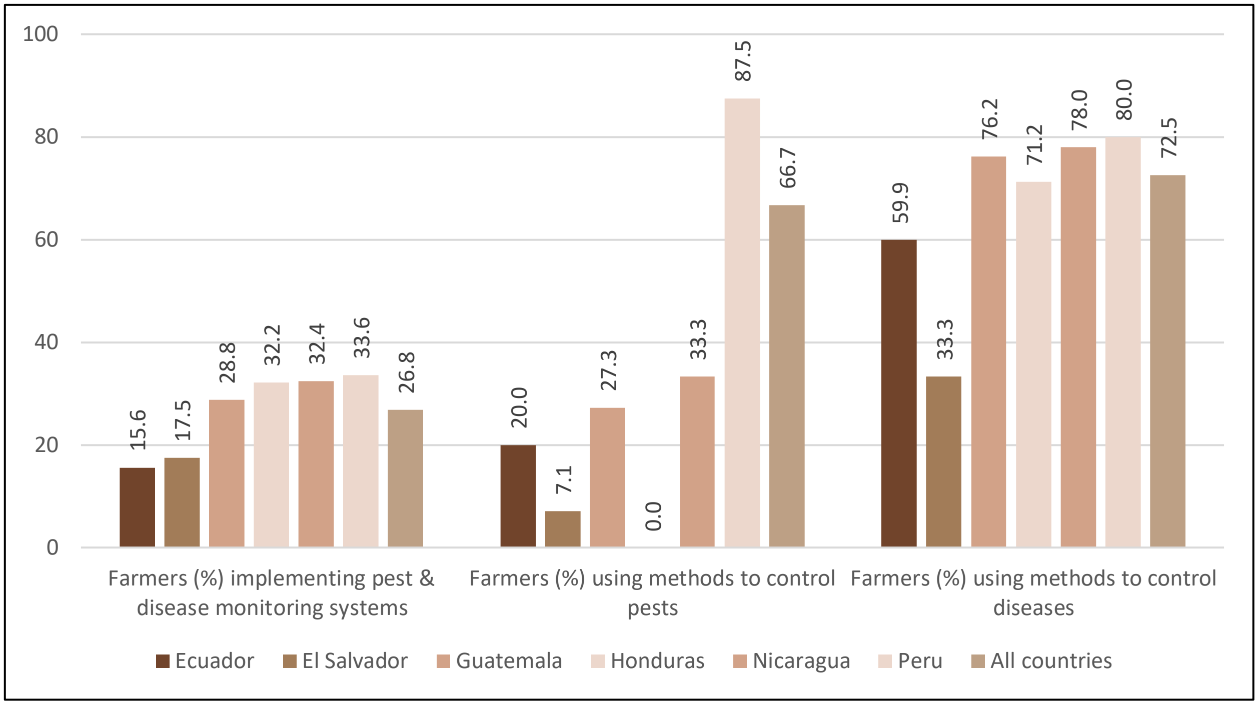


Figure 38. Cacao farmers (%) having a fertilization plan, by level

4.3.4 Integrated Pest Management

The percentage of farmers implementing pest and disease monitoring systems, in general, is low (26.8%), especially in Ecuador (15.6%) and El Salvador (17.5%). Methods to control pests and diseases have the highest level of adoption (66.7% and 72.5% respectively). Peru stands out as the country with the highest rate of adoption of pest management practices (87.5%). El Salvador has a different pattern using methods to control diseases, being lower than other countries (33.3% vs 72.5%) (Figure 39).

Figure 39. Cacao farmers (%) adopting integrated pest management practices at baseline, by country



For *use of methods to control pest/disease*, farmers who used at least 1 control method for every pest/disease present, and incidence of pests/diseases was 10% below average incidence level determined at baseline were considered to be *doing the practice well*, while the farmer who used 2 or more control methods for every pest/disease present *and* at least 1 of these is an ecological (non-chemical) method of control, *and* incidence of pests/diseases was 20% below average incidence level determined at baseline *and* integrated pest management is implemented according to an agro-ecological calendar was considered to be *doing the practices optimally* (Table A 25).

Same as nutrition, the majority of the farmers that implemented practices (> 90%) did them well[44]. This implies room for improving their implementation to optima level (Figure 40 and Figure 41). For more details, see Table A 27.

[44] The percentages are related to producers implementing the practices.

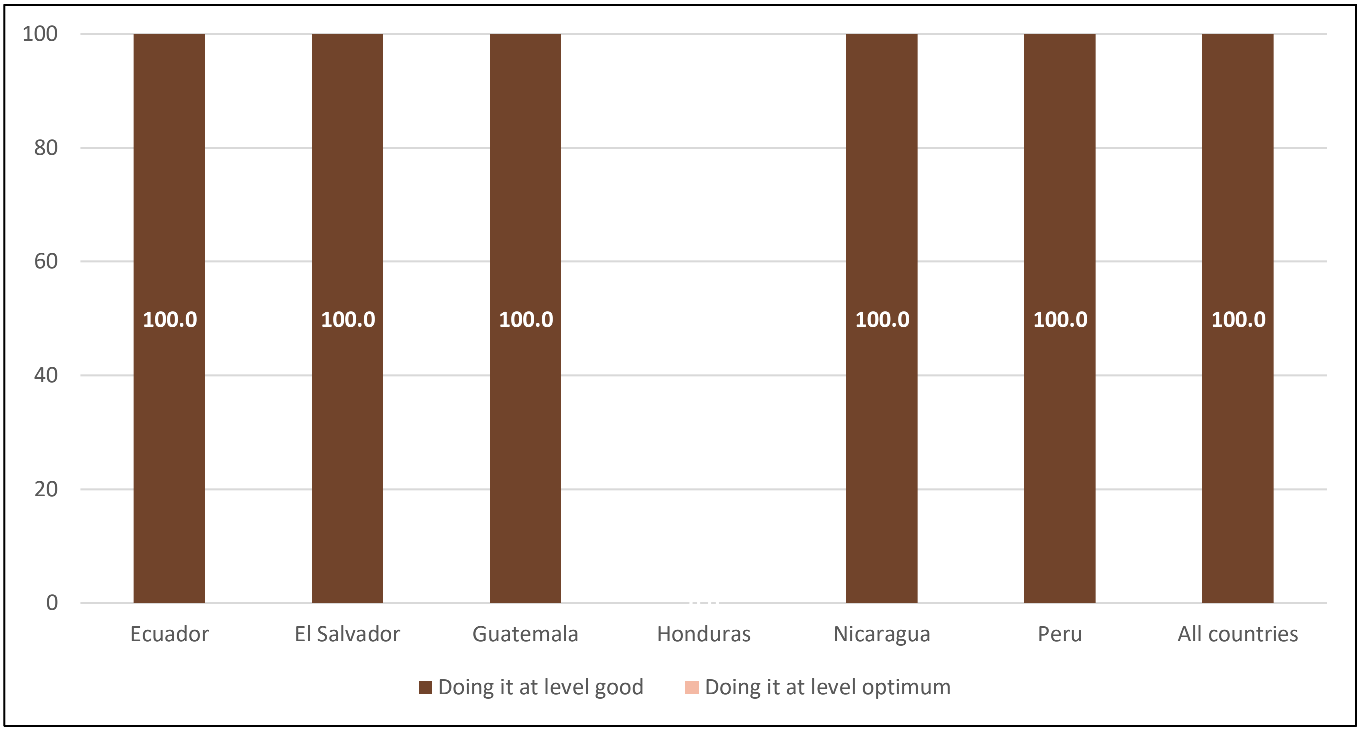


Figure 40. Cacao farmers (%) using methods to control pest, by level

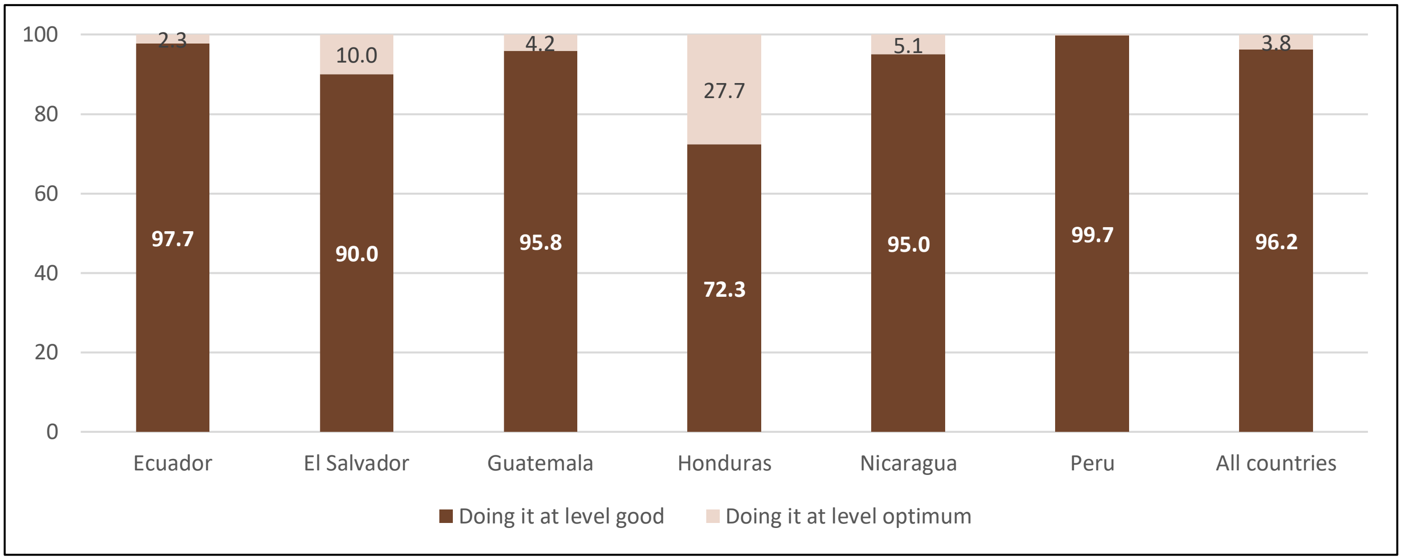


Figure 41. Cacao farmers (%) using methods to control diseases, by level

4.3.5 Nursery

For nursery practices, farmers who *selected seeds or budwood from elite trees* (highly productive, vigorous, disease and pest tolerant trees) were considered to be *doing the practice well*, while farmers who select seeds, budwood or seedlings produced by a nursery or clonal gardens with genetic materials from registered and/or identifiable and trustworthy sources (does not apply to

Guatemala and El Salvador as there are no regulations yet) were considered to be *doing the practice optimally*.

The percentages of farmers who carry out selection of cacao seeds for planting is low (only 9,7%), but most of those that do carry out seed selection for planting implement the practice well (88.35%). Honduras and El Salvador have larger numbers of farmers implementing this practice optimally (50%) (Table 36).

Table 36. Cacao: adoption of nursery practices at baseline

Nursery MOCCA-promoted practices*	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) selecting cacao seeds or grafts, and % farmers…:	2.64	3.88	5.47	6.89	11.26	15.61	9.70
Selecting from elite trees/mothers	100.00	50.00	100.00	50.00	100.00	89.55	88.35
Selecting seeds or grafts produced by greenhouse or clonal gardens with genetic material coming from registered/identifiable and trustable sources	0.00	50.00	0.00	50.00	0.00	10.45	11.65
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	**1061**
	*Levels well or optimally as defined by MOCCA's criteria (see training curriculum for details)						

Preparation of substrates for cacao nurseries and application of organic fertilizers have a low level of adoption. Just 11.12% of farmers prepare a particular substrate for use in nurseries, with Peru having the highest level (18.41%). Most farmers do not disinfect the substrate mix; those that did disinfect used boiling water (11.86%), solarization (12.71%), or other methods (17.79%). Only 8.95% of farmers apply organic fertilizers, most of them using farm residues to prepare them (61.05%). However, a significant number of farmers incorporate organic matter between cacao rows (58.9%), mainly in Guatemala (76.71%), the exception is Nicaragua with only 23.23% (Table 37).

Table 37. Cacao: other MOCCA-promoted practices

Other MOCCA-promoted practices*	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) preparing substrate mix for greenhouse, and % farmers…:	3.08	4.85	6.85	3.45	13.38	18.41	11.12
Not disinfecting the substrate mix	28.57	60.00	5.47	66.66	36.84	48.10	47.45
Disinfecting substrate with solarization	28.57	20.00	0.00	0.00	26.31	8.86	12.71

Disinfecting substrate with boiling water	0.00	0.00	0.00	33.33	5.26	15.18	11.86
Disinfecting substrate with chemicals	42.85	0.00	0.00	0.00	10.52	0.00	4.23
Disinfecting substrate with other method	0.00	0.00	0.00	0.00	21.05	20.25	17.79
Farmers (%) applying organic fertilizers, and %:	4.40	5.82	19.17	13.79	1.40	11.88	8.95
Using farm residues to prepare them	50.00	83.33	0.00	91.66	0.00	72.54	61.05
Farmers (%) incorporating organic matter between cacao rows	66.96	63.10	76.71	65.51	23.23	61.07	58.9
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	**1061**
*Levels well or optimally as defined by MOCCA's criteria (see training curriculum for details)							

4.3.6 Soil/weed management practices

Figure 42 give an overview of practices used to manage the ground' of the cacao plantation, including weeds and soil (see more details in Table A 28). A high percentage of farmers implement some kind of applied floor management practices (76.15%). 19.98% of farmers apply mulch or use living mulch plants to cover soil. This percentage is lower in countries like Ecuador (7.48%), El Salvador (6.79%), and Guatemala (6.84%). El Salvador has the highest percentage of farmers adopting weeding practices (62.13%) while in general, only 28.08% of farmers across all countries use them.

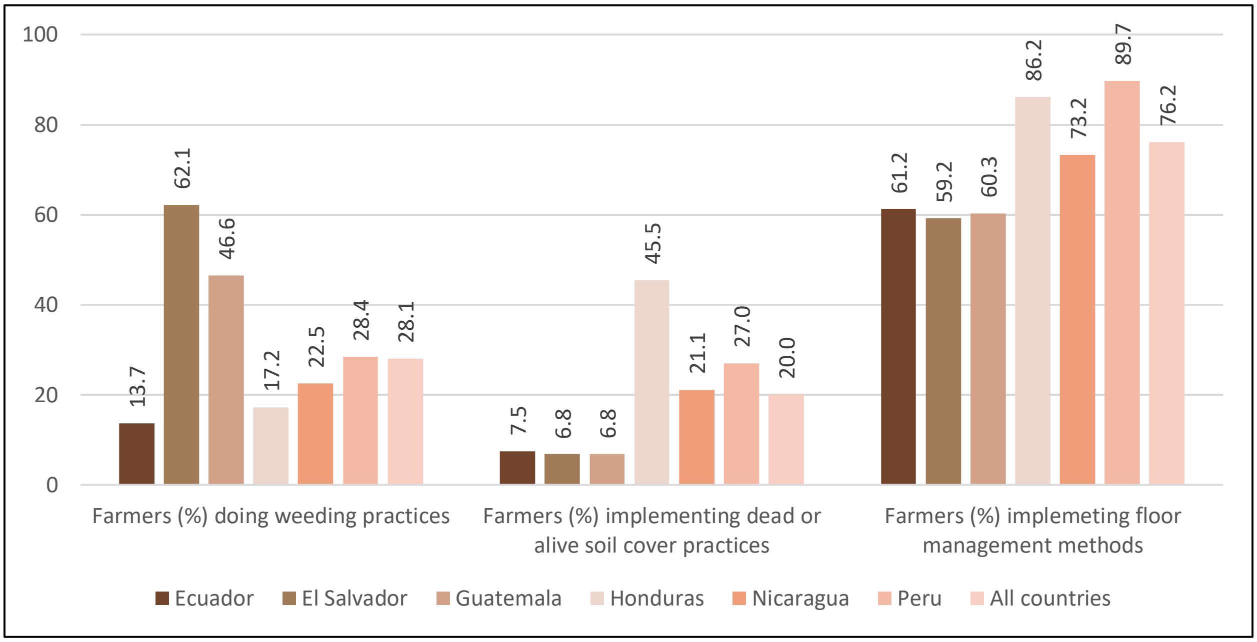


Figure 42. Cacao: Adoption of floor management practices at baseline, by country

Weeding practices were considered to be done well when the farmer carried out at least 1 weeding practice. It is considered to be done optimally if the farmer did selective weeding according to a calendar of activities. Regarding the *use of soil cover or mulch* (*dead or alive*), the practice was considered *to be done well* if the farmer Implemented at least 1 soil cover crop (legumes, other crops), and considered *to be done optimally* if they implemented at least 1 soil cover crop and 1 soil and water conservation practice (live or dead contour barriers, contour planting). *Floor management* (live or dead barriers, cover crops, herbicides) is considered to be done well if the farmer implemented at least 1 practice to manage the floor of the plantation, and optimally if they Implemented 2 or more practices to manage the plantation floor. Finally, if *the farmer incorporated organic matter around their trees (organic matter and/or harvested pods)* they were considered to be *doing the practice well*, while farmers who incorporated organic matter around their trees and in the rows, and prepared and applied organic fertilizers according to a local agronomic calendar, they were considered to be *doing the practice optimally*.

Figure 43, Figure 44 and Figure 45, describe the levels of adoption (well and optimally) of those farmers that are implementing FM practices. For the first three practices, most implement them at an optimal level, but due to low overall adoption these percentages represent few farmers in practical terms. This is the case for Guatemala, with 100% adoption at optimal level but only 6.84% of farmers who adopt soil cover practices (representing just five farmers in this case).

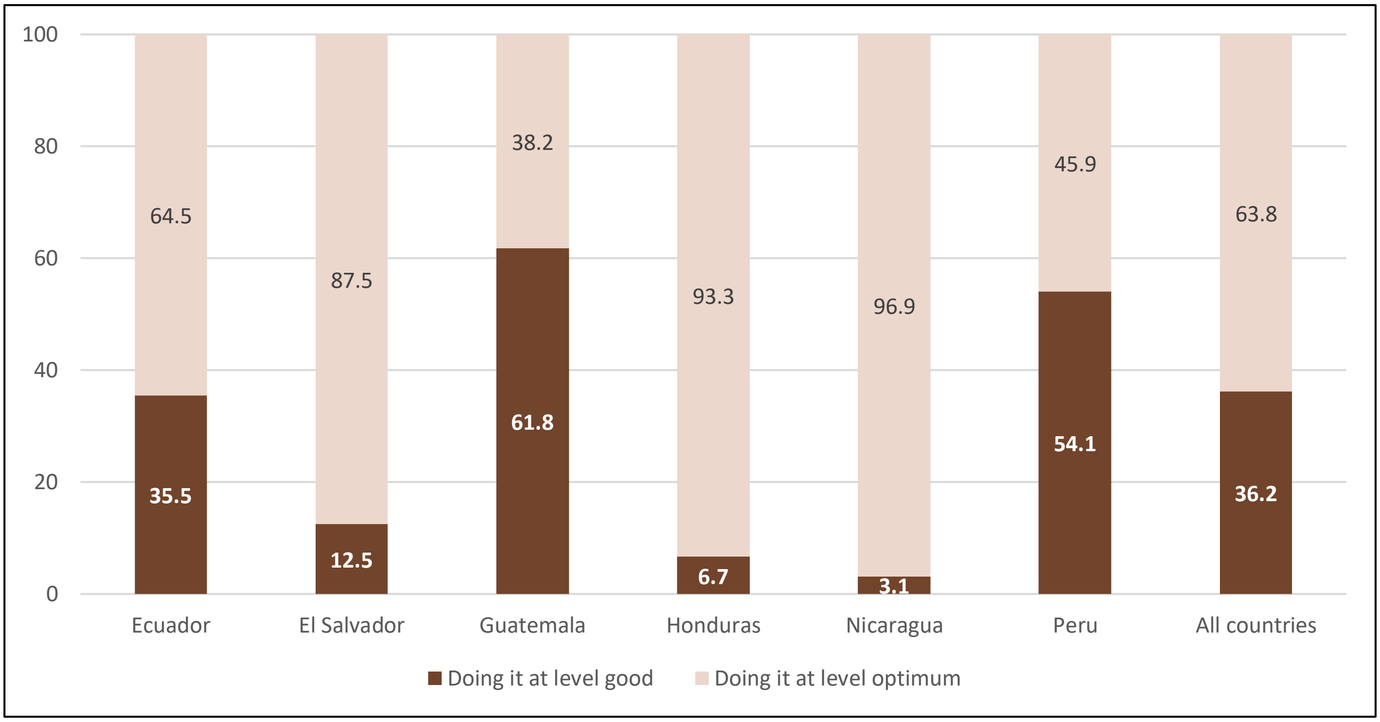


Figure 43. Cacao: Adoption (% farmers) of weeding by level at baseline, by level

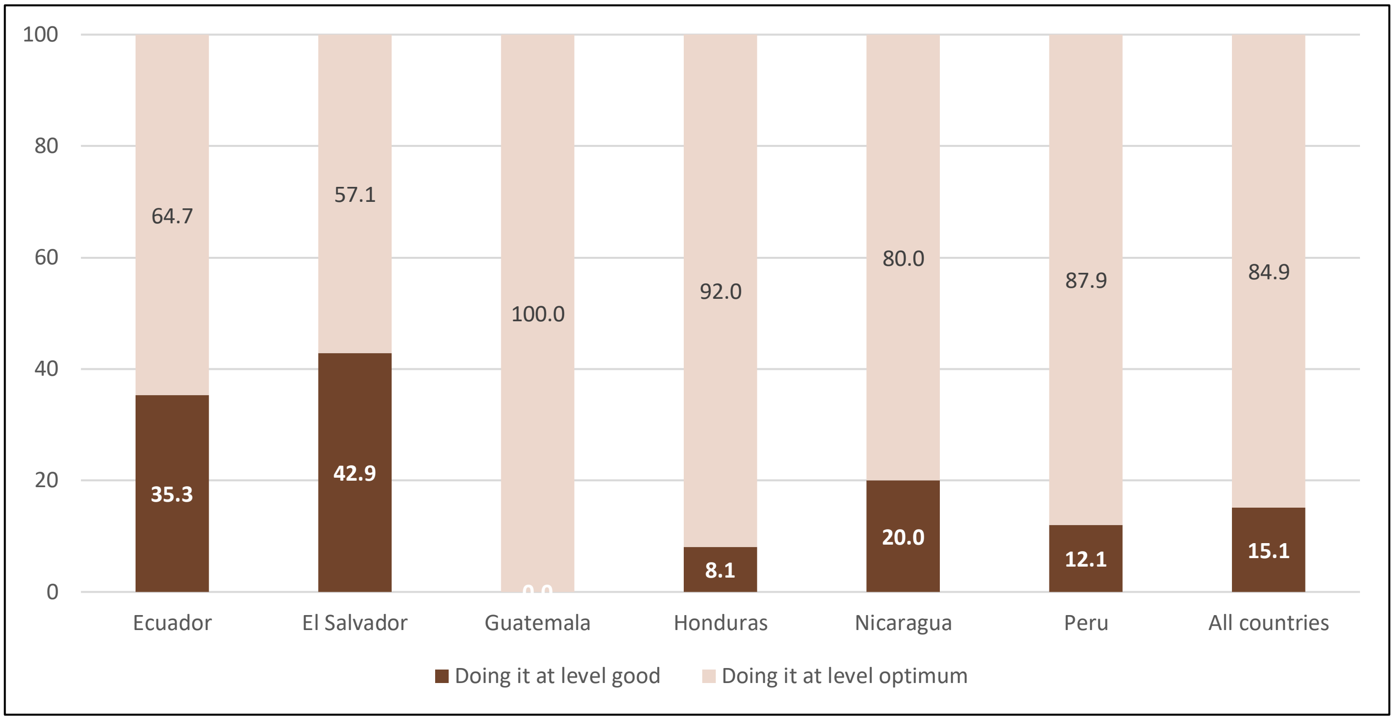


Figure 44. Cacao farmers (%) implementing dead or alive soil cover practices, by level

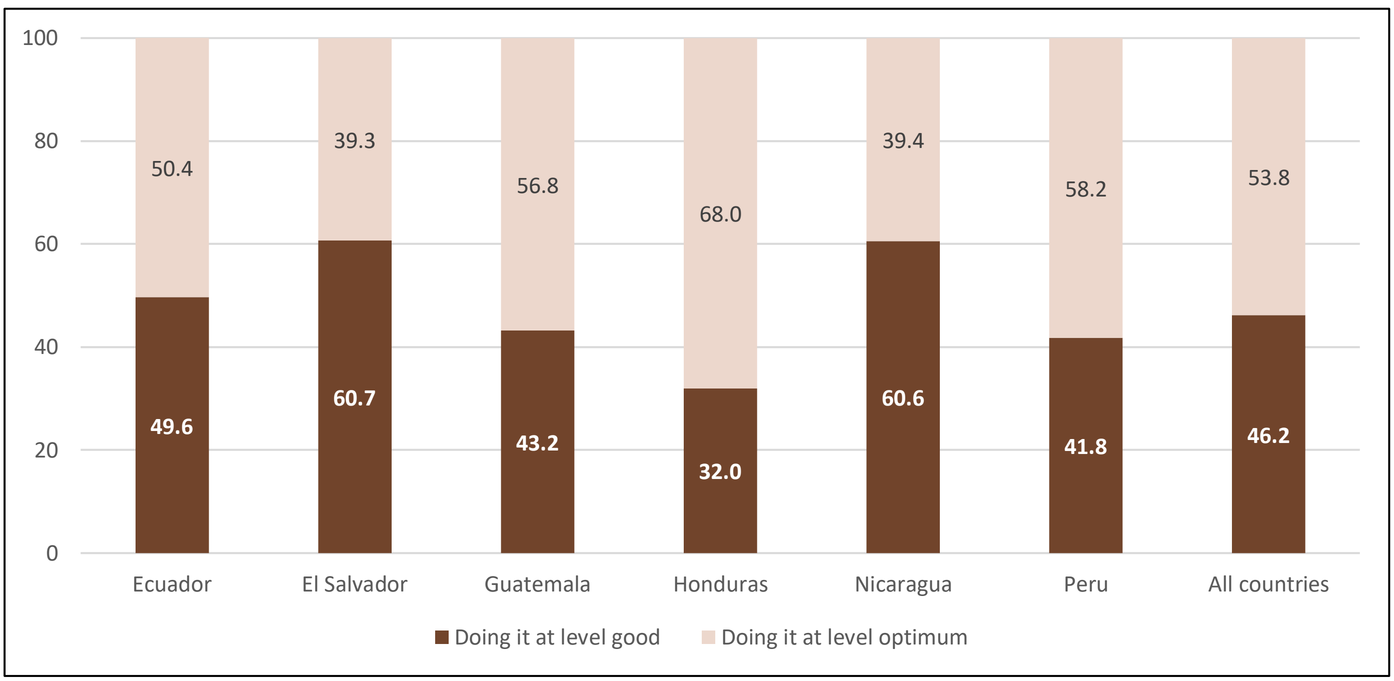


Figure 45. Cacao farmers (%) implementing floor management methods, by level

4.3.7 Harvest, post-harvest and processing

Figure 46 give an overview of harvest practices on the farm. Harvesting cacao, selective cacao harvesting, and removing the cacao beans within three days after harvest are implemented by more than 70% of farmers, except in El Salvador, where 60% of farmers do not yet have harvests.

Table A 29 includes details about post-harvest practices. As we see, only 22.62% of farmers fermented cacao on their farms, largely in Peru and Ecuador, while on-farm fermentation was rare in Central America. It is important to mention that most of the fermenting process is done in *centros de acopio*; this explains the low percentages of the variable. Drying and Fermentation are practices recommended for the organizations. Farmers fermenting cacao started this process within 3 hours after beans were removed from pods, mostly using fermentation methods such as boxes/trays or crates in stair-like arrangement, fermenting cacao for between 2 and 6.5 days. Most farmers (80%) cover the beans during this process and turn them between 2 and 3 times. However, most farmers (79.17%) do not monitor temperature nor do they verify the moisture of the cacao (only 21.3%) during this process. When verifying moisture, most farmers do so by testing if the beans break (95.13%) and/or by visual assessment (65.04%); using equipment for this was rare, except in El Salvador.

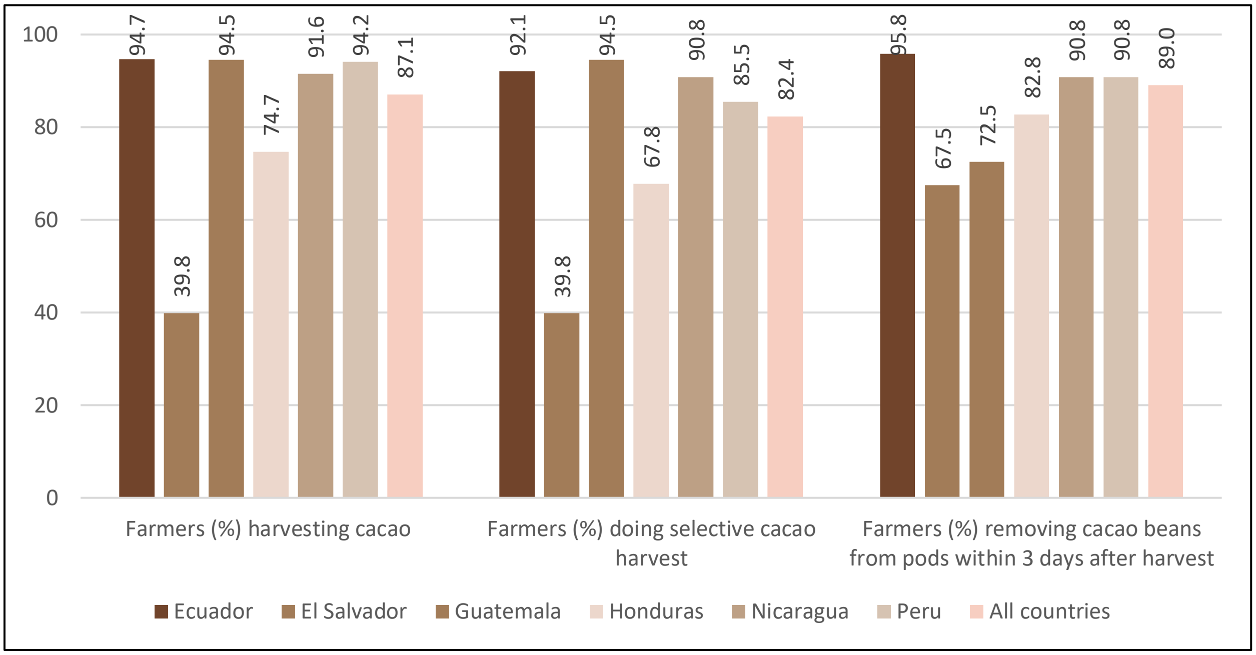


Figure 46. Cacao: Harvest practices, by country

Figure 47 describe the levels of adoption (well and optimally) of those farmers that are implementing FM&H practices. For the first three practices, most implement them at an optimal level, but due to low overall adoption these percentages represent few farmers in practical terms. This is the case for Guatemala, with 100% adoption at optimal level but only 6.84% of farmers who adopt soil cover practices (representing just five farmers in this case).

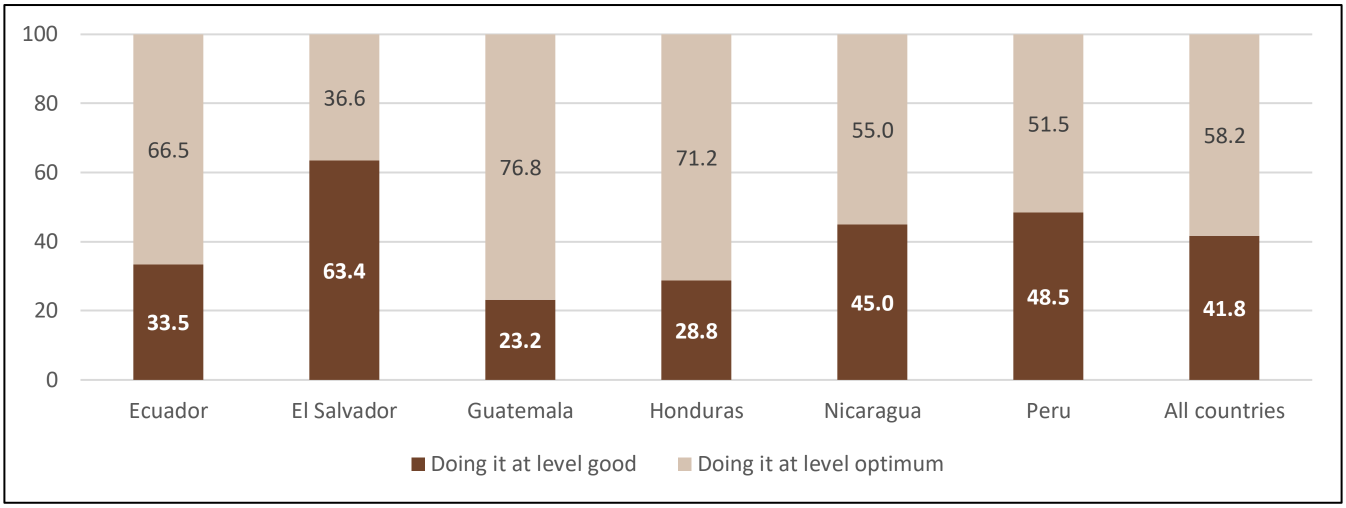


Figure 47. Cacao farmers (%) doing selective cacao harvest, by level

4.3.8 Quality, certifications, business management and high-value markets

More than 90% of farmers consider their cacao of well quality, 57.2% identified physical characteristics that affect the quality of their cacao (Figure 48). The main reasons in most of the countries for considering their cacao to be well quality are the uniform seed size (40.77%) where Guatemala stands out with 74.62% of farmers considering their cacao to be of well quality due to uniform seed size. The second most cited reason is the variety (35.6%), except for Guatemala (<2%). Healthy beans is the last one with 21.55% (Figure 49) 45.6% of farmers have some form of certification.

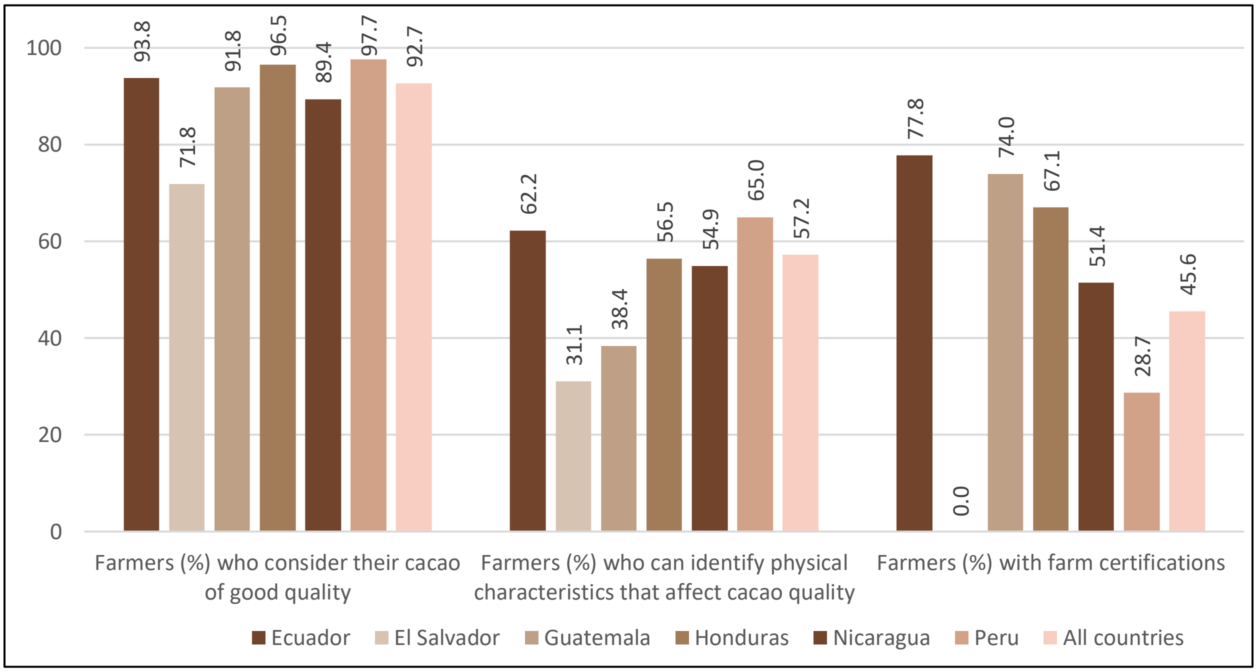


Figure 48. Cacao quality and farm certification, by country

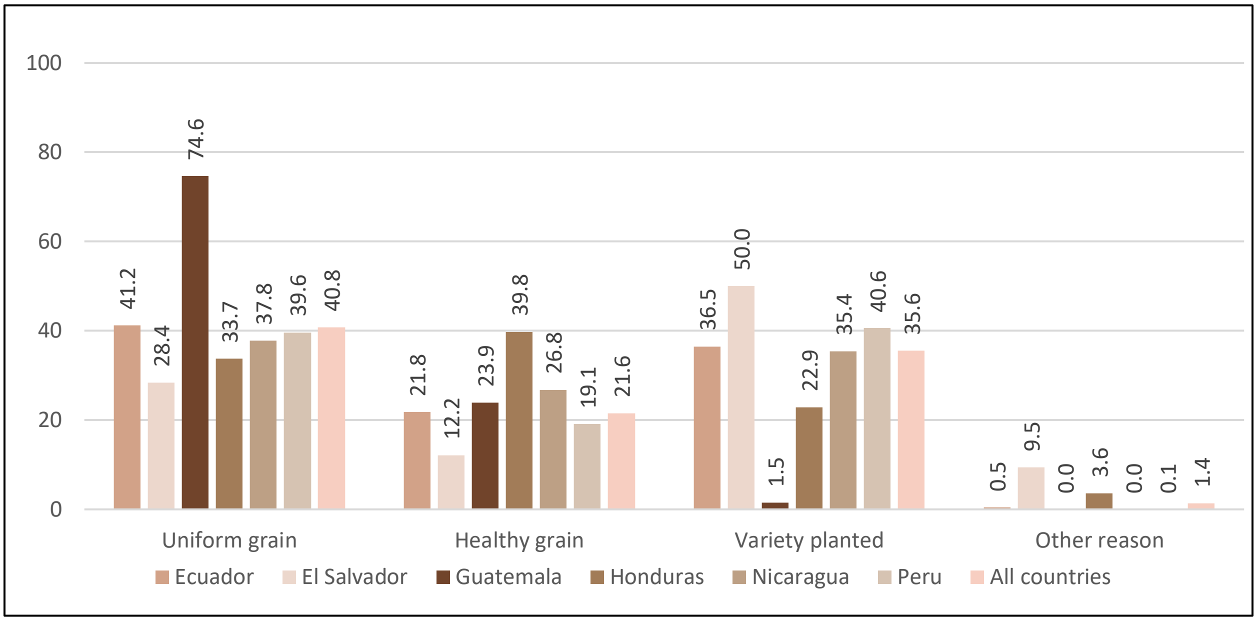


Figure 49. Why farmers considered their cacao of high quality, by country

The main cacao buyers for farmers are cooperatives or farmer organizations. They buy around 52% of production. Depending on the country another important actor are intermediaries, mainly in Peru (50.99%) and Ecuador (26.76%). In El Salvador, the production is sold in the local markets (Figure 50). This is an interesting reflection of both the overall market context for cacao in each country as well as the selection process for MOCCA cacao farmers through anchor firms who buy from farmer organizations.

Organic certification is the most popular cacao certification across the countries except in Nicaragua (39.72%). In Guatemala, 100% of the certified farmers are organic, followed by Peru (95.93%) and Ecuador (84.93%). Other important certifications are Fair Trade (22.40%) and FLO (20.95%), especially in Ecuador and Honduras. In Nicaragua UTZ certification is relevant (57.53). Currently, El Salvador does not report certified production (Figure 51).

Most cacao sold in Ecuador, Guatemala, and Honduras is wet beans, from ripe pods (79.34%, 84.05%, and 75.38%, respectively). Farmers in El Salvador (65.85%) and Peru (62.12) sell dry cacao beans (Figure 52). For more details on harvest and commercialization practices, see Annex (Table A 30).

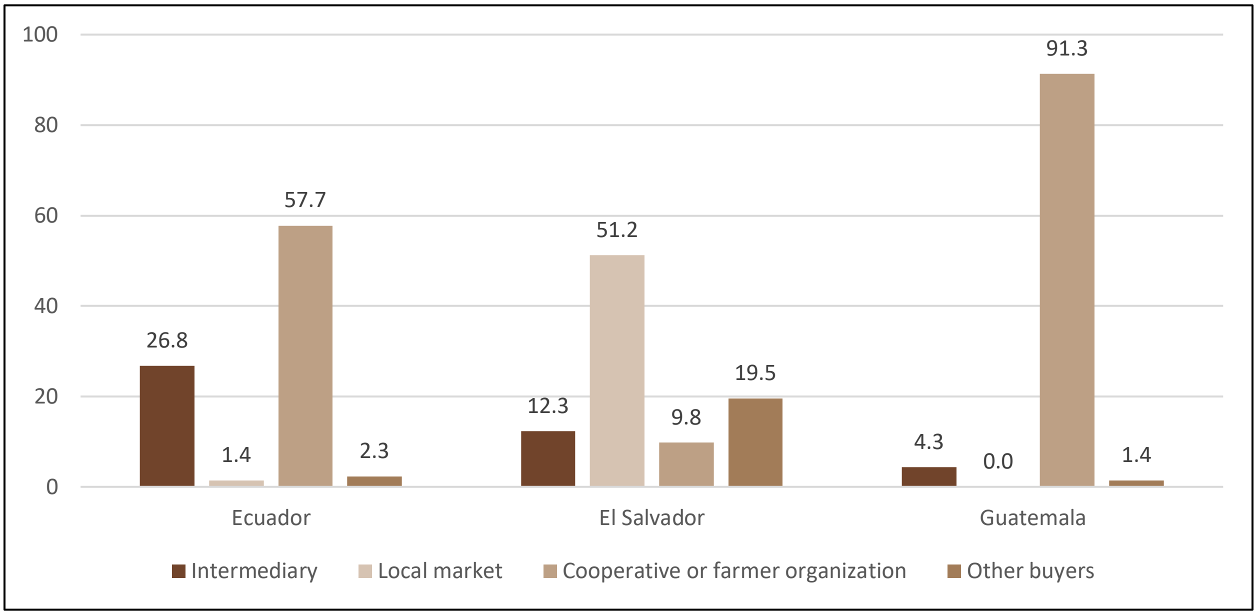


Figure 50. Main types of buyers to whom farmers (%) sell cacao, by country

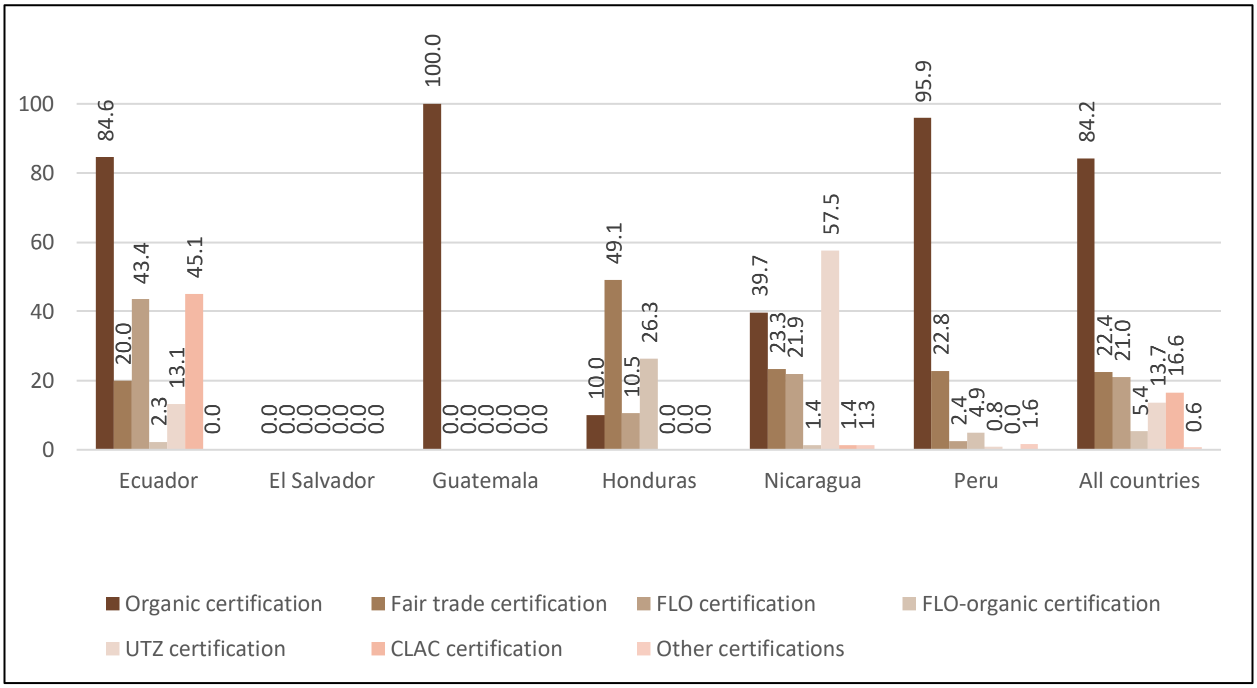


Figure 51. Cacao: types of certifications (% farms), by country

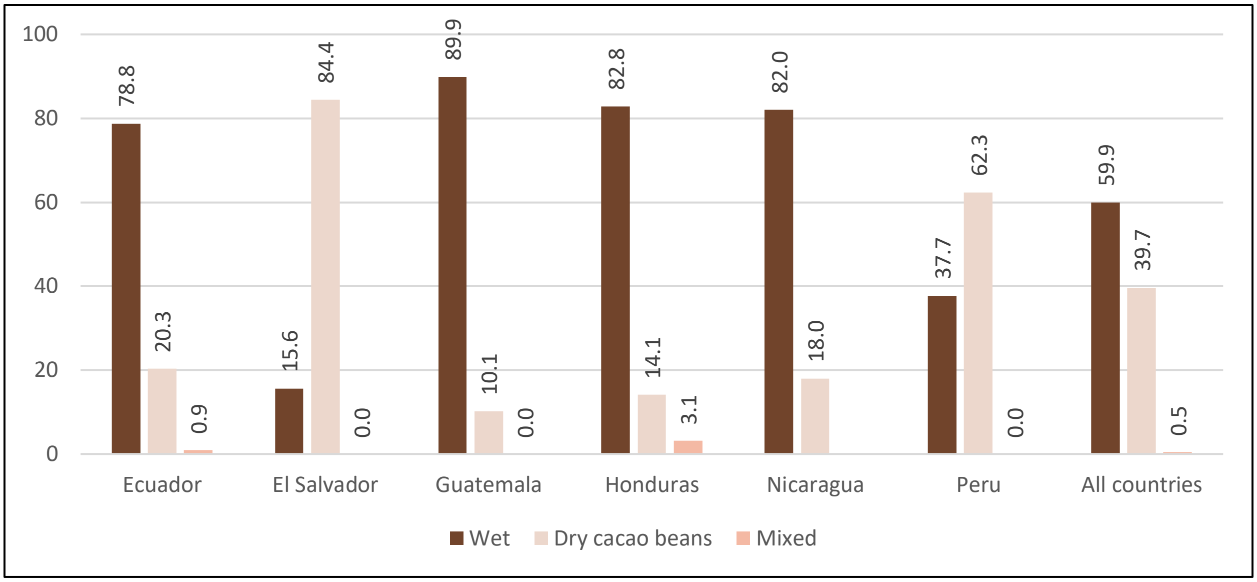


Figure 52. Type of cacao (wet, dry, both) sold by farmers (%), by country

4.4 Farm characteristics

4.4.1 Land use

Nicaragua has on average the largest farm area (15.4 ha). Although farm areas are mainly dedicated to cacao (2.44 ha -14.03%), the other significant crop is pastures, especially in Peru (2.76 ha – 30.94%). Forest and fallow areas are also important in Guatemala and Peru. In El Salvador, coffee represents an important additional crop area. (Table 38). Additional details in (Table A 31).

Table 38. Cacao: land use in the baseline year

	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Total farm area (ha), and area (ha) under…:	8.11	2.93	4.33	3.01	15.40	8.92	7.13
Cacao	44.14%	53.92%	23.56%	51.83%	14.03%	26.23%	34.22%
Coffee	4.19%	41.30%	0.00%	0.00%	7.34%	1.23%	3.79%
Temporary (short cycle) crops	13.44%	3.07%	15.47%	8.31%	17.79%	3.59%	7.01%
Permanent crops	2.47%	3.07%	10.16%	9.30%	3.57%	1.12%	2.38%
For grazing or forage	20.84%	7.85%	1.15%	21.26%	n.a.	30.94%	24.82%
Rented out	0.49%	0.00%	0.23%	0.00%	n.a.	8.18%	0.56%
Fallow (>1 year unused)	2.84%	6.14%	41.11%	3.32%	n.a.	18.05%	13.74%
Non-agricultural (house, warehouse, etc.)	2.96%	0.68%	3.70%	29.90%	n.a.	1.46%	1.96%
Forest	8.51%	3.41%	13.16%	19.93%	n.a.	19.39%	14.03%
Other uses	n.a.	n.a.	n.a.	n.a.	57.27%	n.a.	n.a.

4.4.2 Land tenure

Farmers with land titles represent 53.44% of the sample. Most farmers in El Salvador (96.11%), and Ecuador (81.50%) have land titles. Guatemala and Honduras have high levels of informality in property rights, and this is reflected in the lack of official documents that confirm ownership (only 34.2 and 41.37% possess titles) (Table 39).

Table 39. Land tenure among cacao growers

Land tenure (% HH)	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Owning land with deed	81.49	96.11	65.75	51.72	65.49	22.61	53.44
Female	87.23	96.29	52.38	54.16	19.71	23.38	23.27
Male	80.00	96.05	71.15	50.79	16.19	22.29	24.12
Owning land without deed	16.74	3.88	34.24	41.37	19.71	27.03	23.27
Female	17.02	3.70	47.61	41.66	20.00	13.70	19.02
Male	16.66	3.94	28.84	41.26	19.65	32.45	24.71

4.5 Access to and use of inputs and services during the crop cycle

4.5.1 Access to inputs

Car and motorcycle are the most popular modes of transportation to reach the closest town where farmers normally buy inputs for cacao. On average, the time (min) to get to the nearest town using the most common form of transportation is 49.92 min. In Ecuador, farmers take 26.39 min while in Guatemala and Nicaragua, they take 59.61 and 59.89 min. Chemical fertilizers are the most common type of input that 37.45% of the farmers buy in the closest town, followed by pesticides, and herbicides (20.18% and 23.49%) (Table 40).

Table 40. Cacao: access to inputs at baseline

Characteristics	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) using the following transportation mode to reach the closest town where they usually buy inputs for cacao:							
Mode 1	Car (55.31)	Car (80.58)	Car (71.23)	Motorbike (29.89)	Bus (34.51)	Motorbike (38.46)	Car (35.85)
Mode 2	Horse (16.81)	Walk (8.74)	Bus (23.28)	Bus (27.59)	Horse (21.13)	Car (21.45)	Motorbike (25.66)
Mode 3	Motorbike (23.45)	Bus (4.85)	Walk (2.73)	Car (18.39)	Walk (18.31)	Walk (9.32)	Bus (12.55)
Other transportation mode	4.43	5.83	2.76	24.14	26.05	30.77	25.94
Time (min) to reach closest town where farmers buy inputs, using the most common transportation	26.39	45.72	59.61	40.42	59.89	31.94	49.92
Farmers (%) who usually buy the following inputs in the closest town:							
Chemical fertilizers	29.20	84.44	24.65	0.80	58.45	31.7	37.45
Pesticides	23.00	50.48	15.06	1.14	26.05	14.21	20.18
Herbicides	24.77	17.47	13.69	13.79	56.33	17.01	23.49
Cacao plants (seedlings)	6.19	0.00	8.21	9.19	3.52	6.75	5.84
Cacao seeds	0.88	0.97	24.65	0.00	1.40	5.59	2.83
Number of households	**227**	**103**	**73**	**97**	**142**	**429**	**1061**

4.5.2 Use of fertilizers, pesticides, and herbicides

Fertilizers

The percentage of farmers applying fertilizers in the 2019-2020 agricultural year was 27.11% in Ecuador, 86.41% in El Salvador, 19.18% in Guatemala, 19.54% in Honduras, 17.61% in Nicaragua, 45.45% in Peru, with an average of 37.87% across all countries. In Nicaragua (80%) Ecuador (54.10%), Peru (58.97%), and El Salvador (60.67%) most farmers apply only chemical fertilizers, while in Honduras (70.59%) and especially Guatemala (100%) organic fertilizer is the option most used[45]. The most commonly used fertilizer in Ecuador is Completo, with 23.33% of farmers using it. In El Salvador is 15-15-15, used by 71.91% of farmers while 71.43% also use Ferticomsa in Guatemala same as Nicaragua (20.83%). Farmers in Honduras use compost (37.5%) and in Peru NPK (48.97%). On average, fertilizer was applied 1.24 times during the agricultural year (Table A 32 & Figure 53).

[45] In Guatemala, 100% with certification are organics (73.97%). The difference could be producers who are not certified organic.

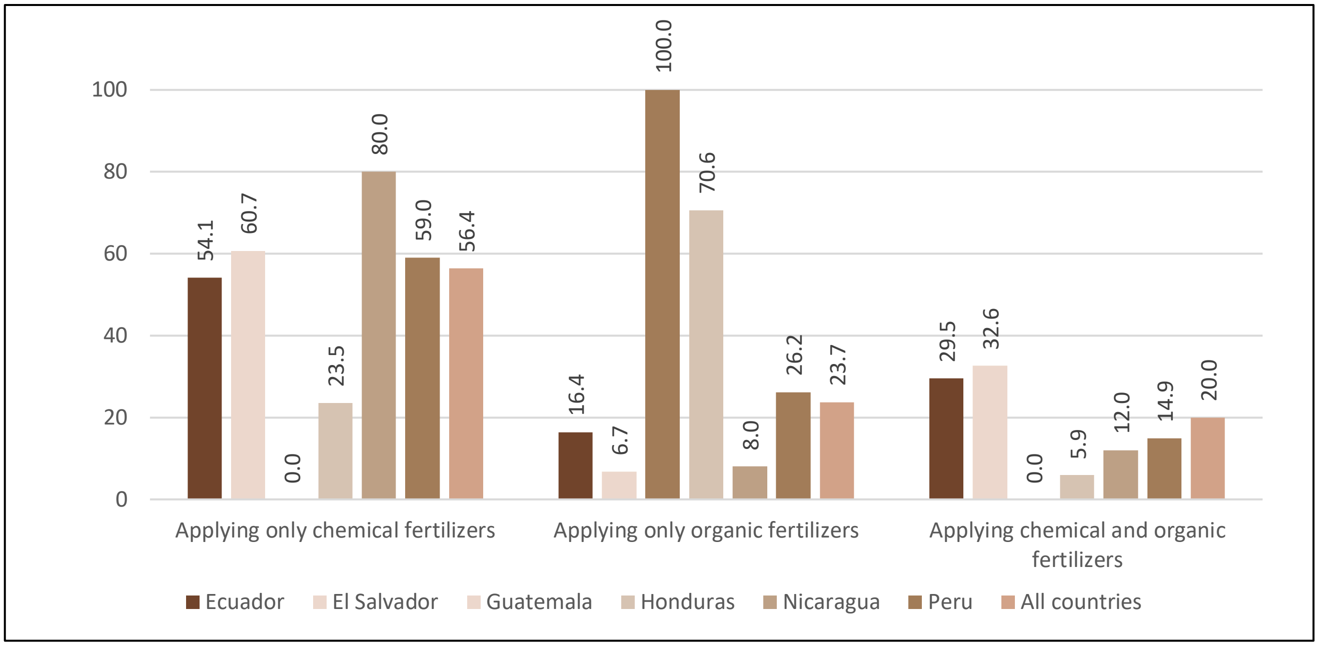
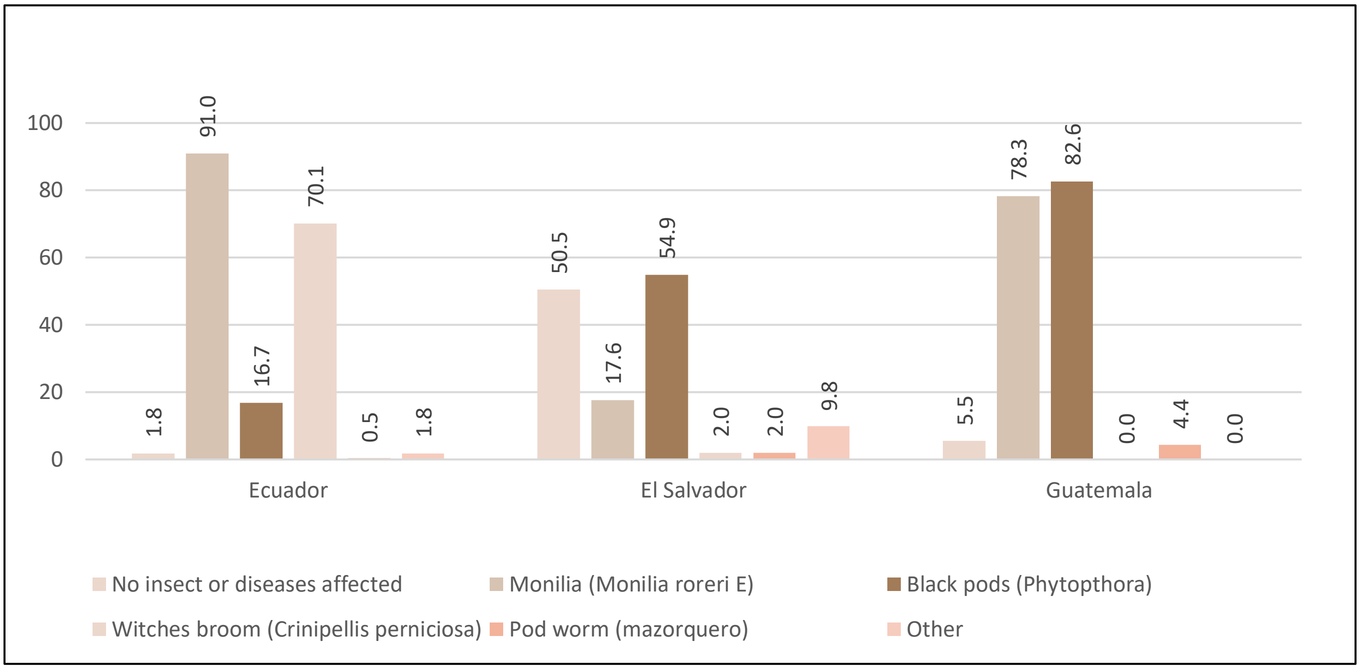


Figure 53. Cacao farmers (%) applying organic or chemical fertilizers, by country

Pesticides

Just 4.01% of cacao farmers applied pesticides (for insects or diseases) in the 2019-2020 agricultural year (with the exception of El Salvador where 34.28% of farmers applied pesticides. The main insect pests and diseases affecting the cacao crop are Monilia (79.17%) and Witches broom (37.19%). Ecuador is especially affected by both diseases (90.95% and 70.14%) and black pod is important in Central America (Figure 54).



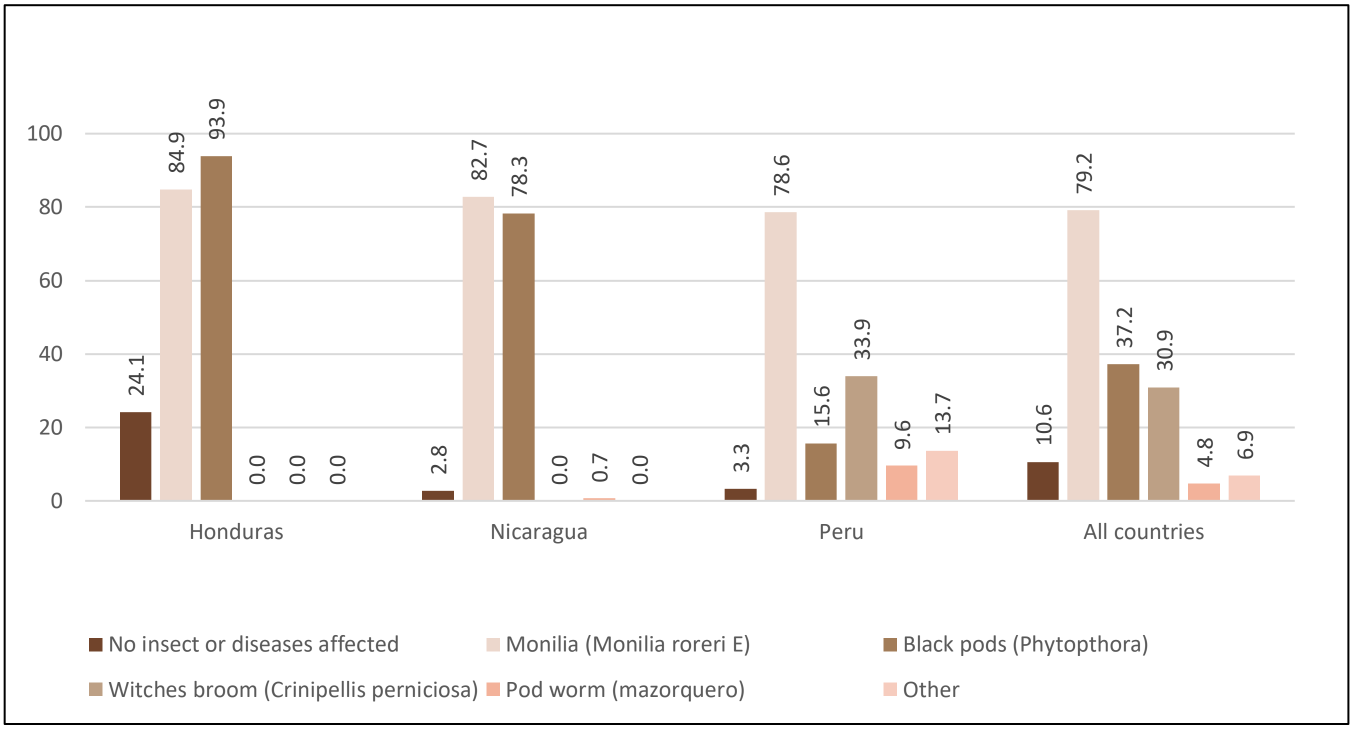


Figure 54. Main insect pest or diseases affecting the cacao crop, by country

On average, for the most important insect pest, a high percentage of farmers are doing field monitoring (70.59%). Guatemala and Peru have smaller percentages of farmers monitoring pests in the field (33.33% and 32.50%). This could represent a risk considering that 33.33% of Guatemalan farmers reported incidence levels between 11-30% and Peruvian farmers levels of 62.50%. In Ecuador, farmers do not control this pest, and in most countries farmers use cultural control methods (94.12%). Related to the most important disease, 49.34 % of the farmers are monitoring incidence in the field, reporting high levels of incidence, > 50% in 7.22% of the cases. Cultural control is the most used method (77.56%), exceptionally high in Peru, Nicaragua and Honduras (90.83%, 87.83%, and 85.48%) (Table 41). For details of the second pest and disease, see Table A 31 in the Annex.

Table 41. Cacao: first insect pest and disease affecting the crop

For the first insect pest, % farmers…:	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Doing field evaluation	100.00	50.00	33.33	n.a.	0.00	32.50	70.59
Reporting <10% incidence	100.00	0.00	66.67	n.a.	100.00	25.00	17.65
Reporting 11-30% incidence	0.00	100.00	33.33	n.a.	0.00	62.50	39.22
Reporting 31-50% incidence	0.00	0.00	0.00	n.a.	0.00	12.50	35.29
Reporting >50% incidence	0.00	0.00	0.00	n.a.	0.00	0.00	7.84
Not controlling it	100.00	0.00	33.33	n.a.	0.00	5.00	1.96
Using cultural control	0.00	0.00	33.33	n.a.	0.00	80.00	94.12
Using biological control	0.00	100.00	33.33	n.a.	0.00	0.00	1.96
Using chemical control	0.00	0.00	0.00	n.a.	0.00	0.00	0.00
Using other control methods	0.00	0.00	0.00	n.a.	0.00	12.50	1.96
For the first disease, % farmers…:							
Doing field evaluation	18.91	46.43	44.44	70.97	48.70	63.61	49.34
Reporting <10% incidence	21.39	25.00	75.93	30.65	59.13	25.69	33.20
Reporting 11-30% incidence	44.78	50.00	16.67	35.48	26.96	51.99	42.91
Reporting 31-50% incidence	21.89	17.86	7.41	19.35	10.43	16.82	16.67
Reporting >50% incidence	11.94	7.14	0.00	14.52	3.48	5.50	7.22
Not controlling it	27.36	17.86	9.26	8.06	0.87	0.61	9.06
Using cultural control	54.23	50.00	62.96	85.48	87.83	90.83	77.56
Using biological control	1.49	0.00	5.56	0.00	1.74	2.14	1.97
Using chemical control	3.48	32.14	0.00	0.00	0.87	1.22	2.36
Using other control methods	13.43	0.00	22.22	6.25	9.57	5.20	9.06

Herbicides

Farmers applying herbicides in the reference year represented 16.37% in Ecuador, 5.83% in El Salvador, and 10.72% in Peru. Most (67.04%) of farmers use a weed wacker, except in Guatemala and Nicaragua where only 13.79% and 9.22% reported using a mower. 25.16% carry out weed control on a schedule, with Ecuador having significantly less farmers who follow a schedule for weeding (7.08%). Using selective weed control (8.85%) is also low in Ecuador as compared to the average across all countries (17.32%) (Table A 32).

4.5.3 Genetic planting material: nursery management

Only 10.79% of farmers had nurseries and grafted seedlings in the 2019-2020 agricultural year with Peru having the highest percentage (18.41%). The average number of seedlings produced ranged from 184 in Honduras to 1,271 in Ecuador, with El Salvador, Guatemala, Nicaragua, and Perú producing 480, 615, 551, 884 plants per farmer/year respectively. Farmers produce most of their seedlings (58.23%), especially in Nicaragua (80.76%) and Peru (73.45%). In El Salvador and Honduras, most of the seedlings are obtained for free, while 74.19% of farmers in Guatemala buy their seedlings (Figure 55).

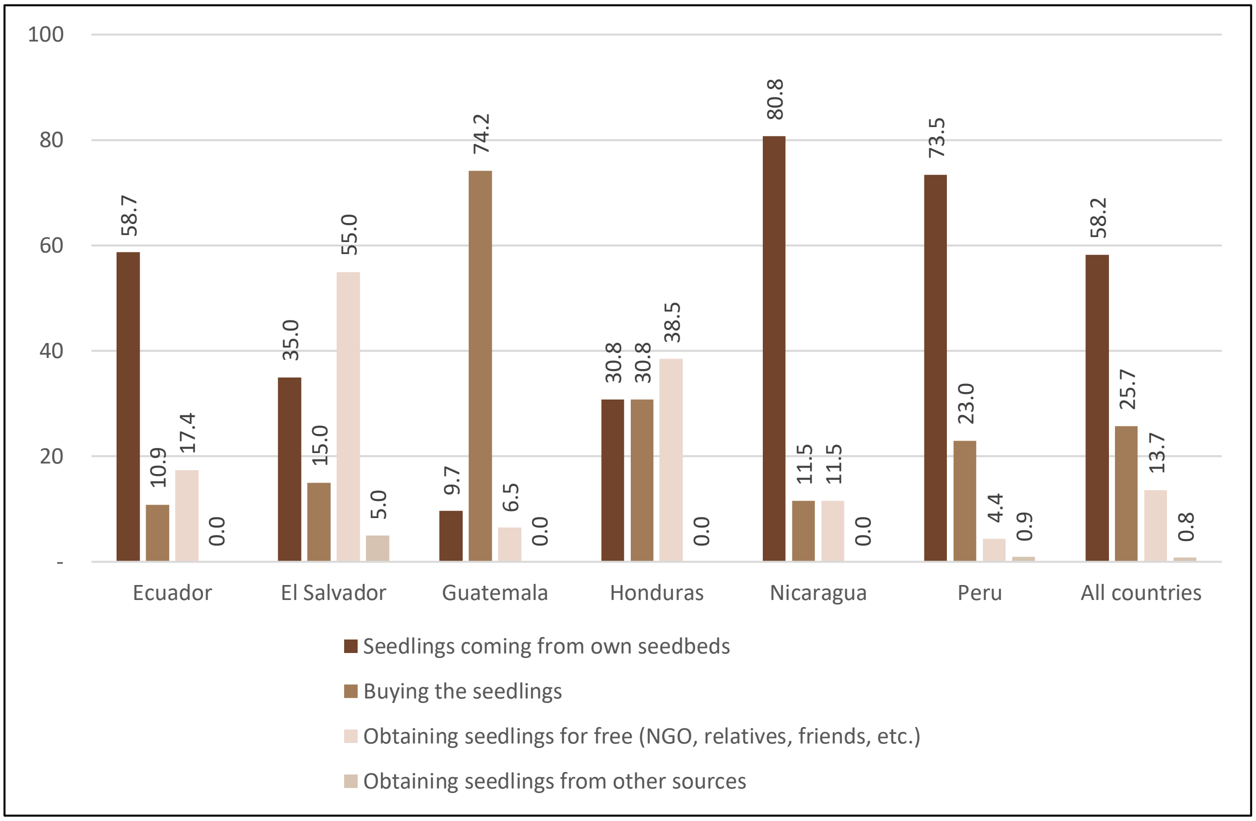


Figure 55. Farmers (%) with nurseries or acquiring cacao seedling, by country

For farmers buying cacao seedlings, the sources they buy from include neighbors (11.43%), certified nurseries (47.14%), non-certified nurseries (32.86%), and other sources (8.57%). The percentages across the different sources vary among countries (Table A 33). Of farmers who do not buy cacao seedlings, just 34.35 % know where to acquire certified or verified plants. 33.73% of farmers buying cacao seedlings. This percentage is highest in Nicaragua (80.76%), and lowest in Guatemala (6.45%) possibly a reflection of the relatively mature cacao genetic material system (and cacao sector in general) in Ecuador as compared to Guatemala. The number of seedlings purchased are in the range of 3,249 in Ecuador to 133 in Nicaragua, with an average of 1,665 across all countries. The price paid per seedling ranges from US$0.01 in El Salvador to US$0.17 in Peru (US$0.02 in Guatemala and Honduras, US$0.04 in Ecuador, US$0.12 in Nicaragua). Most of the farmers (87.65%), on average, stated that the quality of the seedlings was good or excellent. This indicator is constant across countries; from 77.78% in Nicaragua to 95.00 % in El Salvador. Most farmers who buy seedlings (61.90%) are willing to pay more for certified or verified genetic material except for Nicaragua (31.8%) (Table A 33).

4.5.4 Financing and loan requirements

Just one fifth of farmers (17.28%) had requested credit during the 2019-2020 agricultural year. El Salvador has the lowest percentage (<5%) of farmers requesting credit for cacao. Informal sources, largely through intermediaries, is the most common form of obtaining credit. The finding that El Salvador has such a low percent (3%) of farmers obtaining credit for cacao from a formal source is consistent with the market system level finding that financial services for the cacao sector in El Salvador were practically non-existent. We found the same for Guatemala at the market system level but among farmers surveyed, 18% obtained credit from formal sources. It will be important to understand how MOCCA beneficiaries in Guatemala are currently accessing credit for cocoa and how this can be amplified in the existing context. The main reason why farmers were unable to receive credit is lack of collateral (69.23%). Farmers who did receive credit used their farm as collateral (36.56%) or used a cacao harvest guarantee (23.66%). A significant percentage did not require collateral to access credit (35.48%).

The different types of need for credit in cacao can be decomposed into several categories as shown in Table 42. These include inputs for cacao (21.63%), equipment/tools for cacao (9.94%), cacao renovation (5.84%), cacao rehabilitation (2.92%), infrastructure (milling, drying, etc.) (1.16%) and other uses (51.04%). In other uses of the credit different for cacao includes mainly home improvements (5.2%), input for other crops and food (4.04%). The length of the loans on average were 19 months, but in some countries, particularly in Ecuador and El Salvador it could be around 41 and 37 months, respectively. In 92.55% of the cases, the loan is paid in cash. In a small number of cases the payment is deducted from the cacao harvest payment (7.45%). This is particularly common in Ecuador and Nicaragua (22.22%). Interest rates also vary from 12.66% in Ecuador to 18% in El Salvador.

Table 42. Cacao: access to financing and financing requirements at baseline

Financing details	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%):							
Not requesting a loan	82.22	95.15	82.19	86.21	88.73	77.39	82.72
Requesting a loan but was denied	1.78	0.97	0.00	2.30	0.70	1.17	1.23
Obtaining a loan from a formal source (bank, rural bank, micro-financing, cooperative)	15.56	2.91	17.81	11.49	6.34	20.75	15.01
Obtaining a loan from an informal source (intermediary)	0.00	0.97	0.00	0.00	0.00	0.00	0.47
Obtaining a loan from any other source	0.44	0.00	0.00	0.00	1.41	0.70	0.57
For farmers being denied a loan, main reason (%):							
Lack of collateral	100.00	100.00	0.00	100.00	0.00	40.00	69.23
Too indebted	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lack of deed for my farm	0.00	0.00	0.00	0.00	100.00	60.00	30.77
Other reason	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prefer not to respond	0.00	0.00	0.00	0.00	0.00	0.00	0.00
For farmers obtaining a loan, % willing to provide additional information	47.22	50.00	30.77	10.00	60.00	58.70	55.88
For the largest loan obtained							
Farmers (%) investing the loan in:							
Cacao renovation	16.66	0.00	0.00	4.59	11.11	3.77	5.84
Cacao rehabilitation	11.11	0.00	0.00	2.29	0.00	13.73	2.92
Inputs for cacao	11.11	50.00	50.00	1.14	22.22	56.60	21.63
Equipment/tools for cacao	33.33	50.00	0.00	0.00	0.00	20.75	9.94
Infrastructure (milling, drying, etc.) for cacao	0.00	0.00	0.00	0.00	0.00	3.77	1.16
Other uses	66.66	50.00	75.00	66.67	88.88	37.03	51.04
% of credits used different of cacao purposes							
Inputs for other crops	16.66	0.00	0.00	1.14	44.44	0.00	4.62
Animals	16.66	0.00	0.00	0.00	0.00	3.77	2.89
Non –agricultural investments	5.55	0.00	50.00	2.29	0.00	13.20	0.69
Food	11.11	0.00	0.00	0.00	44.44	1.88	4.04
Health or education	5.55	0.00	0.00	0.00	0.00	5.66	2.31

House	11.11	0.00	25.00	0.00	22.22	7.54	5.20
Others	16.66	50.00	0.00	3.44	22.22	16.98	10.40
For this loan, % farmers required to provide…:							
No collateral	44.44	50.00	75.00	88.89	55.56	16.98	35.48
Mortgage on the farm	44.44	50.00	25.00	11.22	22.22	41.51	36.56
Guarantee over cacao harvest	11.11	0.00	0.00	0.00	22.22	33.96	23.66
Other collateral	0.00	0.00	0.00	0.00	0.00	7.55	4.30
Length of the loan (months)	41.77	36.00	12.5	23.55	10.77	11.33	18.69
Loan paid/being paid (% farmers) in…:							
Cash	77.78	100.00	100.00	100.00	77.78	98.15	92.55
Deducted from cacao harvest payment	22.22	0.00	0.00	0.00	22.22	1.85	7.45
Other payment mode	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Farmers (%) knowing the interest rate paid, and:	100.00	100.00	75.00	100.00	100.00	100.00	98.31
Interest rate paid (%) per month when reporting monthly	4.60	11.00	9.33	3.75			
Interest rate paid (%) per year when reporting annually	12.66	n.a.	12.00	18.00	2.75	8.25	7.56
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	**1061**

4.5.5 Access to research products

Farmers who reported ever having received information about cacao research products represent on average 24.07% across countries, with the lowest value of 17.71% in Peru and the highest value of 33.33% in Honduras. The primary source of information is NGOs (54.12%) on average, reaching 89.66% in Honduras). Government or extension agents are another important source, particularly in Ecuador (35.59%) and Peru (35.53%). It is positive that most farmers (92.52%) claim to make use of the information to make farming decisions. Where they did not use these research products, it was because the information was difficult to understand. When farmers need technical advice for cacao, they contact an extension agent working for an NGO (39.87%) or Government (20.74%). Farmers generally waited for the extension agent or visit in order to receive or seek advice (54.34%) (Table A 34).

Comparing these farmer level results with the market system level assessment of the research and technical assistance supporting systems reveals some interesting findings. First, despite research supporting systems for cacao that ranged from nonexistent (El Salvador) to present (Ecuador and Peru), there was little variation between countries in terms of the proportion of farmers receiving information about cacao research. This may suggest that countries where cacao research is less developed are able to make research outputs from other countries available to farmers through extension services. This is may be reflected in the fact that government and other sources are relatively more important in Ecuador and Perú where the government does carry out research on cacao, while NGOs, who typically do not carry out research, dominate as the source of research information for farmers in Central American countries. Technical assistance services were found to be more developed for Peru as compared to the other four countries at the market system level. This can again be seen as reflected in the greater engagement with government and other sources of technical assistance for Peru and to a lesser extent Ecuador, while again Central American farmers are more reliant on NGOs for technical assistance, largely from transient development projects as opposed to institutional technical assistance programs serving farmers over time. We may also see this reflected in the fact that farmers in Peru can depend on an extension agent visiting them while for all other countries, they had to call extension agents when questions arose. Of course, this could also respond to other dynamics of communication across the different countries.

4.5.6 Materials grown, tree density and crop age

78.51% of farmers surveyed grow only 1 variety of cacao, 13.29% two varieties and 3.2% more than three. At country level, 25.11% of Ecuadorian farmers have two varieties and 17.24% in Honduras have at least three varieties. For farmers growing >1 variety, 69.64% established them in rows by variety. Table 43 describes the name and area of the most planted varieties per country

Table 43. Name (and % cacao area) of the most commonly planted varieties

Variety	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Variety 1	Nacional (55.99)	Trinitarios (63.96)	Otros (44.09)	Otros (35.75)	Trinitarios (24.15)	CCN-51 (52.90)	CCN-51 (28.75)
Variety 2	CCN-51 (31.11)	Criollo (15.44)	CATIE-R1 (27.59)	ICS-95 (10.15)	Hibrido (23.50)	Criollo (39.81)	Criollo (20.98)
Variety 3	EET-103 (5.66)	ICS-95 (14.30)	UF-676 (24.44)	Forastero (8.47)	Criollo (21.01)	Nacional (2.10)	Nacional (12.97)
Variety 4	EET-800 (2.95)	Otros (3.33)	CATIE-R6 (1.87)	ICS-1 (8.11)	Otros (9.26)	Otros (1.58)	Trinitarios (8.89)
Variety 5	EET-577 (1.51)	Forastero (1.48)	CATIE-R2 (0.07)	Hibrido (8.02)	Forastero (6.02)	VRAE99 (1.55)	Otros (8.12)
Variety 6	EET-576 (0.09)	ICS-39 (0.07)	Trinitarios (0.07)	ICS-39 (5.00)	UF-667 (4.58)	VRAE15 (0.08)	Hibrido (3.82)
Variety 7	Otros (0.04)	CCH-91 (0.02)	CATIE-R4 (0.04)	UF-613 (3.96)	CATIE-R6 (3.28)	ICS-95 (0.04)	ICS-95 (2.56)
Variety 8	EET-801 (0.02)	ICS-6 (0.02)	UF-29 (0.01)	Criollo (3.70)	CATIE-R4 (2.77)	UF-667 (0.01)	CATIE R1 (2.08)
Other	1.04	0.16	-	16.8	5.39	0.53	11.78
Cr.= criollo							

The following figures describe the characteristics of the three main cacao varieties farmers had on their farms, in terms of number of trees planted (Figure 56), number of trees per hectare (Figure 57), percentage of productive trees (Figure 58), age of the cacao trees (Figure 59), percentage of trees that were renovated by grafting or by seeds in the 2019-2020 ag year (Figure 60), percentage of trees that were renovated by grafting adult trees in the 2019-2020 (Figure 61) ,% trees that need to be renovated (Figure 62), and percentage farmers who pruned trees in the 2019-2020 ag year (Figure 63).

Some highlights next, for more details see Table A 35:

- A planting density averaging 887 cacao trees per hectare and the average age 11.72.
- CCN-51 in Ecuador is the variety with the highest quantity of trees per farmer (3,900), while CATIE R6 in Honduras the lowest (278).
- 888 trees/ha of Trinitario are planted in Salvador while 302 trees/ha of Forastero are planted in Honduras
- Around 70-90% of trees are productive except for in El Salvador, where the proportion of productive plants varies from 12-35%.
- The oldest trees are in Ecuador (35 years) and the newest in El Salvador (3 years)
- In general, the percentages of trees renovated by grafting or by seeds in the year of reference were less than five percent, except for Ecuador (up to 12.15%).
- Trees renovated by grafting adult trees in the year reference were less than 1% of renovated trees, except for Nacional variety in Peru where grafting adult trees represented 6.46% of renovated trees.
- 22.03% of Nacional tress in Ecuador, 2.44% of Trinitarios in Salvador, 12.90% of CATIE-R1 in Guatemala, 4.27% ICS-95 in Honduras, 9.84% of Trinatarios in Nicaragua and 4.93 of CCN-51 of trees in Peru need to be renovated.
- Most of the varieties in some countries were pruned in 2019-2020 while just 57.53% of Nacional
  in Ecuador was pruned.

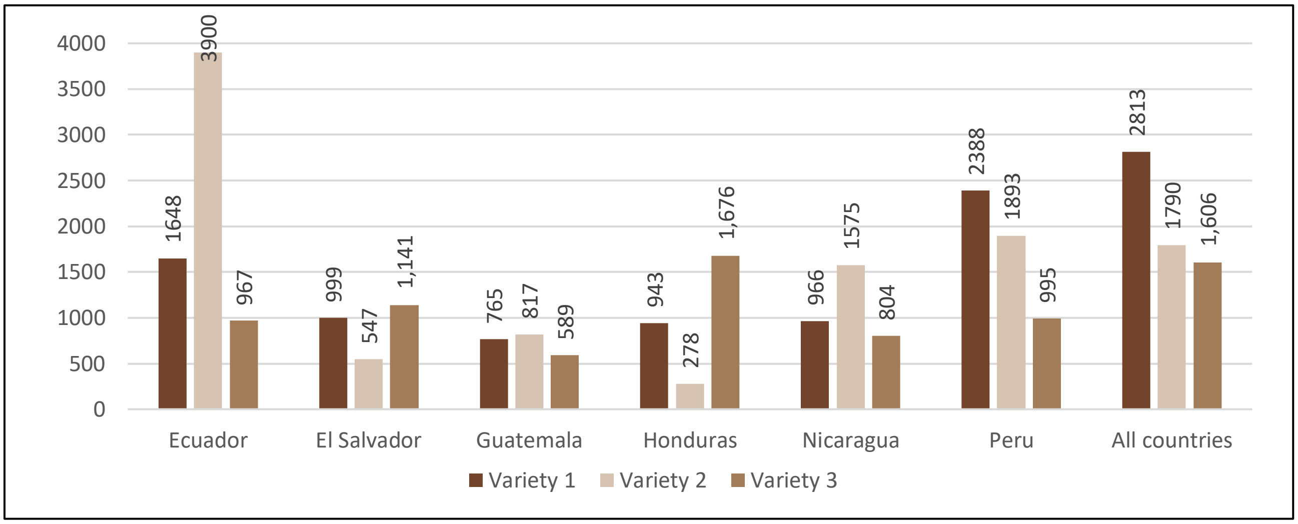


Figure 56. Cacao: # of trees planted, by variety

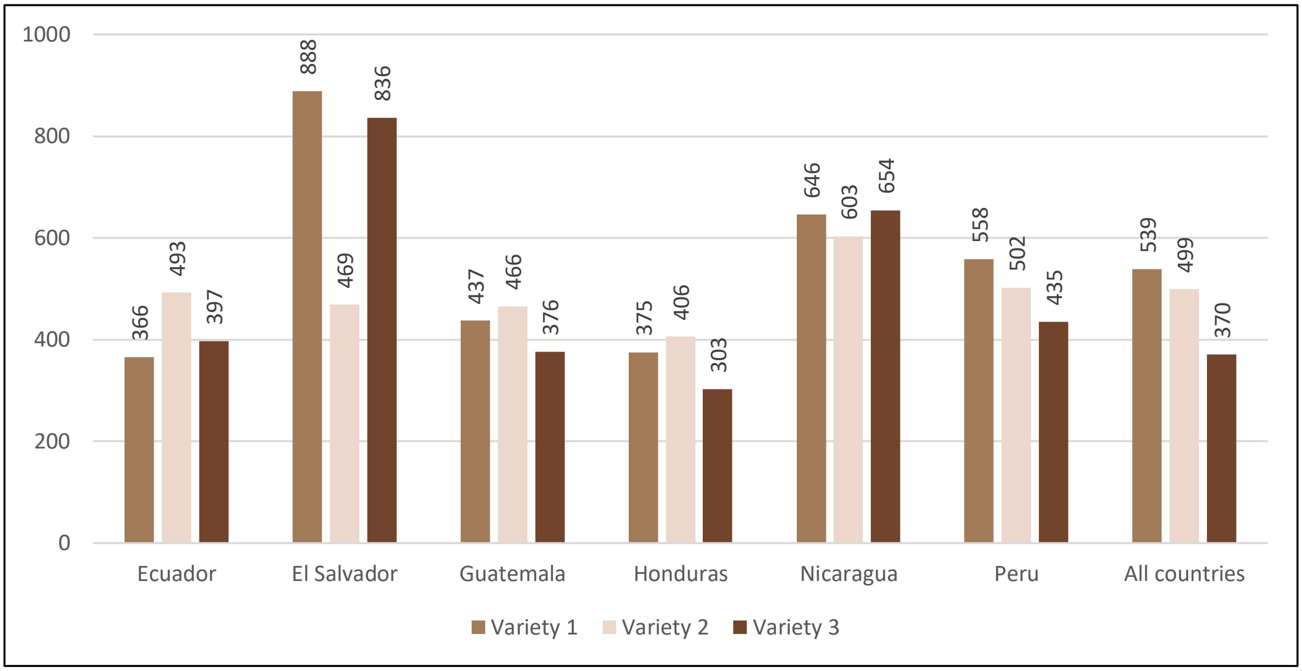


Figure 57. Cacao: # of trees planted/ha, by variety

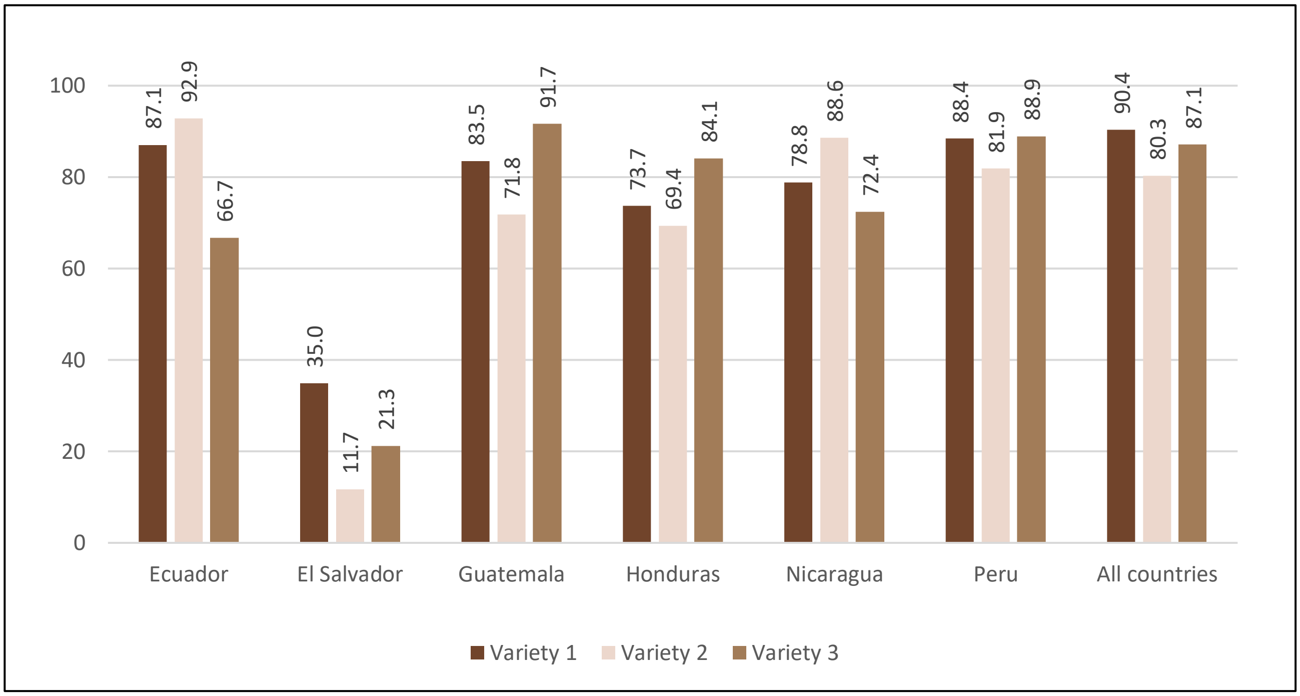


Figure 58. % of productive cacao trees, by variety

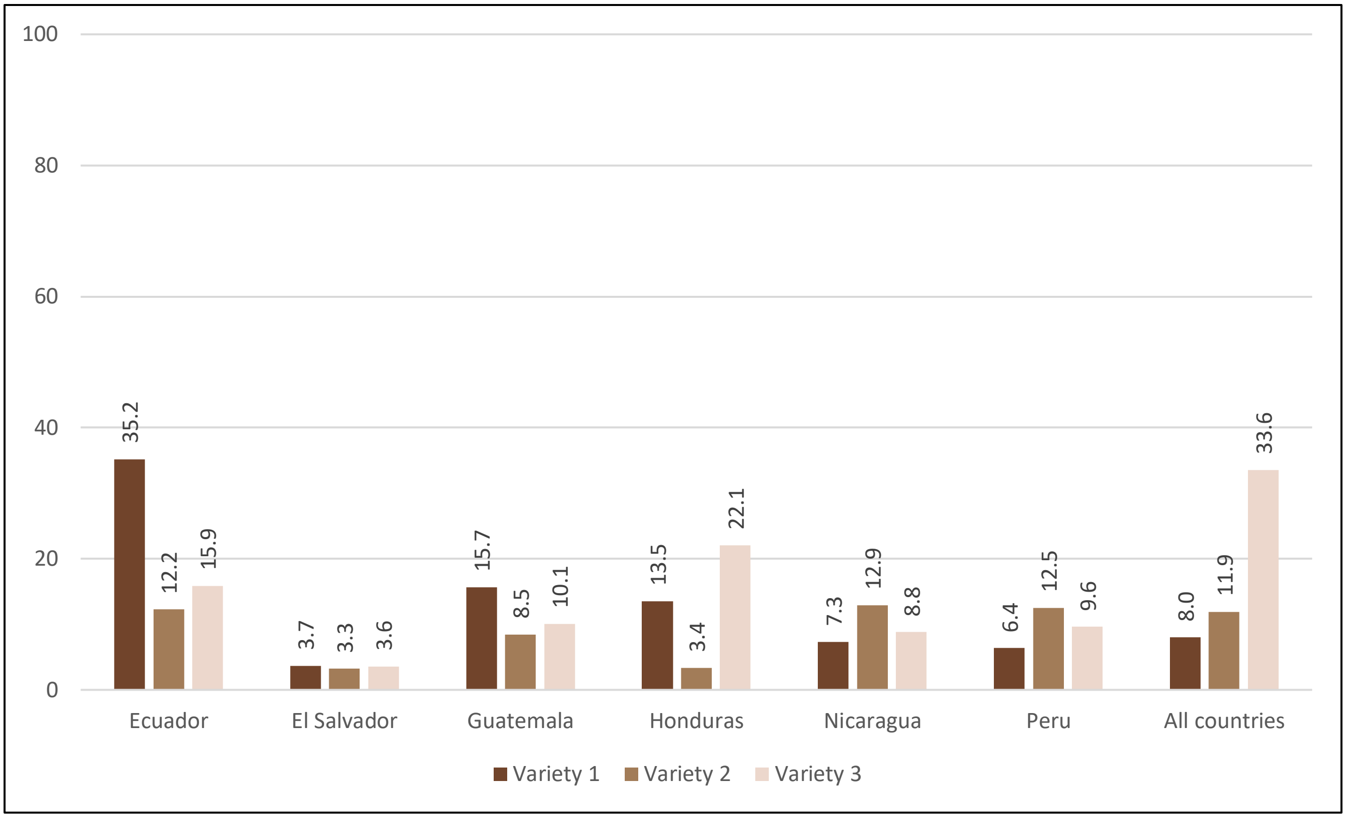


Figure 59. Age (yr) of cacao trees, by variety

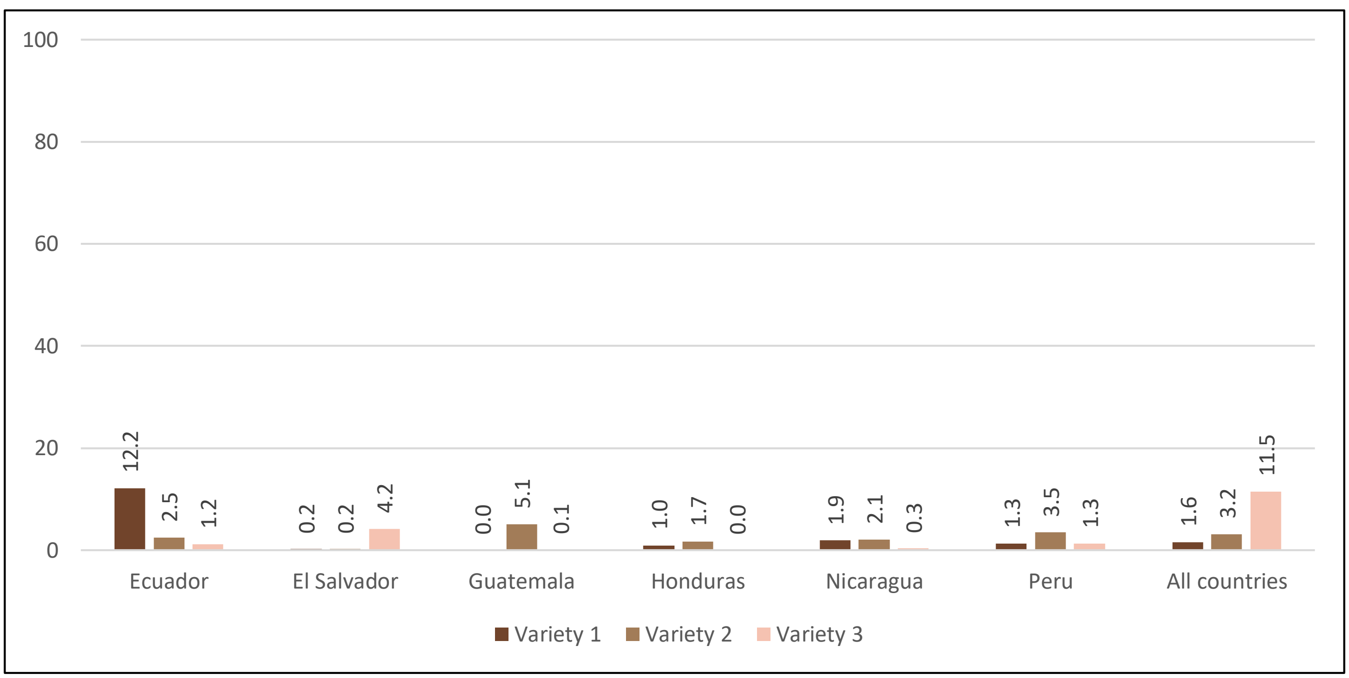


Figure 60. Cacao: % trees that were renovated by grafting or by seeds at baseline, by variety

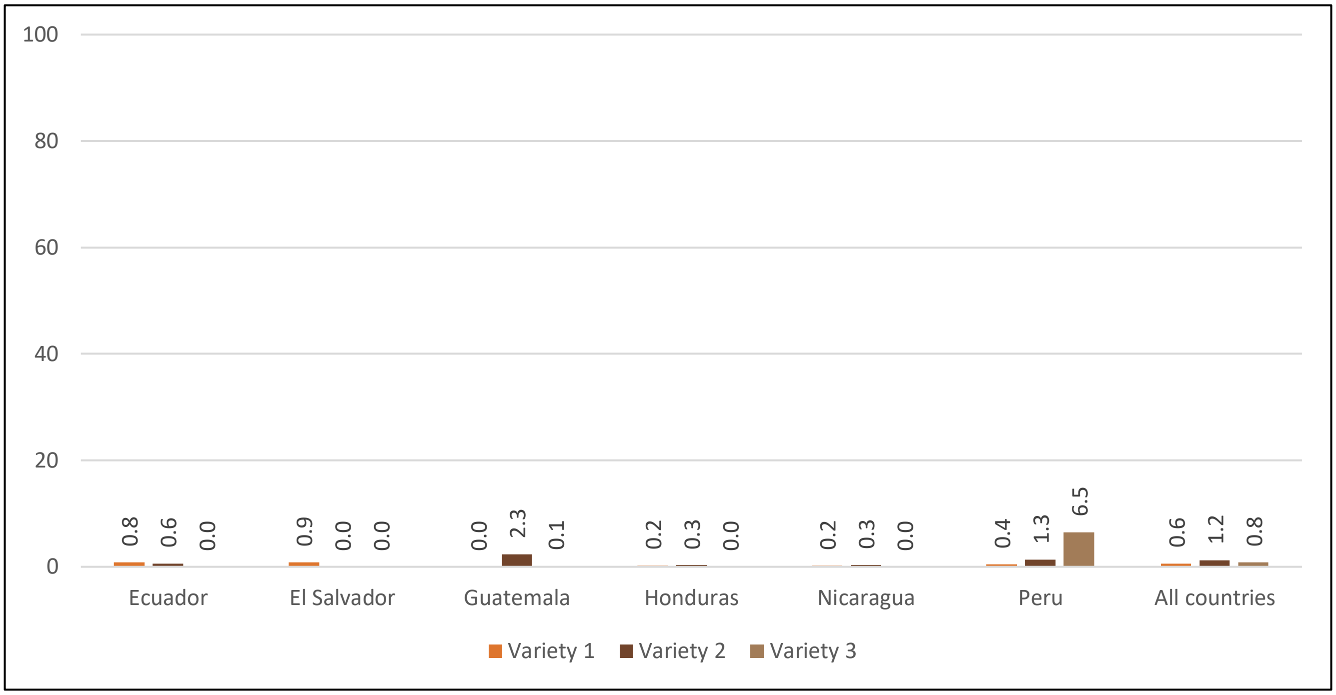


Figure 61. Cacao: % trees that were renovated by grafting adult trees at baseline, by variety

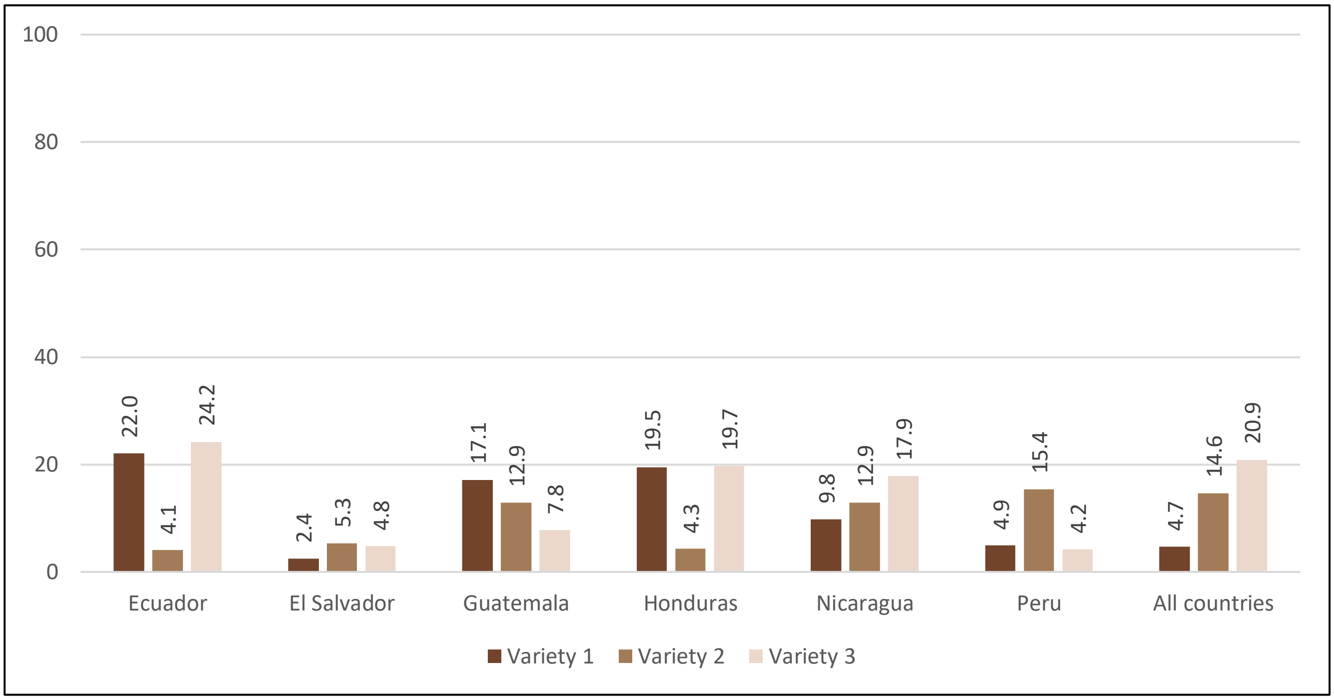


Figure 62. Cacao: % trees that need to be renovated, by variety

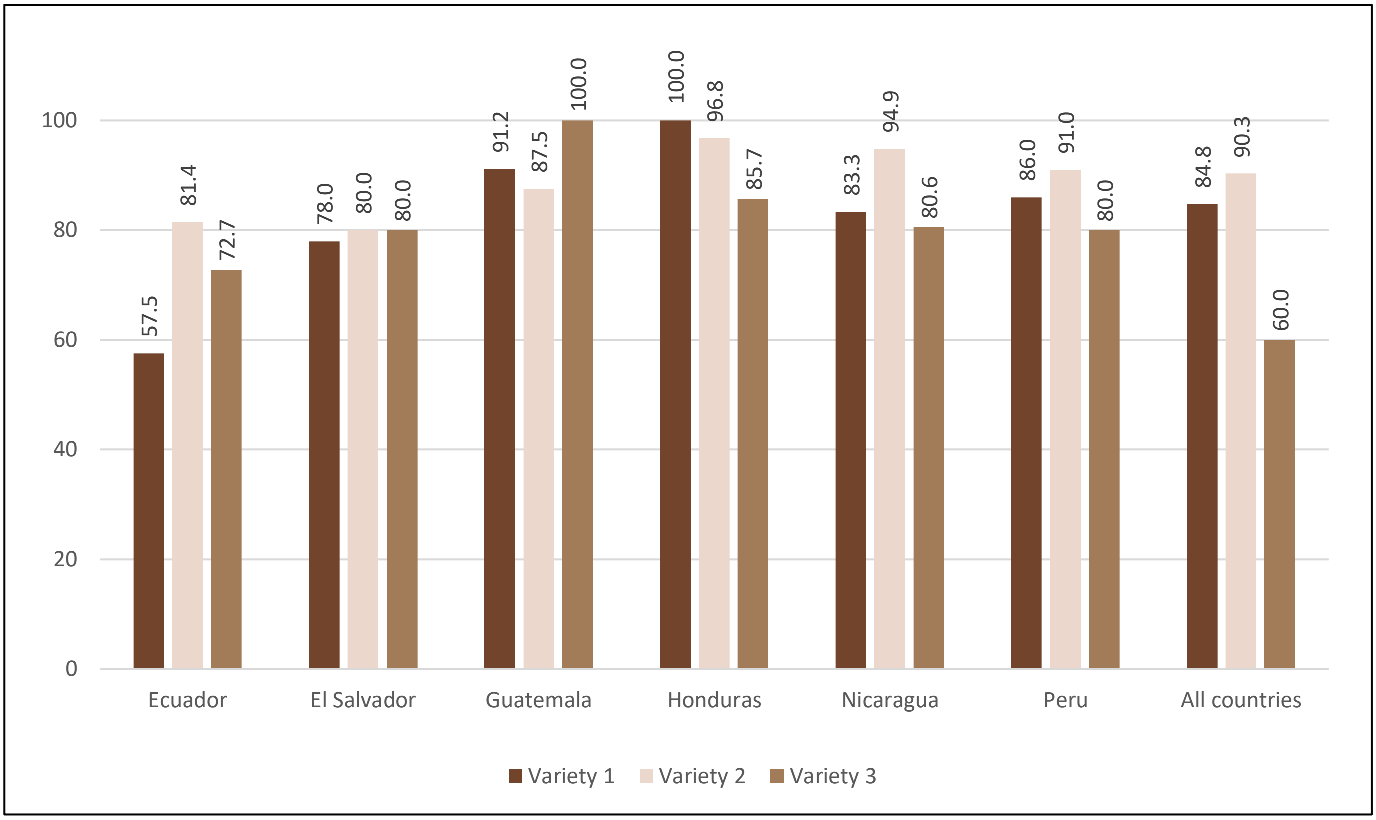


Figure 63. Cacao: % farmers who pruned trees at baseline, by variety

4.5.7 Cacao shade

The average of all countries shows large areas of cacao without shade or with little shade. Plots without trees (35.62%) are the largest percentages, while plots with >40% shade was just over 12% (11.96%). These numbers are driven by Peru and Ecuador with only 11.63% and 22.67% of plantations with >20% shade, respectively. For the Central American countries, cacao plantations have much higher shade cover, with between 42% and 94% of farmers reporting >20% shade cover in cacao plantations across all countries in the region (sum of 20-40% and >40%).

Farmers planted new shade trees in around 16.02% of all cacao plots, with the highest being Nicaragua having 24.64 % of plots with shade trees planted in the past two years, followed by Honduras (20%). Farmers in Honduras and El Salvador reported pruning roughly 60% of cacao plots during 2019-2020, while farmers in Ecuador and Peru had pruned only a very low proportion of plots (27.06% and 16.33% respectively).

Use of mulch and crop residues for soil conservation and water infiltration shows higher adoption by farmers (56.55% of plots) than cover crops (23.27% of plots). However, this indicator has significant heterogeneity, with values ranging from 79.49% in Peru to 22.53 % in Nicaragua for the most important practice and from 45.71% in Honduras to 9.17% in El Salvador for the second most important practice (Table 44).

Table 44. Cacao: shade in cacao plots at baseline

Details	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Share (%) of plots…:							
Less than 5% shade	27.0	0.00	2.25	5.71	20.42	60.89	34.97
With 5-20% shade	50.33	6.42	34.83	12.38	94.29	39.11	65.03
With 20-40% shade	18.00	45.87	53.93	51.43	35.21	27.48	30.98
With >40% shade	4.67	47.71	8.99	30.48	42.95	11.63	34.05
Plots (%) where shade trees were:					26.05	9.94	23.47
Planted in the past 2 years	7.67	11.01	7.87	20.0	16.90	1.69	10.58
Pruned in the 2019-2020 ag. Year	16.33	57.8	41.57	60.95			
Plots (%) with:							
Dead cover (mulch, residues)	32.33	56.88	42.7	74.29	24.64	17.34	13.45
Cover crops	11.67	9.17	15.73	45.71	44.36	27.06	31.63
Number of cacao plots	**300**	**109**	**89**	**105**		**473**	

4.5.8 Grafting

A relatively small proportion (14.35%) of farmers carry out grafting, mainly in El Salvador (22.33%), El Guatemala (26.025%), and Peru (21.44%). 92.72% of farmers are grafting adult trees, and only 5.96 % of farmers are grafting seedlings, again mainly in Ecuador (22.22%). 38.82% of farmers are paying for others to provide this service on their farms (Figure 64). The most common variety/clone grafted in each country is CCN-51, by 33.33% of Ecuadorian farmers; Trinitario in El Salvador with 43.48%; UF in Guatemala with 42.11%, and ICS -95 (75%) and CCN-51 (43.48%) in Honduras. We did not collect this information for Nicaragua. The total average number of plants grafted varies from 23 in Honduras to 718 in Ecuador. For farmers grafting, 40.4% considered the topic to be important, and 58.28% considered the topic very important. For grafting, most farmers say they learned about grafting from trainings held by NGOs, (54.97%), from their neighbor (16.56%), relative (11.26%) or other sources (17.22%). More than half of farmers (58.94%) considered their knowledge about grafting to be at an intermediate level, while almost a quarter (24.50%) considered their knowledge of grafting to be at a high level (Table A 33).

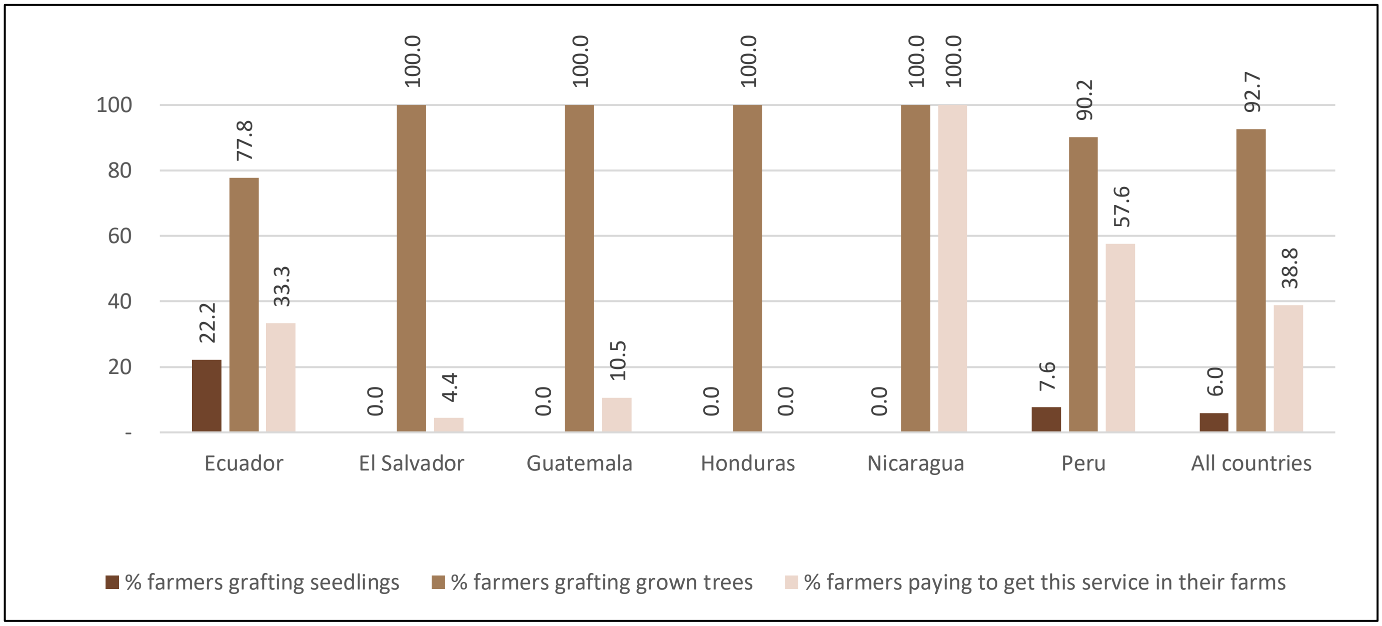


Figure 64. Grafting of cacao, by country

4.5.9 Use of labor

This section describes labor use in different cacao production and harvest activities including household and hired labor. It includes percent of household members or hired labor working on these activities as well as total number of days worked by activity. The activities included are nursey activities (Figure 65 & Figure 66) land preparation for planting (Figure 67 & Figure 68) planting cacao (includes renovation), (Figure 69 & Figure 70),weeding (Figure 71 & Figure 72), pruning (includes rehabilitation) (Figure 73 & Figure 74), fertilizer application (Figure 75 & Figure 76), harvesting (Figure 77 & Figure 78), post-harvest (fermenting, drying) activities (Figure 79 & Figure 80), and other crop management activities (Figure 81 & Figure 82).

Below are some highlights from that data. For more details, see Table A 36.

- Collecting labor data (both family and hired labor) was challenging as farmers had difficulties recalling details about the use of labor in cacao activities. To facilitate data collection, we inquired about the use of labor for categories of activities instead of each possible activity.
- Weeding and cacao harvesting activities have a larger percentage of hired labor (42.88% and 35.72%) and household with members working on those activities (72.36% and 77.91%)
- Nursey is the activity where farmers reported the most days worked/ha (10.29 days household members and 6.81 hired labor) while farmers reported more people per ha involved in weeding activities (3.28 household member and 1.02 hired labor).
- Nicaragua is the country that most uses household members to carry out the majority of cacao activities while in Guatemala and El Salvador farmers use more hired labor.

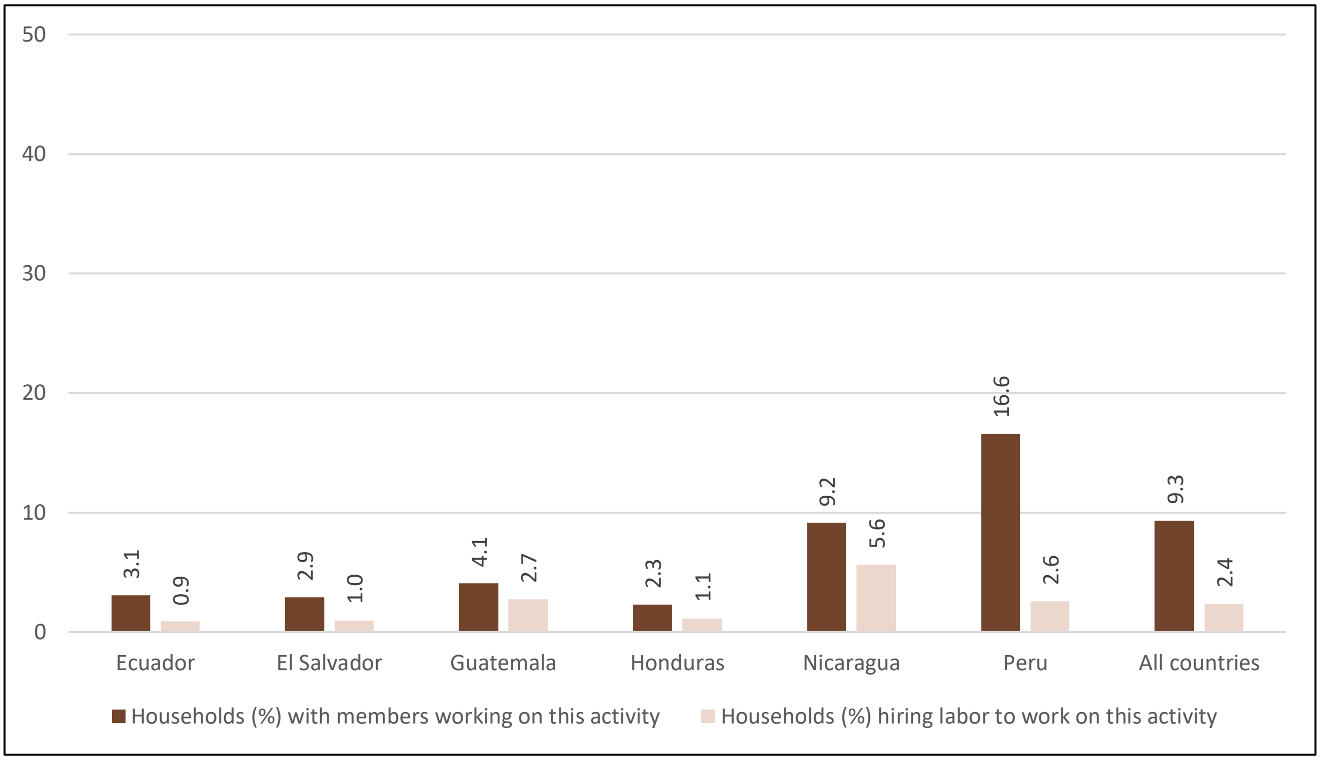


Figure 65. Cacao: family and hired labor for nursery activities

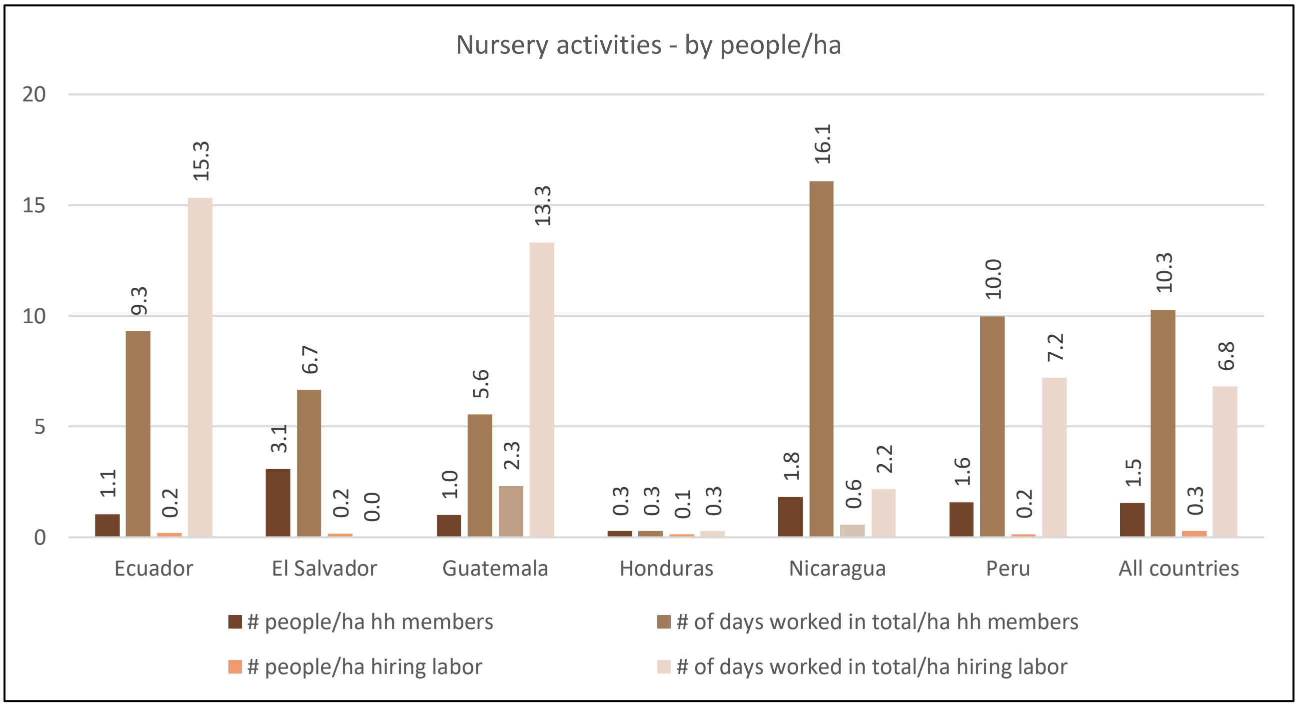


Figure 66. Cacao: # people and # days working on nursery activities, by country

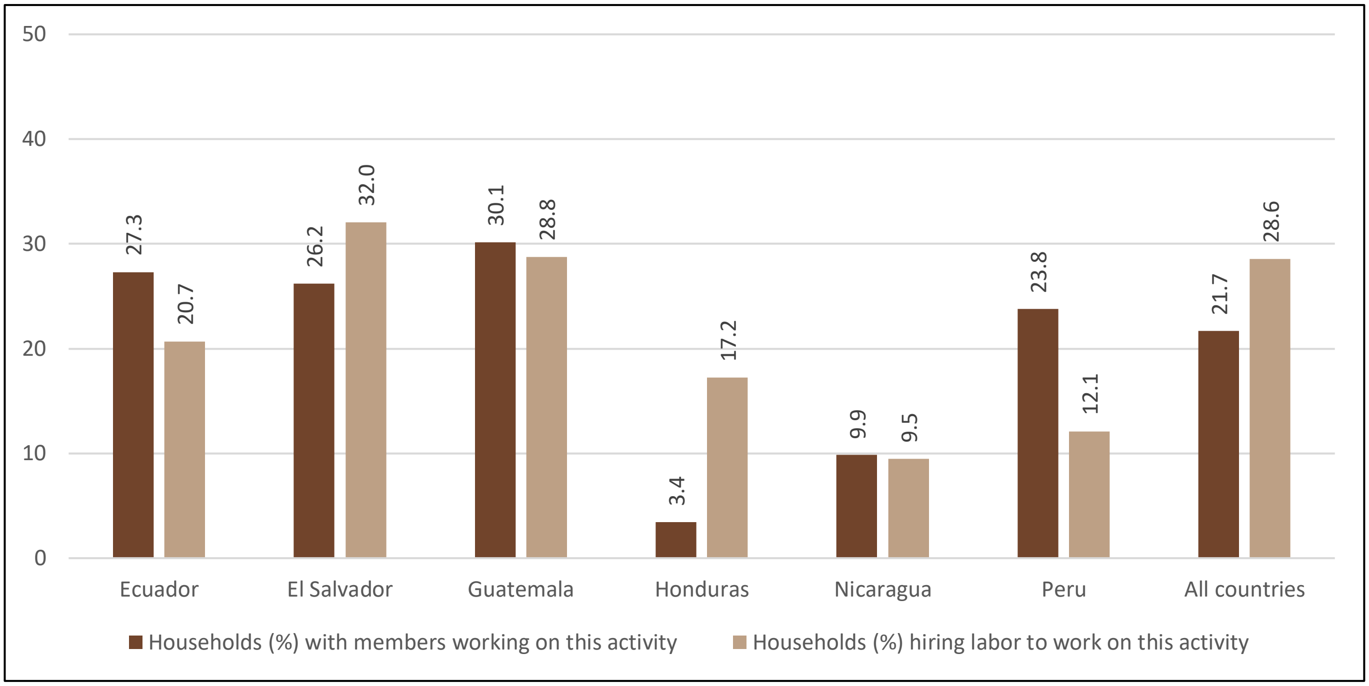


Figure 67. Cacao: family and hired labor for land preparation activities

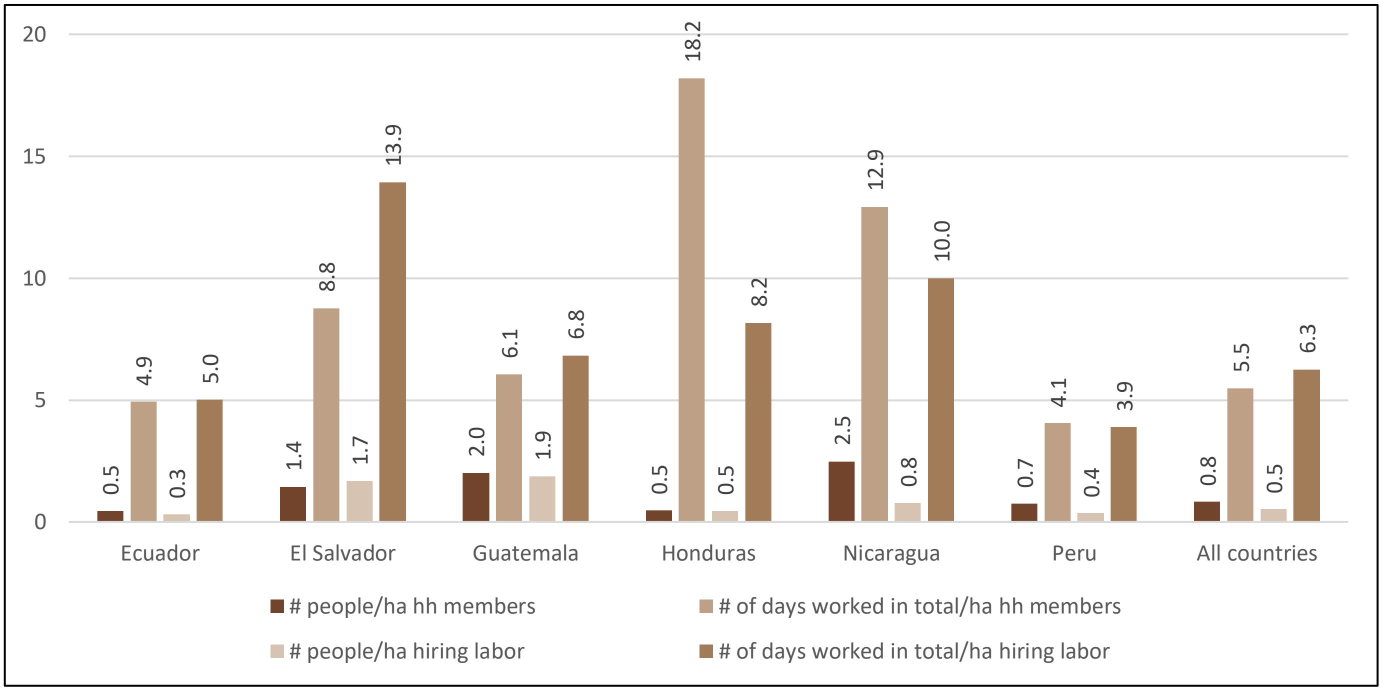


Figure 68. Cacao: # people and # days working on land preparation activities, by country

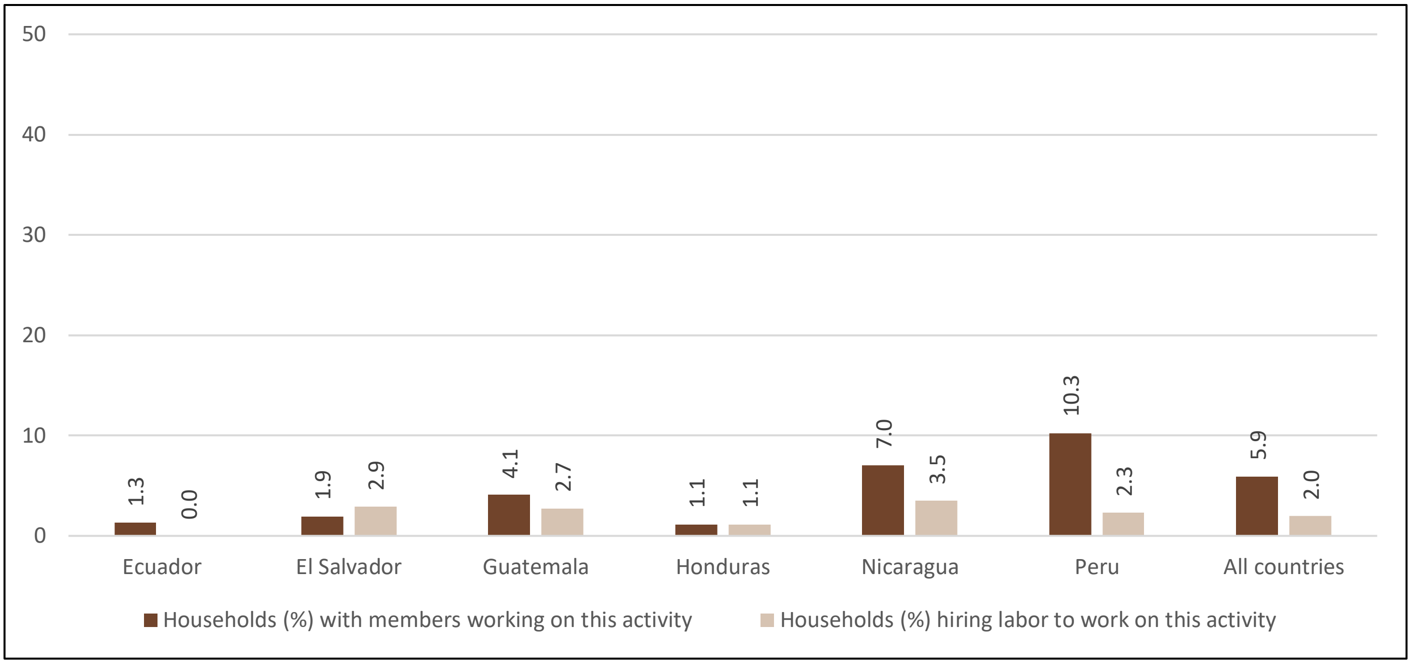


Figure 69. Family and hired labor for cacao planting (includes renovation)

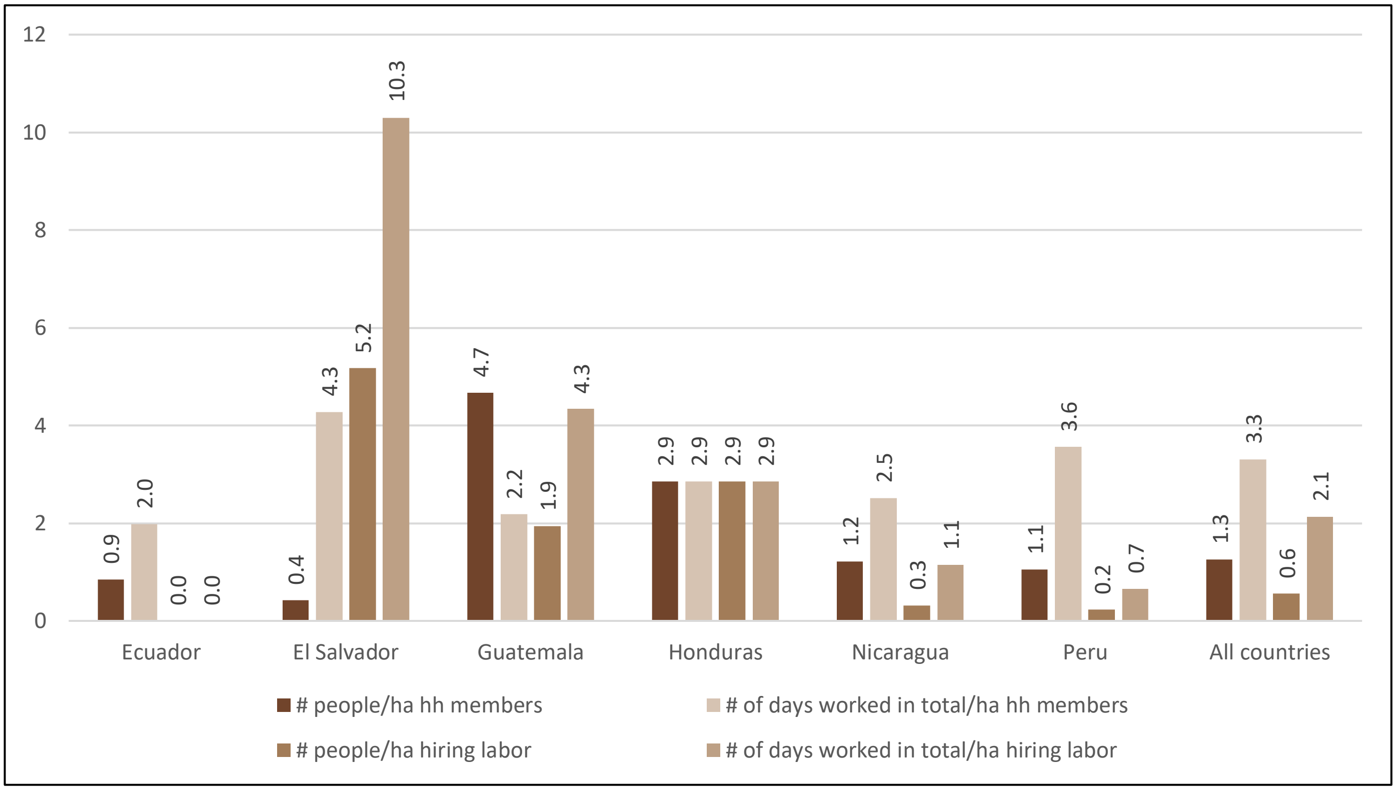


Figure 70. Cacao: # people and # days working on planting (includes renovation), by country

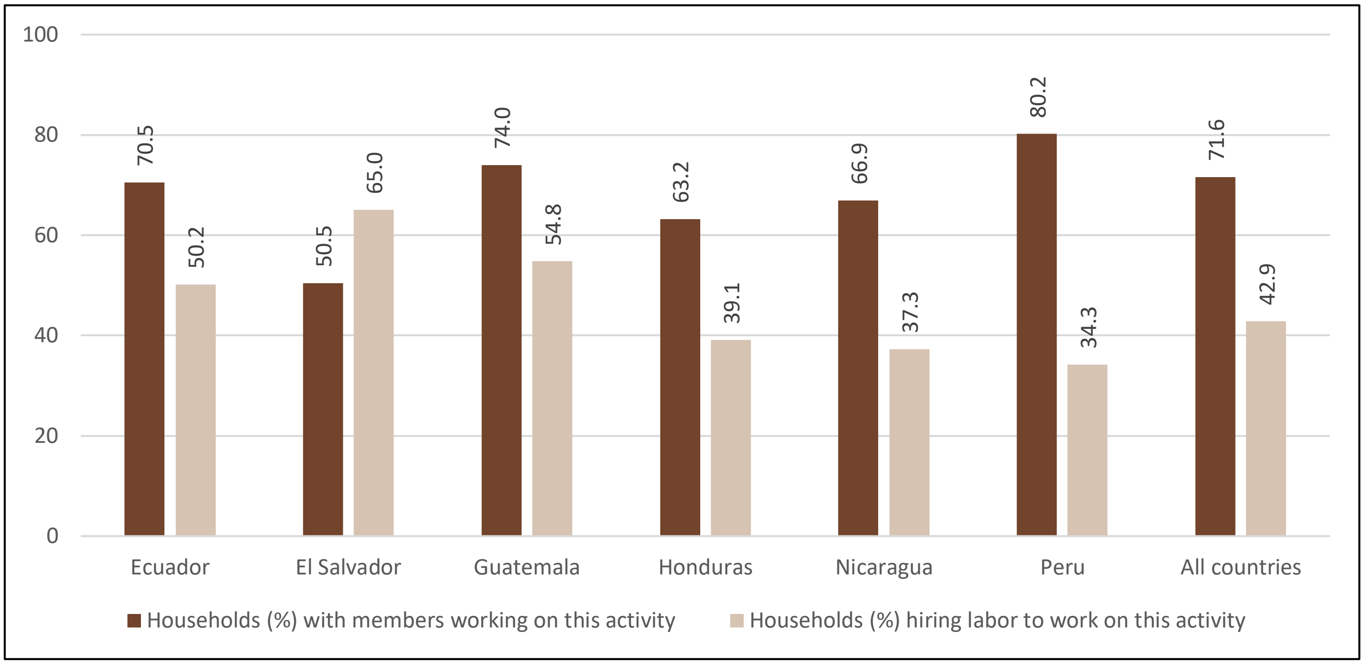


Figure 71. Cacao: family and hired labor for weeding

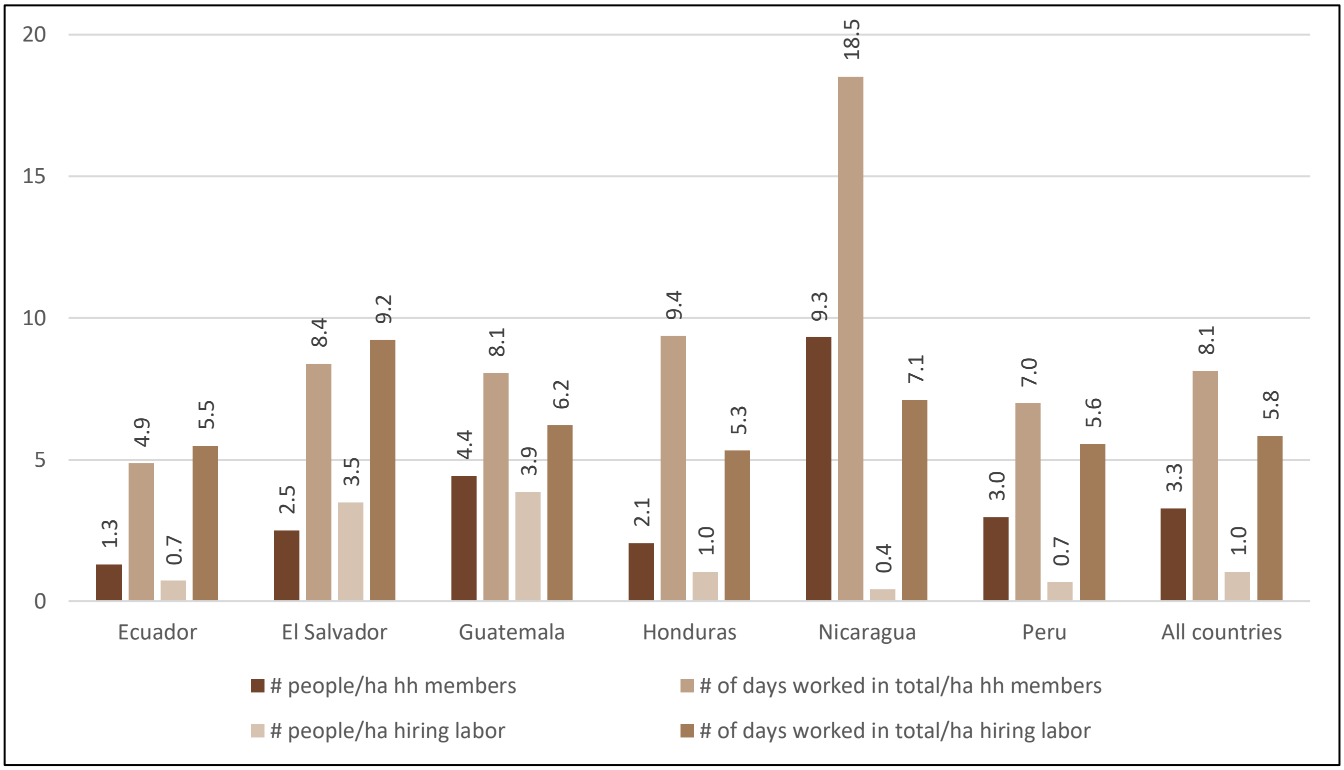


Figure 72. Cacao: # people and # days working on weeding, by country

Figure 73. Family and hired labor for cacao pruning (includes rehabilitation)

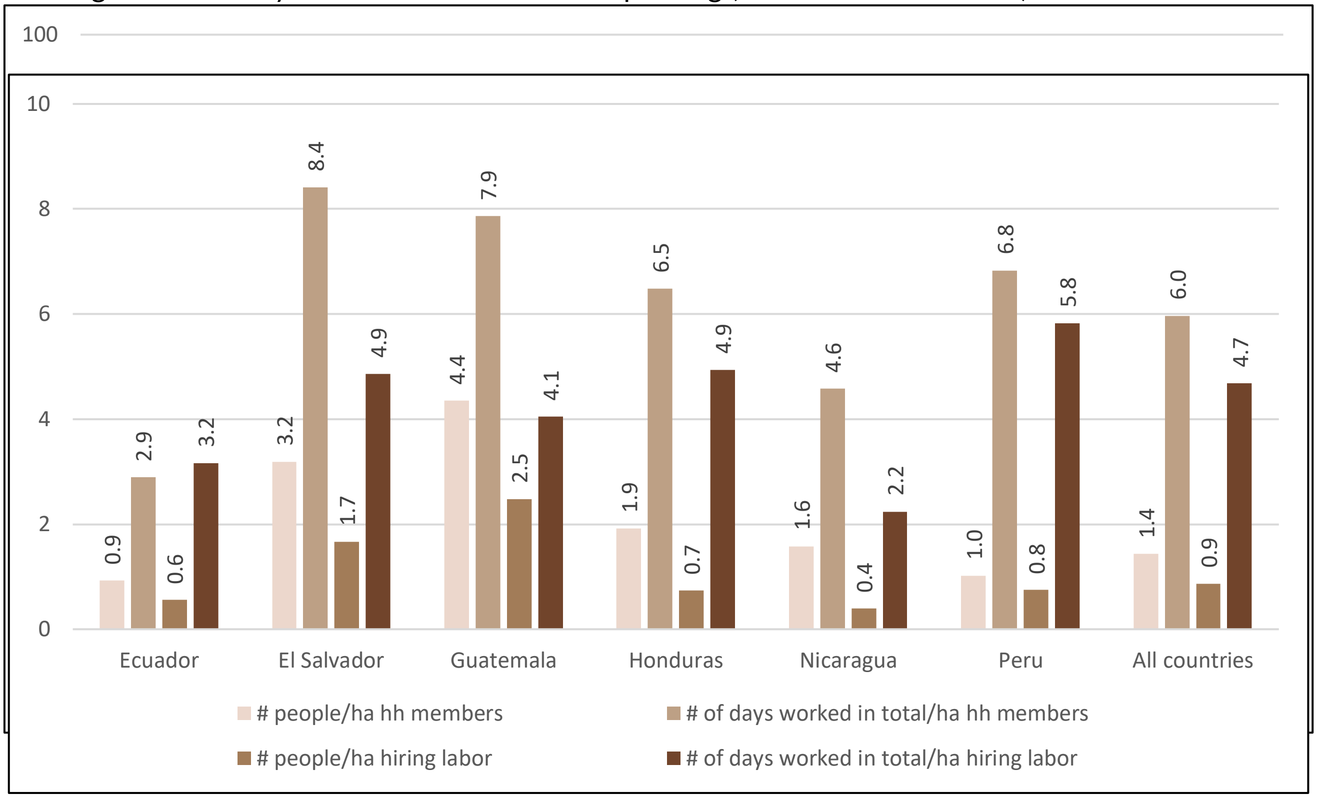


Figure 74. Cacao: # people and # days working on pruning (includes rehabilitation), by country

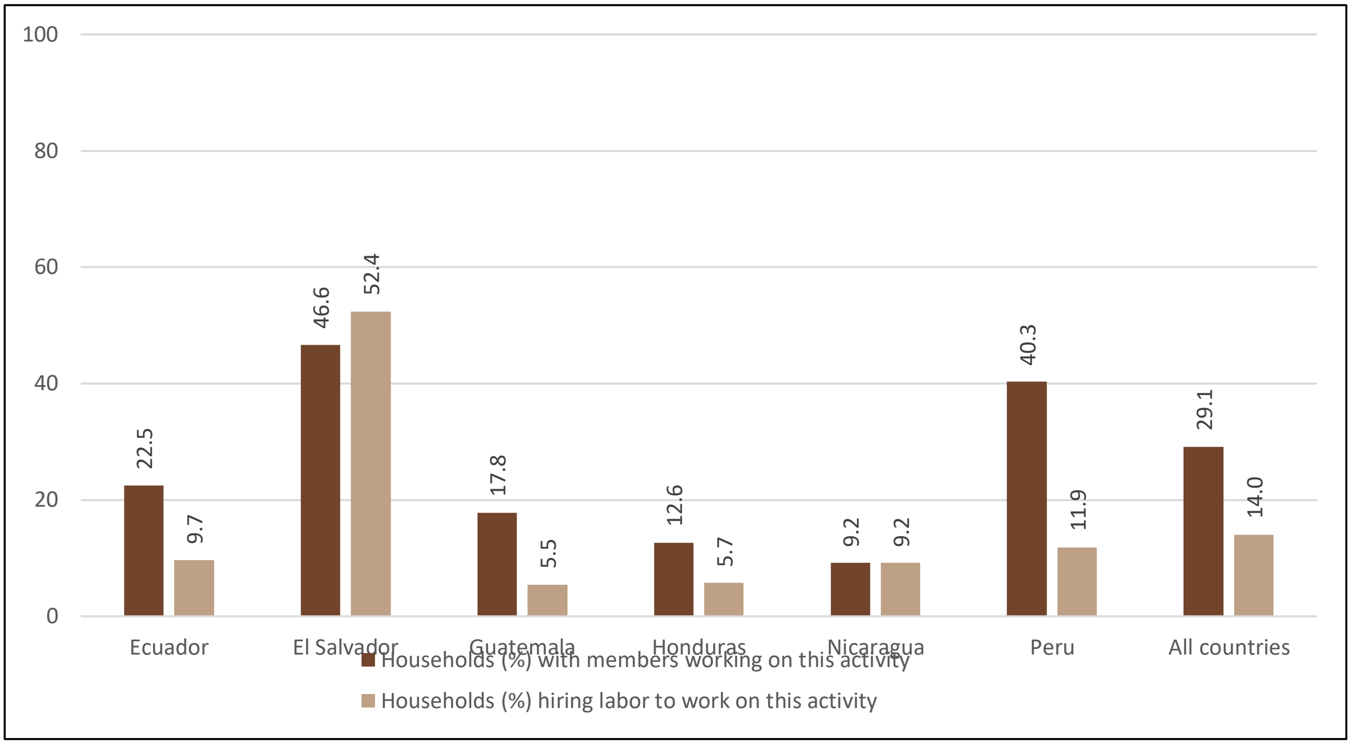


Figure 75. Cacao: family and hired labor for fertilizer application

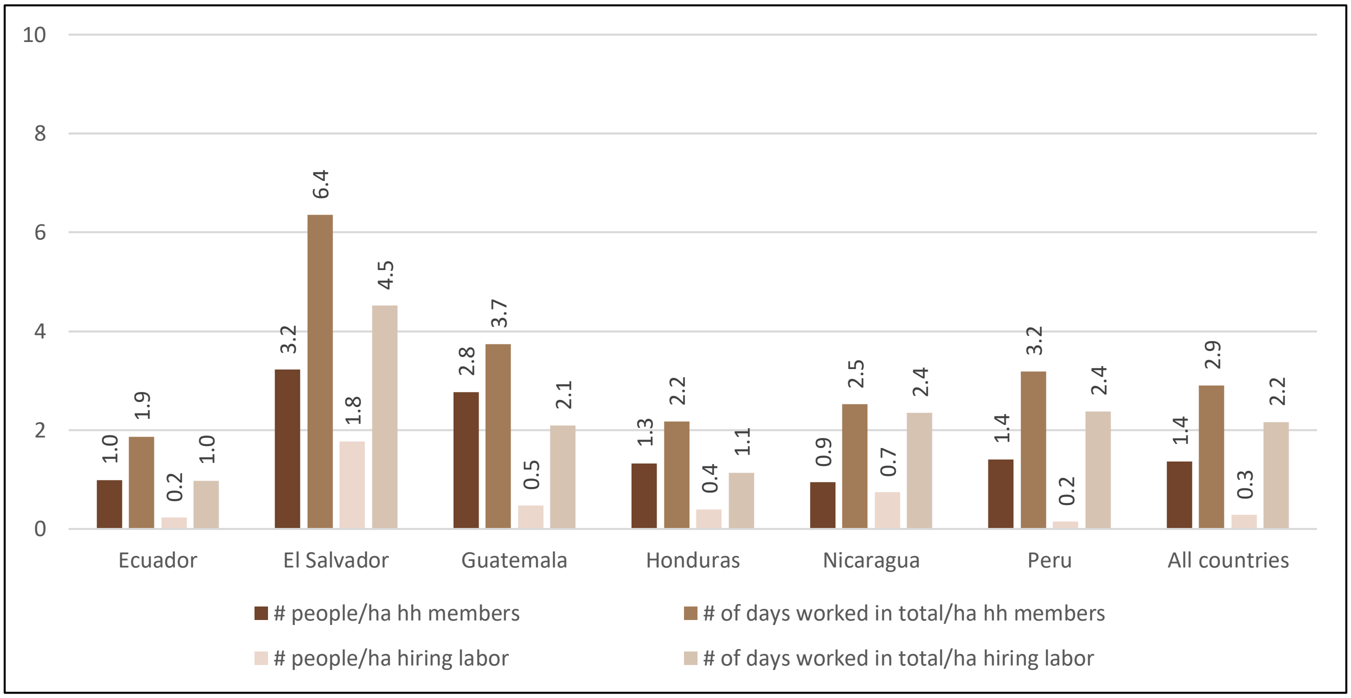


Figure 76. Cacao: # people and # days working on fertilizer application, by country

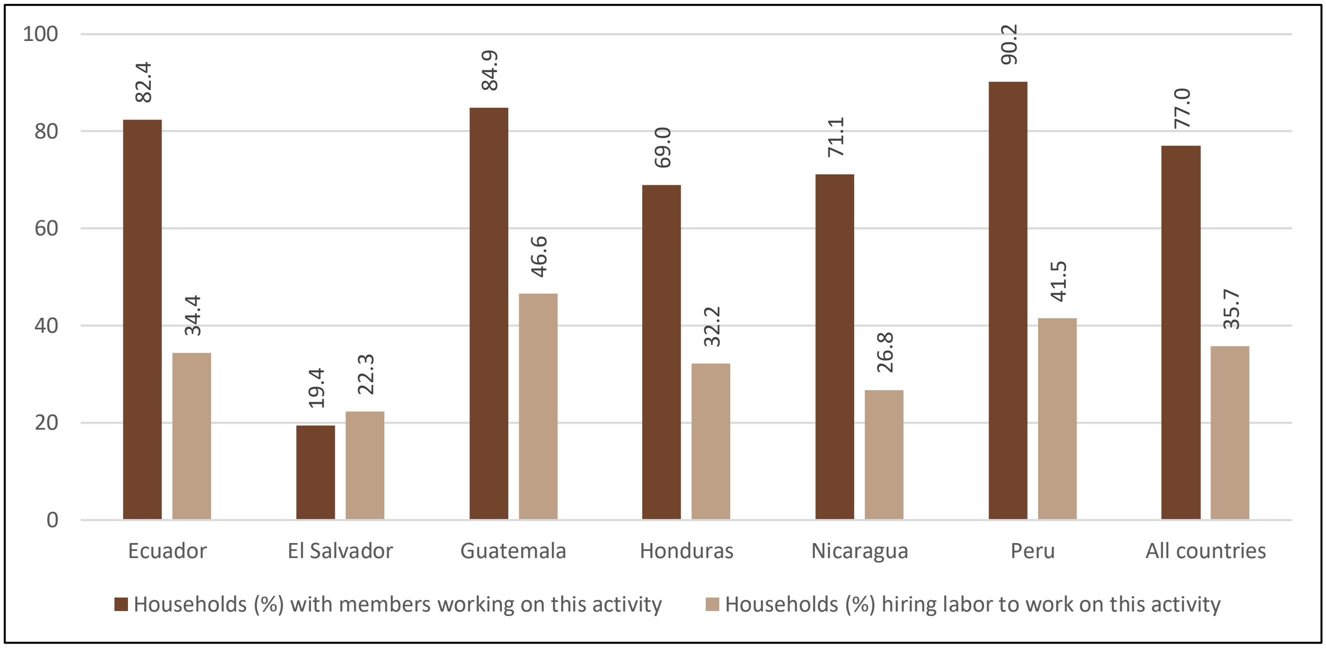


Figure 77. Family and hired labor for cacao harvesting

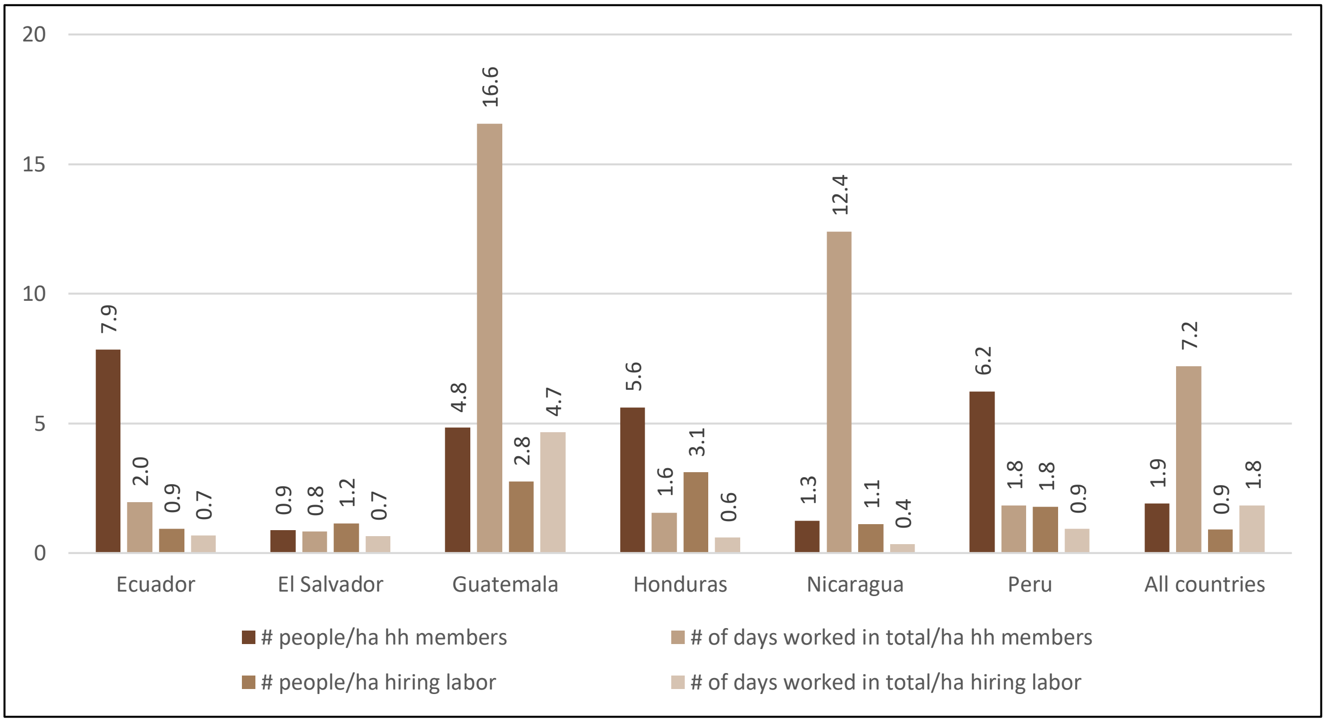


Figure 78. Cacao: # people and # days working on harvesting, by country

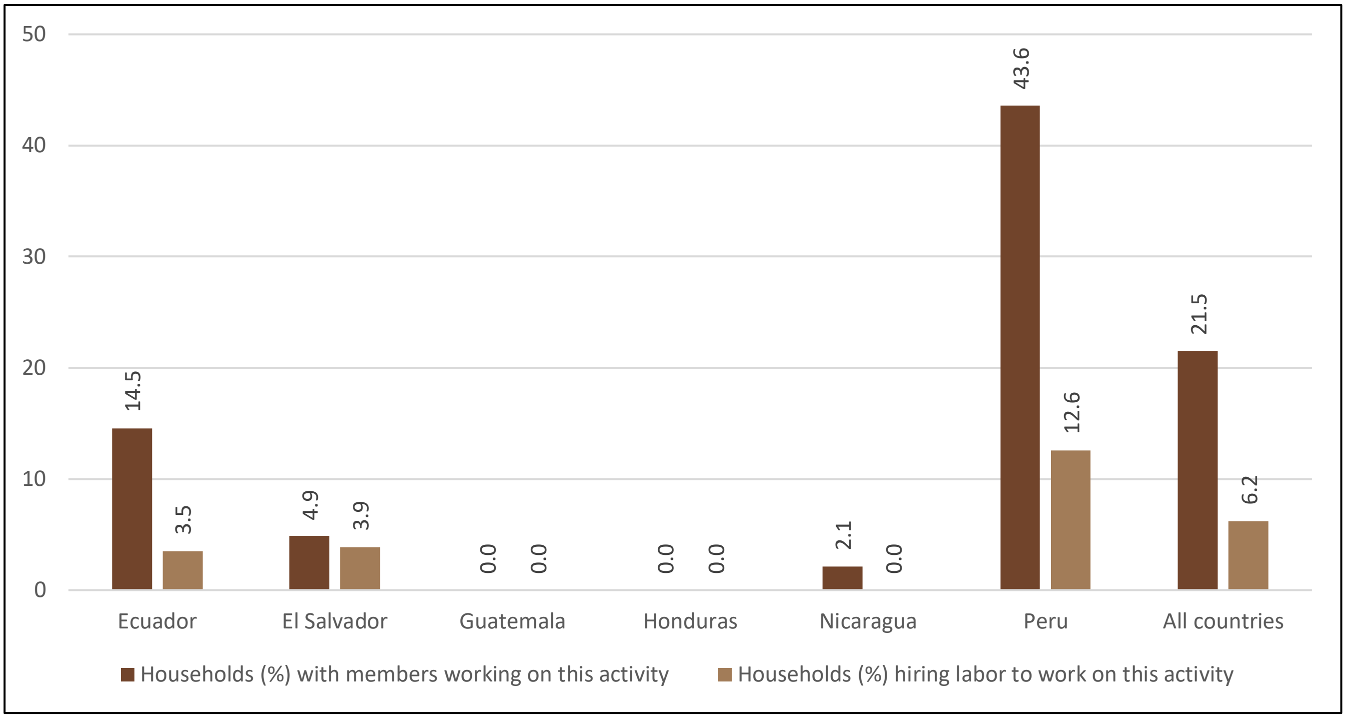


Figure 79. Cacao: family and hired labor for post-harvest (fermenting, drying) activities

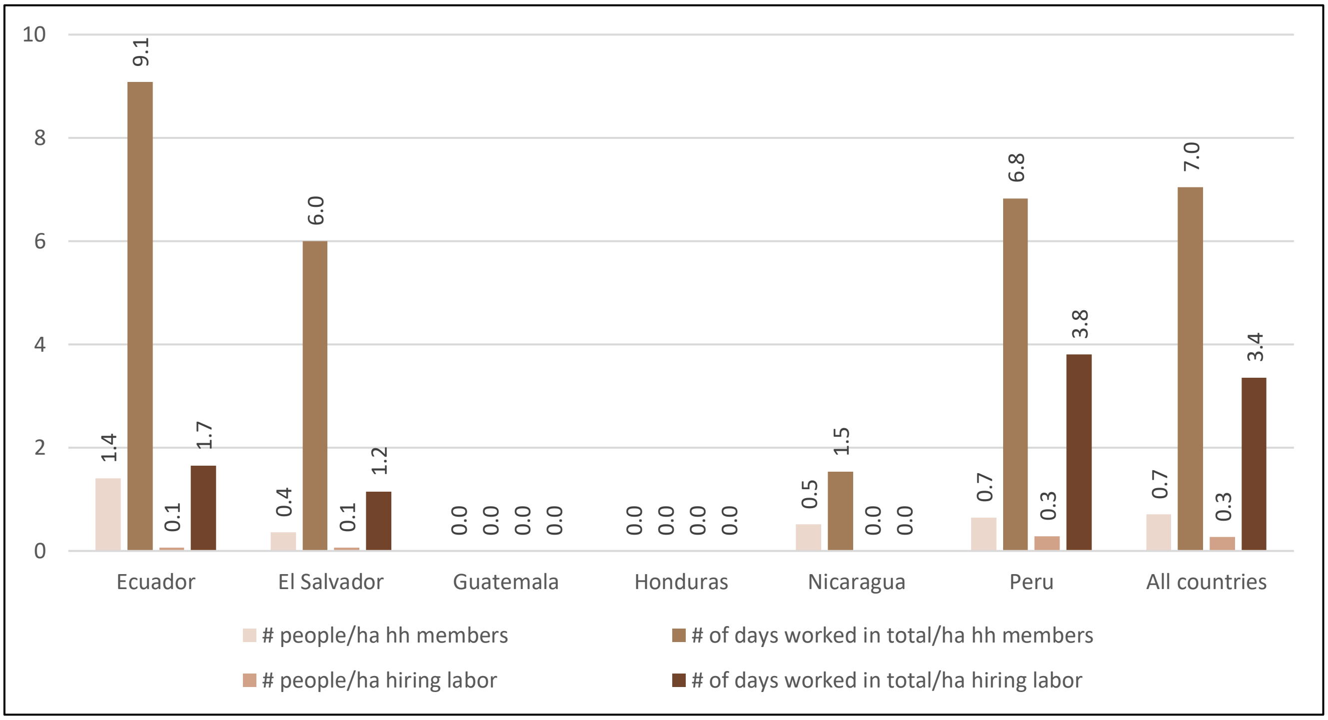


Figure 80. Cacao: # people and # days working on post-harvest (fermenting, drying) activities, by country

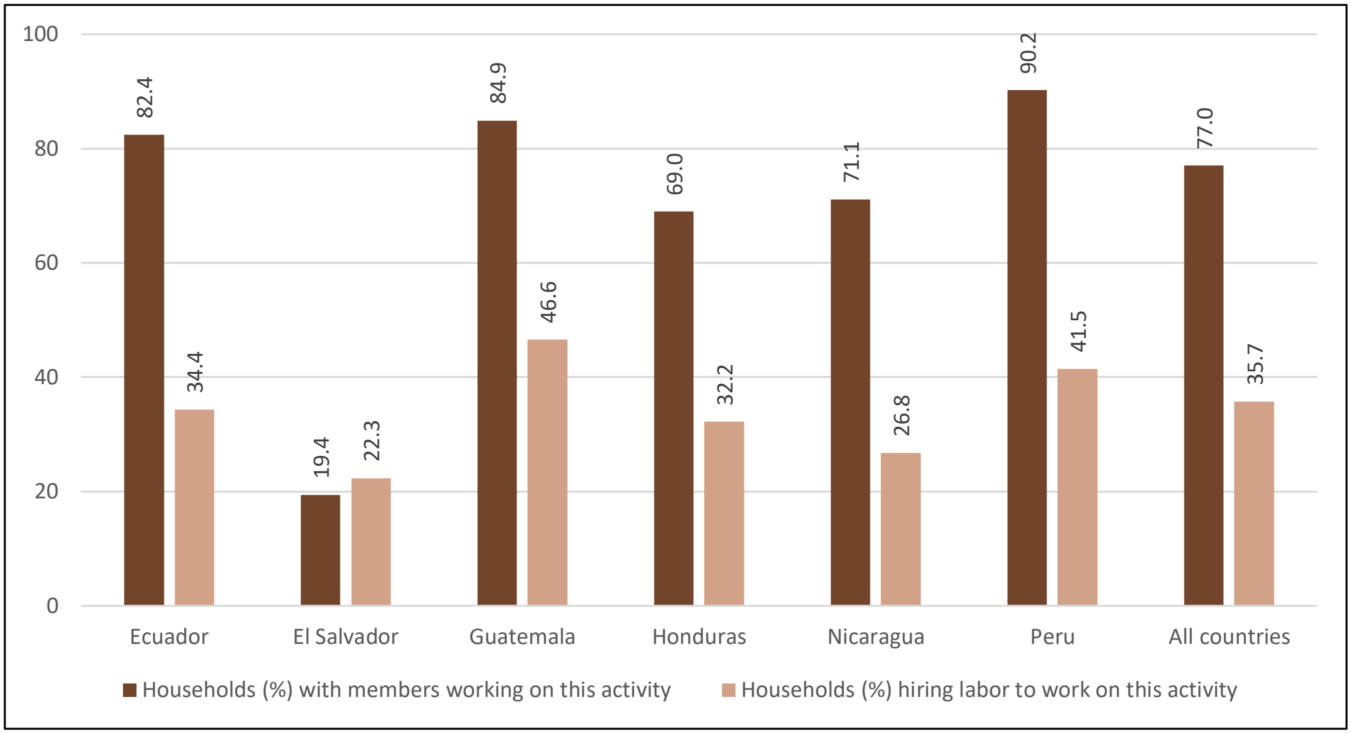


Figure 81. Cacao: family and hired labor for other crop management activities

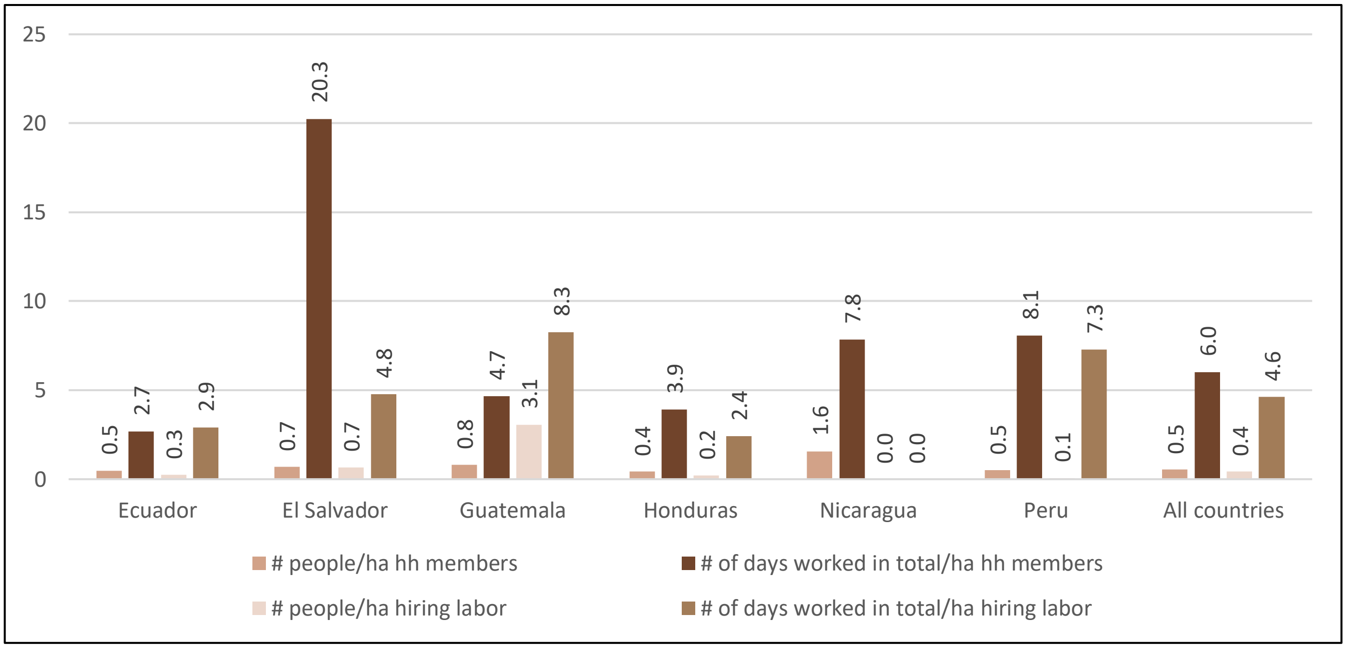


Figure 82. Cacao: # people and # days working on other crop management activities, by country

4.6 Evaluation of cacao trees in the main plot

We evaluated the state of cacao trees in the farmer's main plot. The results showed an average plot size of 2.82 ha with Ecuador at the larger end with an average of 1.92 ha and an average of 1,749 trees per plot, and Guatemala at the smaller end with average plot size if 1.04 ha an average of 1.328 trees per main designed plot. El Salvador has the lowest quantity of trees on their main plot (802). Cacao production is relatively new in El Salvador, which explains the low percentage of productive trees (30.40%) in El Salvador as compared to the average across countries of 72.17%. A quarter of trees (26.93%) are in need of pruning, mainly in Ecuador (36%) and Nicaragua (32.98%). The percentage of trees that need renovation is lower (8.18%) and the percentage of trees that need to be removed is even lower (2.59%). In Central American countries, these percentages are < 1% except for Nicaragua (3.5%) (Table 45).

Table 45. Cacao: technician's evaluation of the main cacao plot, at baseline

Evaluation details	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Area (ha) of the main cacao plot	2.82	1.12	1.04	1.23	1.84	1.96	1.92
# cacao trees in this plot, and % of...:	2,432.79	802.50	1,328.60	1,413.81	950.51	2024.5 1	1749.12
Productive trees	75.36	30.40	66.56	72.4	68.14	84.56	72.17
Trees in need of pruning	36.00	14.12	23.52	31.36	32.98	23.4	26.93
Trees in need of renovation (grafting)	11.20	6.00	6.36	9.08	3.38	9.36	8.18
Trees that need to be removed	3.00	0.92	0.68	0.96	3.50	3.60	2.59
Trees recently renovated/grafted (adults)	3.84	2.24	3.8	1.04	3.33	2.80	2.88
Physical failures (missing trees)	7.88	8.08	3.68	8.16	7.69	3.32	5.80
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	**1061**
*1 ha (hectare) = 10,000 square meters							

4.7 Cacao harvesting and income from cacao sales

Peru harvested 452 kg/ha of dry cacao beans and sold 482.19 kg/ha of dry cacao, followed by Guatemala (350.96 kg /ha, 367.64 kg /ha dry cacao sold). However, Ecuador is the country with highest incomes due to larger plot sizes (US 3,188). The average price per kg of dry cacao was US 2.44 (Table 46).

Table 46. Cacao: harvest and income from sales at baseline

Details	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Cacao area (ha)	3.58	1.58	1.02	1.56	2.16	2.34	2.40
Cacao yields:							
Kg dry/ha	329.32	88.87	350.96	190.91	250.92	451.84	370.47
Kg sold (dry)/ha	321.93	60.63	367.64	214.11	264.91	482.19	369.25
Amount of cacao sold (kg dry)	1123.26	69.24	417.41	335.44	1385.89	1219.63	992.53
Income from cacao sales:	3188.69	92.56	501.76	509.06	686.82	2387.16	2000.41
US$ only includes farmers who sold	909.51	196.14	886.74	428.30	345.10	1055.86	829.33
US$							
US$/ha	78.77	15.63	89.86	82.81	82.03	37.72	59.91
Prices (US$/kg)	1.32	0.92	0.45	0.75	0.65	0.96	1.01
Wet (kg)	20.28	84.38	10.14	14.06	17.97	62.28	39.65
Dry (kg)	2.17	3.2	1.05	1.08	1.53	2.01	2.44
Number of plots	**227**	**103**	**73**	**87**	**142**	**429**	**1061**
*1 ha (hectare) = 10,000 square meters							

4.8 Other crops grown

14.04% of the farmers grow crops other than cacao, especially in Nicaragua where 78.53% have an additional crop. In El Salvador only 0.97% of farmers reported growing other crops. The number of other crops grown on average is less than two (1.71) without Nicaragua (with this country is 3.13) showing high dependence of farmers on cacao for farm income. 40.94% of farmers, provided complete information about other crops. The most commonly reported crops are oranges, plantains, and corn. On average total area (ha) planted in these crops is 1.2 ha. The majority (80.60%) of farmers report selling part of the harvest of these crops. The share of production sold is 68.86 % and income from sales of these crops is US$232.68. Farmers in Ecuador who grow additional crops have the highest income from these other crops grown at US$561.6 (Table A 37).

4.9 Socioeconomic characteristics of farmers and their households

4.9.1 Characteristics of interviewed farmers

In 93.86% of the cases, the person in charge of the cacao plots was interviewed. In all countries, more than 73% of those interviewed were male. The average age is 50 and most farmers are married or in a consensual union (75.42%) (Table 47).

Table 47. Cacao: demographic characteristics of beneficiaries at baseline

Characteristics of farmers	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Characteristics of interviewed person (% yes)							
Is the person in charge of cacao plots	85.39	96.11	97.26	94.25	93.66	97.20	93.86
Sex of interviewed person (% male)	78.95	72.04	70.83	78.87	81.54	71.82	76.57
Is married/free union	76.78	88.34	80.82	78.82	83.80	69.65	75.42
Age (years)	55.63	54.40	47.72	50.83	48.51	47.94	50.33
Characteristics of farmer from sampling list							
Sex (% male)	79.30	73.79	71.23	72.41	84.50	87.41	86.14
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	**1061**

4.9.2 Household and home characteristics, and household income

At least one household member migrated within the last 12 months in 7.4% of households, mainly in Peru (13.51%). One fifth (18.29%) of households received a subsidy from government or NGOs with Peru having the highest proportion of households with subsidies (34.5%), and Honduras with the lowest (2.3%). 57.2% of farmers reported no effects of the COVID19 pandemic on their cocoa production with the main consequences identified being higher prices and lack of labor for crop management and harvesting. Cocoa farmers in Ecuador, El Salvador and Honduras had the highest level of assets (home, transportation, and productive assets) while cocoa farmers in Peru and Nicaragua presented the lowest levels of assets across the countries. The average household income from all sources is US$2,634.45 and ranges from US$850.06 in El Salvador to US$4,507.56 in Ecuador. The majority of income by far comes from agriculture (US$2,256.07) with less than 10% (US$240.48) coming from non-agricultural sources (Table A 38).

4.10 Determinants of adoption of renovation and rehabilitation, and factors affecting cacao yields

In the three regressions (renovation, rehabilitation and yields) we considered variables that would affect the adoption of R&R practices and yields, that were conceptually appropriate and with high quality data, and that were exogenous. Given that the processes that determine adoption of R&R practices are similar, we used the same variables in these two regressions. However, for yields, some of the variables were different as we consider the factors that affect yields are different.

In R&R regressions, we included the sex and age of the household head, whether decisions about what inputs to purchase for cacao were taken jointly (between the two heads), the cacao area, number of MOCCA practices implemented, whether a household member had migrated within six months prior to the interview, whether anyone in the household received remittances within 12 months prior to the interview, the number of cacao varieties, the distance between the farm and the closest town where farmers could purchase inputs, altitude, whether farmers obtained information of cacao research products from NGOs or the Government, the age of the cacao trees, if anyone in the household had access to credit and whether the cacao had a shade crop.

In the yields regression, we included the sex and age of the household head, whether decisions about what inputs to purchase for cacao were taken jointly (between the two heads), number of family members working in all cacao activities, whether a household member had migrated within six months prior to the interview, whether anyone in the household received remittances within 12 months prior to the interview, the number of MOCCA practices implemented, the number of cacao varieties, the distance between the farm and the closest town where farmers could purchase inputs, the number of farm certifications, altitude, whether the cacao had a shade crop, the age of the cacao trees, if anyone in the household had access to credit and whether farmers obtained information of cacao research products from NGOs or the Government.

In all three regressions, the combined analysis (for all countries) included variables to control for country-specific effects (i.e., dummy variables for countries/region). Further, in all regressions we estimated standard errors considering municipality fixed effects. Next we discuss the regression results.

4.10.1 Renovation

The factors affecting the likelihood of implementing renovation practices by cacao farmers vary by region and country. Table 48 presents the Probit regression results for each region/country separately, and for all countries together[46].

In Central America[47], only one factor had a statistically significant influence on the probability of implementing renovation practices: age of the trees (negative effect at an increasing rate). The probability of adopting renovation practices decrease up to a certain age of the tree (46 years), after which the probability of adoption starts to increase. This is consistent with the fact that relatively young plantations do not need renovation during their first years. However, 46 years could be late, taking into account that after 15 years, trees may begin to lose productivity, and may need to be renovated.

In Ecuador, five variables significantly explain adoption probabilities of implementing renovation practices. Area in cacao and whether producers received information from the government, universities, or extension agents about the cacao crop both have a negative effect, while number of cacao varieties planted, migration of household members within last 6 months, and whether farmers received remittances have positive effects on the probability of adoption. A larger cocoa plantation likely requires more effort (operational costs) from farmers to implement this type of practice. The number of cacao varieties explained positively the rate of adoption, perhaps because farmers who are already combining a high number of varieties in their plantation may be more likely to invest in productivity through renovation practices. To have a family member migrating also increases the likelihood of implementing renovation practices, potentially due to remittances

[46] Statistic of the variables included in the regressions are described in Table A 37 and Table A 38.

[47] Because of the small number of observations per country, Guatemala, Honduras and El Salvador were analyzed as a region.

from those family members that can be used for crop management (remittances also has a positive and significant effect). The sign of the information variable was unexpected, and maybe could be related to the quality of the information received.

In Peru, households where the head of household is younger, make joint decisions about which inputs to purchase for cacao, implement management practices or/and have shade crop with cacao are less likely to adopt renovation practices. The variables that positively influence the probability of adoption in this country are cacao area, the number of cacao varieties, and altitude. Younger farmers have a lower probability of adopting renovation practices up to a certain age after which the probability increases, maybe because they have more experience in crop management or greater resources to invest. Households making joint decisions about which inputs to purchase for cocoa are less likely to implement renovation practices. This is an unexpected sign for this relationship that maybe can be explained by the low number of answers in this category. As the altitude of the farm increases, the probability of adopting renovation practices increases, up to a certain altitude (1,886 m.a.s.l), after which the probability of adoption starts to decrease. The probability of adopting renovation practices decrease up to a certain age of the tree (15 years), after which the probability of adoption starts to increase as expected. Related to number of cacao practices implemented, the probability decrease up to 9.2 practices, when probability starts to grow. The interpretation has to be country specific. In this case, perhaps in Peru, producers do not have enough resources (time, cash) for implementing more practices. We will only discuss the ones not previously explained.

Table 48. Determinants of adoption of cacao renovation practices, marginal effects

Variables	Central America	Ecuador	Peru	All Countries
Sex of HH head (1=male)	0.029	-0.006	0.018	0.004
	(0.057)	(0.051)	(0.040)	(0.028)
HH head age (years)	-0.007	0.007	**-0.023*** **	**-0.011** **
	(0.007)	(0.011)	(0.007)	(0.004)
HH head age squared	0.000	-0.000	**0.000*** **	**0.000** **
	(0.000)	(0.000)	(0.000)	(0.000)
Joint decision (spouses) on purchase of cacao inputs (1=yes)	0.091	-0.081	**-0.097***	**-0.085***
	(0.132)	(0.093)	(0.050)	(0.047)
Cacao area (Ha)	0.005	**-0.020***	**0.022***	0.008
	(0.039)	(0.012)	(0.012)	(0.010)
Cacao area squared	0.001	0.001	-0.000	-0.000
	(0.005)	(0.000)	(0.001)	(0.001)
Number MOCCA practices implemented	0.001	0.001	-0.000	-0.000
	(0.005)	(0.000)	(0.001)	(0.001)
Number MOCCA practices squared	-0.010	-0.010	**0.017*** **	**0.008***
	(0.012)	(0.011)	(0.005)	(0.004)
Number of cacao varieties	-0.025	**0.077** **	**0.054** **	**0.041*** **
	(0.023)	(0.035)	(0.025)	(0.014)
Cacao age	**-0.046*** **	-0.005	**-0.015***	-0.000
	(0.014)	(0.005)	(0.008)	(0.003)
Cacao age squared	**0.001*** **	0.000	**0.001** **	-0.000
	(0.001)	(0.000)	(0.000)	(0.000)
Distance to closest town (hours)	0.001	0.106	-0.047	-0.023
	(0.024)	(0.067)	(0.033)	(0.019)
Altitude (m.a.s.l.)	-0.000	-0.000	**0.001*** **	**0.000*** **
	(0.000)	(0.000)	(0.000)	(0.000)
Altitude squared	0.000	0.000	**-0.000*** **	**-0.000*** **
	(0.000)	(0.000)	(0.000)	(0.000)
Owns land (1=yes)	0.050	-	0.021	0.041
	(0.077)		(0.035)	(0.029)
Received remittances (1=yes)	0.087	**0.444*** **	0.028	0.071
	(0.094)	(0.146)	(0.094)	(0.063)
Access to credit (1=yes)	0.078	0.052	0.053	**0.068** **
	(0.078)	(0.059)	(0.039)	(0.035)
Obtained information of cacao research products from NGOs or government (1=yes)	0.003	**-0.174** **	0.002	-0.021
	(0.054)	(0.073)	(0.053)	(0.032)
Has shade crop with cacao (1=yes)	0.029	-0.019	**-0.064***	-0.012
	(0.068)	(0.049)	(0.036)	(0.029)
HH member migrated within last 6 months (1=yes)		**0.179***	0.055	0.046
		(0.096)	(0.044)	(0.046)
Country dummies	Yes	No	No	Yes
Observations	**283**	**212**	**409**	**920**
Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1				

4.10.2 Rehabilitation

In Central America, to make joint decisions on purchase of cacao inputs decrease the probability of implement rehabilitation practices. However, if farmers have shade crop together with the cacao, this increases the adoption probability.

The number of practices implemented increases the likelihood of rehabilitating cacao, in Ecuador and Peru. Possibly this is because these farmers have higher expertise in the management of the crop. Households with members who migrated within the last six months have less probability of adopting rehabilitation practices, perhaps because the availability of family labor is lower, which may limit implementation of the practice.

In Ecuador, household joint decision-making on the purchase of cacao inputs negatively affects the probability of adoption of rehabilitation practices. In this country, the age of cacao trees also has a negative effect on the probability of adoption for rehabilitation up to 10 years, when start to increase. Younger trees need fewer rehabilitation practices than older trees. In Peru, sex of the head of household (negatively) and the age of the cacao trees (positively) also affect adoption probabilities. Female-headed households are less likely to implement rehabilitation practices. Relate to the cacao age, the probability of adopting rehabilitation practices adoption increase up to 16 years when start to decrease. This is a non-expected results, perhaps in Peru, the younger plantations do not have expected characteristics and they have to implement these types of practices (Table 49).

Table 49. Determinants of adoption of cacao rehabilitation practices, marginal effects

Variables	Central America	Ecuador	Peru	All Countries
Sex of HH head (1=male)	-0.017	0.061	**-0.122*** **	**-0.045***
	(0.040)	(0.063)	(0.038)	(0.026)
HH head age (years)	0.001	0.006	-0.001	0.003
	(0.006)	(0.012)	(0.007)	(0.004)
HH head age squared	-0.000	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Joint decision (spouses) on purchase of cacao inputs (1=yes)	**-0.149***	**-0.271*** **	-0.049	**-0.105*** **
	(0.090)	(0.104)	(0.050)	(0.038)
Cacao area (Ha)	-0.040	-0.007	0.004	-0.002
	(0.030)	(0.015)	(0.011)	(0.005)
Cacao area squared	0.004	0.000	-0.000	0.000
	(0.005)	(0.001)	(0.000)	(0.000)
Number MOCCA practices implemented	0.058	**0.294** **	**0.173** **	**0.124*** **
	(0.077)	(0.132)	(0.083)	(0.049)
Number MOCCA practices squared	0.004	-0.014	-0.007	-0.002
	(0.009)	(0.014)	(0.008)	(0.005)
Number of cacao varieties	-0.011	-0.042	-0.010	-0.023
	(0.018)	(0.047)	(0.023)	(0.015)
Cacao age	0.006	**-0.010***	**0.016** **	0.001
	(0.009)	(0.005)	(0.007)	(0.002)
Cacao age squared	-0.000	0.000	**-0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Distance to closest town (hours)	0.019	0.033	0.023	0.020
	(0.020)	(0.082)	(0.026)	(0.018)
Altitude (m.a.s.l.)	0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Altitude squared	**-0.000** **	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Owns land (1=yes)	0.031	-0.115	-0.032	-0.037
	(0.065)	(0.153)	(0.031)	(0.028)
Received remittances (1=yes)	-0.005	0.313	-0.072	0.009
	(0.075)	(0.278)	(0.077)	(0.057)
Access to credit (1=yes)	-0.088	-0.047	-0.032	-0.040
	(0.066)	(0.074)	(0.033)	(0.030)
Obtained information of cacao research products from NGOs or government (1=yes)	-0.030	-0.078	0.094	0.023
	(0.040)	(0.089)	(0.061)	(0.028)
Has shade crop with cacao	**0.150***	0.050	-0.007	0.018
	(0.091)	(0.064)	(0.032)	(0.027)
HH member migrated within last 6 months (1=yes)	-0.031	0.103	-0.053	-0.032
	(0.084)	(0.141)	(0.051)	(0.049)
Country dummies	Yes	No	No	yes
Observations	**292**	**219**	**409**	**920**
Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1				

4.10.3 Yields

This indicator is expressed in kg/ha of dry cacao. For Central American countries, the statistically significant variables that relate positively to yields are sex of head of household, the number of family members working in all cacao activities, number of practices implemented, age of cacao trees (positive effect at a decreasing rate), having certifications and distance to closest town (hours). As expected, male-headed households obtained higher yields (51.38kg/ha) than female-headed households, highlighting the need to develop targeted interventions for female headed cocoa producing households. Greater participation of family labor in cacao activities was related to higher yields, potentially related to increased availability and quality of labor available for cocoa related practices. As the number of certification increases, yields are higher which could be a function of the certification standards. Same as the number of controlling practices implemented, in plantations, this should imply better management of pests, diseases, fertilization that could be reflected in the yield. Related to number of cacao practices implemented, the probability increase up to 10.3 practices, when probability starts to decrease. As cacao trees become older, yields increase, which is expected, as older plants are more productive up to 36.80 years, when the yield starts to decrease, according to the collected data.

In Ecuador, the number of cacao varieties negatively influence cacao yields. It is important to explain the results taking into account the country context. Ecuador has a long history with cacao and its producers have specialized in certain genetic materials over time. Perhaps this explains the negative sign for the variable of the number of varieties. In Peru, just three factors were found to affect yields - how decisions about which farm inputs to purchase are made for joint decisions, migration - remittances (negative effect), and the number of practices implemented (positive effect at a decreasing rate). Household heads making joint decisions about which inputs to purchase for cocoa were associated with lower yields, which would seem to suggest that joint decisions may prioritize other household needs over cacao investments. The resources coming from the immigrants could be invested in the crop, increasing the yields. Implementing additional practices beyond 13.04 produces a yield decrease, possibly due to decreasing returns to additional practices once the crops basic needs are met. As an example, soil cover may contribute to increased yields, but adding cover crops where mulch is already present may not have a significant increase on yields due to that additional practice (Table 50)

Table 50. Cacao yield (kg dry/ha) regression results

Variables	Central America	Ecuador	Peru	All Countries
Sex of HH head (1=male)	**51.388*** **	58.823	8.689	88.322
	(14.035)	(40.852)	(39.544)	(55.380)
HH head age (years)	-2.953	8.607	13.743	13.378
	(3.364)	(7.939)	(10.039)	(9.653)
HH head age squared	0.025	-0.076	-0.146	-0.146
	(0.031)	(0.064)	(0.115)	(0.096)
Joint decision (spouses) on purchase of cacao inputs (1=yes)	-64.965	58.408	**-146.341*** *	-245.702
	(94.875)	(81.079)	(52.504)	(176.068)
HH head male x Joint decision on purchase of inputs	146.255	-101.607	-14.610	-142.105
	(89.348)	(84.784)	(86.440)	(163.624)
Family labor: # members in all cacao Activities	**15.279*** *	0.750	-23.249	-12.436
	(6.240)	(13.668)	(16.921)	(29.384)
Number MOCCA practices implemented	**108.275*** *	0.017	**189.679*** *	**308.655*** **
	(46.207)	(70.148)	(80.372)	(99.452)
Number MOCCA practices squared	**-10.491*** *	3.891	**-14.323***	**-24.956*** *
	(4.243)	(7.523)	(6.863)	(9.862)
Number of cacao varieties	12.651	**-43.683***	-42.157	-71.331*
	(9.939)	(23.460)	(33.751)	(40.178)
Cacao age	**22.007*** *	-8.276	-8.806	-13.657*
	(9.351)	(5.470)	(10.464)	(7.845)
Cacao age squared	**-0.598*** *	0.100	0.332	0.162
	(0.244)	(0.069)	(0.452)	(0.112)
Distance to closest town (hours)	**18.018***	-59.215	-53.833	-15.970
	(9.670)	(46.484)	(30.432)	(47.664)
Number of certifications	**20.382***	-13.835	36.638	-12.583
	(11.793)	(16.657)	(42.364)	(39.399)
Altitude (m.a.s.l.)	0.214	-0.025	-0.068	-0.540***
	(0.129)	(0.078)	(0.331)	(0.150)
Altitude squared	**-0.000***	0.000	-0.000	**0.000*** *
	(0.000)	(0.000)	(0.000)	(0.000)
HH member migrated within last 6 months (1=yes)	49.926	80.430	-65.050	-168.849
	(68.252)	(76.091)	(52.421)	(125.954)
Received remittances (1=yes)	-56.465	-22.156	-40.534	**-256.017*** **
	(38.650)	(123.995)	(69.938)	(95.913)
HH member migrated x Received remittances	-72.148	-88.422	**-156.886*** *	-102.209
	(67.867)	(161.810)	(59.280)	(176.134)
Has shade crop with cacao (1=yes)	-3.530	-20.865	-40.669	-28.603
	(45.653)	(44.932)	(51.142)	(85.073)
Owns land (1=yes)	-40.626	36.294	120.429	149.263
	(37.475)	(39.339)	(73.042)	(198.344)
Access to credit (1=yes)	41.947	-74.326	117.808	163.943
	(27.721)	(51.729)	(100.476)	(183.681)
Obtained information of cacao research products from NGOs or government (1=yes)	-13.970	-51.019	-78.229	-94.570
	(26.480)	(48.240)	(123.649)	(132.693)
Constant	-227.718	155.741	-199.377	-38.068
	(201.451)	(268.366)	(484.614)	(483.924)
Country dummies	Yes	No	No	Yes
Observations	**262**	**208**	**384**	**843**
R-squared	**0.313**	**0.145**	**0.167**	**0.174**
Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1				

4.11 Summary of cacao results

Household characteristics were relatively similar across countries. Decisions about which farm inputs to purchase and how to use cacao income are largely made by the head of household who was generally a man, across the MOCCA countries. In very few households were decisions made only by women or by both spouses. The producers do, however, consult with different sources in order to make decisions about which farm inputs to purchase, including other household members, extension agents, and input suppliers. Access to financial services for cocoa farmers across countries is deficient (17.28%). The higher percent of cacao farmers with access to formal finance in Peru (20.75%) and Ecuador (15.56%) as compared with El Salvador and Nicaragua (2.91% to 6.34%%).Households rely on household and hired labor, particularly for weeding and harvesting. Most farmers rely heavily on cacao for farm income with only 15% of farmers reporting growing crops other than cacao. The number of additional crops grown as well as the area planted and income generated are low overall.

Yields, plantation size and income from cocoa, however, varied greatly across the MOCCA countries. While in Peru farmers have yields of 451.84 kg dry/ha, followed by farmers in Guatemala (350.96 kg dry/ha), the vast majority of farmers in El Salvador are still waiting for their first harvest as the cocoa sector is relatively young in that country. Ecuador has the largest production area per producer (3.58 ha), generating the highest level of annual cacao sales (US$3,188) while In Central America the numbers are significantly lower with farmers in Guatemala and Honduras reporting annual sales of US$501 and US$509, respectively, just one sixth of annual sales reported by cacao farmers in Ecuador. According to the evaluation in the main plot, a quarter of trees (26.9%) are in need of pruning, mainly in Ecuador (36%) and Honduras (31.36%).

When we disaggregated key MOCCA indicators by sex and age of farmers as well as farm size, we generally found the anticipated differences, though not always significant. Across all countries, the average yields of women farmers are lower than men's, except for Peru where the difference is not statistically significant. Only Honduras has a significant yield difference between men and women farmers of more than 75 kg dry/ha. In terms of cacao sales and access to financial services, the results are similar, with no statistical differences, except for Nicaragua, male farmers receive more than US $500 of annual cacao sales than female. Disaggregating by age of the household head, we found no significant differences in yields, access to finance or annual cacao sales across countries, except for Guatemala where the annual value of cacao sales in the group of producers older than 30 was significantly higher (US$605.04 vs. US$139.66). In general, though, older heads of household scored better on these indicators across countries. When we disaggregated the key MOCCA indicators by farm size, farmers with smaller farms (<5 ha) obtained on average just US$1430 in annual cacao sales, much lower than the US$4,463 obtained by larger producers (> 5 ha). Only Guatemala and Honduras did not have significant differences in annual cacao sales across farm sizes. For Ecuador and Peru, the difference was up to fivefold between smaller and larger farmers. This income differential needs to be taken into consideration in further data collection and analysis focused on impact. In terms of yields, there are no significant differences by farm size.

Adoption of crop management practices including renovation and rehabilitation practices varies by country and practice. During baseline year, we found on average that just 17.62% of farmers renovated cacao trees during the year. Peru and Honduras have the highest rates and El Salvador the lowest. The main reason farmers gave for implementing this practice was low yields, and the main reason to not renovate cacao plantations was the lack of economic resources. However, reasons varied by country, with lack of time being important in Peru and lack of knowledge being important in Guatemala. Methods to control pests and diseases have the highest level of adoption over all, while fertilization based on nutritional deficiencies and a fertilization plan are the lowest. Practices related to appropriate selection of genetic material for planting and production of quality seedlings have low levels of adoption while in general practices related to harvesting practices are widely adopted (more than 70% of farmers). While most farmers do manage the floor (soil and weeds) in their plantations, very few use any kind of mulch or soil cover practices so this may be an area of opportunity. In general, practices that are widely adopted are not yet adopted at an optimal level by most farmers, providing room for improvement through MOCCA training and assistance.

The multivariate regression results explore the variables associated with the adoption of renovation and rehabilitation practices and yields by country and overall. It is interesting to observe that for the three regressions the significance of variables differs greatly across countries with only one instance in which a variable was significant for all countries in the same regression (number of MOCCA practices was significant and positive for all countries for adoption of rehabilitation practices). Across countries and regressions, joint decision-making, the implementation of MOCCA practices, the number of cacao varieties planted, age of cacao plantations, altitude, family member migration and sex of head of household appeared as variables that seem to explain adoption of R and R practices and/or yields. Interestingly, land ownership, distance to nearest town, remittances, credit, shade crops and sources of information on cacao seemed to be less important as determinants of adoption of R and R and yields.

Maximizing Opportunities in Coffee and Cacao in the Americas

V. RECOMMENDATIONS FOR MONITORING ACTIVITIES

5 Recommendations for monitoring activities

We suggest the following recommendations for MOCCA monitoring activities, as they would inform the evaluation process, especially with variables that may have some issues:

1. Collect area planted with each MOCCA crop, in every plot (naming the plots, so the name can be used if one wants to match monitoring with survey data). Ideally, the area for the MOCCA crops should be measured, to reduce potential errors when analyzing this variable.
2. Monitor the number of trees planted in the farm, and conduct diagnosis at least once a year, to collect information about the types (productive, in need of pruning, in need of renovation, recently renovated, etc.) of coffee and cacao trees in the farm.
3. Quantities produced and sold, in each of the possible presentations (e.g., cherry, parchment, green, wet, dry). Baseline information presented many inconsistencies in these data.
4. Monitor areas under renovation and rehabilitation, so monitoring data can be matched with survey data to check consistency.
5. Any monitoring database should include the same unique identification of the farmers used in the baseline. This will allow matching the databases if needed. This excludes farmers not sampled in the baseline.
6. Be sure the identifiers used for each farmer are unique, as during the sampling process, we could identify several farmers with the same identifier. This could cause problems when trying to match data over time and from different databases.
7. The record of number of trainings attended by farmers should include the farmer unique identifier, as this information will be very valuable for the evaluation (databases need to be matched using the unique farmer identifier), as the intensity of training could have an effect on the outcome indicators.
8. Finally, keep a record of farmers who drop-out from the project (with their corresponding unique identifier), as this will help us filter them out of the midline and endline sample, and check for how statistically different these farmers are from the ones who remain in the project.

VI. REFERENCES

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VII. ANNEXES

7 Annexes

Annex 1. IRB approval letter for farmer-level survey activities

CIAT is a CGIAR Center

CIAT
International Center for Tropical Agriculture
Since 1967 Science to cultivate change

August 10, 2020

Dear Carolina González Rojas,

Reference: MOCCA (2020-IRB18)

The Institutional Review Board (IRB) of the Alliance of Bioversity International and CIAT has evaluated your request for review of the baseline survey under the project referenced above. Your research is exempt from full review and with this letter the IRB provides clearance to move forward with the activity. The survey shall be implemented following the guidelines, protocols and consent form that you have described in, and attached to the request for review.

I take this opportunity to inform you that the Alliance is working towards aligning with international standards relevant to the Institutional Review Board and research ethics more broadly. This will influence the composition and procedures of the Board, the institutional policy landscape, and the Alliance researchers' training.

As an Alliance Principal Investigator, please be aware that you and any researcher working under your supervision should complete the CITI human research training offered through CIAT institutional subscription. We are happy to help you identify the most relevant training. You can locate the training here: https://about.citiprogram.org/en/series/human-subjects-research-hsr/

Thank you for taking the time to submit the application, and for addressing the IRB's comments. We wish you success in the project.

Sincerely,

Isabel López Noriega

Alliance IRB Committee Co-Chair

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Annex Tables.

Table A 1. Baseline sample information

Sample information	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Coffee farmers							
# municipalities	n.a.	23	33	24	22	25	127
Altitude (m.a.s.l.)		993.5	1540.5	1154.75	819.61	1553.39	1282.59
Male sampled households (%)		60.66	75.12	77.25	84.94	77.16	75.91
Length of interview (hr)		1.30	1.20	0.96	1.33	1.82	1.32
Number of households		316	455	427	422	677	2297
Cacao farmers							
# municipalities	35	36	3	7	11	9	101
Altitude (m.a.s.l.)	167.67	512.03	155.03	283.90	407.87	591.27	411.49
Male sampled households (%)	79.29	73.78	71.23	72.41	82.39	71.09	74.74
Length of interview (hr)	1.25	1.27	1.19	1.83	1.58	1.00	1.35
Number of households	227	103	73	87	142	429	1061

Table A 2. Virtual trainings of enumerators implemented for MOCCA baseline data collection

#	Date			Crop	Country	Anchor firm	Participants		
	Year	Start	End				Enumerators	Supervisors	Other
1	2020	3-Sep	5-Sep	Coffee	Honduras	Coffee Planet	11	3	TNS (3) CIAT (5)
						RGC	3	1	
2		9-Sep	11-Sep	Coffee	Guatemala	Volcafé	8	1	TNS (3) CIAT (5)
3				Coffee		Unex	12	2	
4		23-Sep	25-Sep	Coffee	Guatemala	OLAM	13	1	TNS (2) CIAT (2)
5				Coffee	Nicaragua	ECOM	5	1	TNS (1) CIAT (2)
6		1-Oct	3-Oct	Cacao	Peru	Agrotec Coffees	3	1	TNS (2) CIAT (5)
						ECOM-CAMSA	3	1	
						APPCACAO	7	1	
7		6-Oct	8-Oct	Cacao	Ecuador	Fortaleza	3	1	TNS(1) CIAT(2)
						ANECACAO	3	1	
						UNOCACE	3	1	
						APEOSAE	1	1	
						APECAP	1	1	
8		7-Oct	9-Oct	Coffee	Nicaragua	Aldea Global	9	2	TNS(3) CIAT(2)
						Mercon-TNS	4	1	
9		21-Oct	23-Oct	Cacao	El Salvador	Independent farmers	10	1	TNS(3) CIAT(4)
					Honduras	Fenaprocacaho	6	1	
					Ecuador	ECONUTRITION	1	1	
						ANECACAO	2	0	
						APECAP	1	0	
						APEOSAE	1	0	
10		28-Oct	30-Oct	Coffee	Peru	OLAM	7	1	TNS(2) CIAT(3)
11		18-Nov	20-Nov	Coffee	Peru	RGC-Coop Flor de café	2	0	TNS(3) CIAT(2)
						RGC-APROCOYCE	1	0	TNS(3) CIAT(2)
12				Cacao	Ecuador	OLAM	3	2	TNS(2) CIAT(2)
						UNOCACE	2	0	TNS(2) CIAT(2)
					Guatemala	Cacao Verapaz	5	1	TNS(2) CIAT(2)
13		25-Nov	27-Nov	Coffee	Peru	Valle Verde	2	2	TNS(3) CIAT(2)
						Monte Verde	1		TNS(3) CIAT(2)
						Alta Montaña	1		TNS(3) CIAT(2)

						Laguna de los Cóndores	2		TNS(3) CIAT(2)
14		7-Dec	9-Dec	Cacao	Ecuador	UNOCACE	2	0	TNS(2) CIAT(2)
15	2021	5-Apr	8-Apr	Coffe e	Peru	APPROCASSI	1	1	TNS(4), CIAT(2)
						CECAFE	7	1	
						L.P.CHIRINOS	4	0	
						UNICAFEC	3	1	
						Cenfrocafe	4	0	
						LIMCOF	4	1	
16		2-Jun	4-Jun	Coffe e	Nicaragua	FDL	10	2	TNS(3), CIAT(5)
					El Salvador	BFA	4	0	TNS(3), CIAT(5)
						CSC	7	1	TNS(3), CIAT(5)
17		7-Jun	9-Jun	Coffe e	Nicaragua	MERCON	3	1	TNS(2), CIAT(3)
18		7-Jun	9-Jun	Cacao	Nicaragua	APAC	3	1	LWR (1) , CIAT (2)
						ASIHERCA	1		
						CACAONICA R L	3		
						CACHERCAM R L	3		
						COODEPROSA	1		
						Cooperativa 20 de abril R L	1		
						Cooperativa Flores del campo R L	1		
						COOPROCAFU C R L	2		
						COOSEMUCRIM R L	1		
						UCA AHMED CAMPOS	1		
						UCA SOPPEXCCA	1		
19		15-Jun	17-Jun	Cacao	Ecuador	OLAM	8	1	LWR (1) , CIAT (4)
						ECONUTRITION	1	0	
20		8-Jul	12-Jul	Coffe e	Honduras	BECAMO	8	1	TNS(1), CIAT(4)

Table A 3. Coffee: MOCCA indicators by El Salvador anchor firms and sex of household head, at baseline

Key indicators	BFA				CSC				Country			
	Female	Male	Total	p-value	Female	Male	Total	p-value	Female	Male	Total	p-value
USDA indicators												
Yield (kg green coffee/ha)	124.46	269.60	212.88	0.007***	123	157	144	0.3189	131.46	200	179.63	0.0199**
Coffee area (ha)	5.11	5.38	5.28	0.8198	2.83	2.47	2.61	0.5720	3.13	3.46	3.34	0.5556
Farmers (%) with access to financing for agriculture	n.a.	n.a.	n.a.	n.a.	4.16	1.72	2.65	0.3142	2.70	1.11	1.72	0.3151
Value of annual coffee sales (US$)	1371	1438	1412	0.8953	1657	1384	1488	0.4942	1556	1403	1462	0.6239
Annual amount of coffee sold (kg green coffee)	275	498	412	0.0112**	296	321	312	0.7477	288	388	350	0.0872*
Farmers (%) with access to improved markets thru MOCCA's anchor firms	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Anchor firm indicators												
Farmers (%) who know the quality of their coffee	2.56	7.93	5.88	0.2669	5.55	0.86	2.65	0.0522*	4.50	3.35	3.79	0.6189
Farmers (%) who received a premium for their coffee quality	0.00	0.00	0.00	n.a.	1.38	0.00	0.53	0.2052	0.90	0.00	0.34	0.2047
Farmers (%) with any certification	2.56	3.17	2.94	0.8609	0.00	0.86	0.53	0.4323	0.90	1.67	1.37	0.5838
Total income (US$)	2550	2180	2311	0.5122	2615	2249	2389	0.3998	2592	2225	2365	0.2844
Household income (US$)	1371	1438	1412	0.8953	1931	1590	1721	0.3987	1734	1537	1612	0.5317
Non-agricultural income (US$)	1179	742	909	0.1449	683	659	668	0.8824	857	688	753	0.2617
Number of households	**39**	**63**	**102**		**72**	**116**	**188**		**111**	**179**	**290**	

Table A 4. Coffee: MOCCA indicators by Guatemala anchor firms and sex of household head, at baseline

Key indicators	OLAM				UNEX				VOLCAFE				Country			
	Female	Male	Total	p-value	Female	Male	Total	p-value	Female	Male	Total	p-value	Female	Male	Total	p-value
USDA indicators																
Yield (kg green coffee/ha)	739	891	857	0.090*	607	688	673	0.2635	404	475	449	0.3970	575	722	686	0.003***
Coffee area (ha)	1.02	1.49	1.39	0.085*	1.21	1.11	1.13	0.8082	0.36	0.91	0.71	0.000***	0.80	1.21	1.10	0.014**
Farmers (%) with access to financing for agriculture	0.00	10.66	8.28	0.044**	0.00	0.00	0.00	n.a.	2.22	2.60	2.46	0.8983	0.93	4.60	3.69	0.079*
Value of annual coffee sales (US$)	2029	4673	4084	0.011**	1119	1957	1806	0.2207	278	1275	907	0.032**	1063	2812	2377	0.000***
Annual amount of coffee sold (kg green coffee)	758	1763	1539	0.008***	488	755	707	0.2980	120	563	399	0.021**	440	1109	945	0.000***
Farmers (%) with access to improved markets thru MOCCA's anchor firms	37.14	33.33	34.19	0.6783	0.00	0.00	0.00	n.a.	0.00	0.00	0.00	n.a.	13.68	13.16	13.28	0.8954
Anchor firm indicators																
Farmers (%) who know the quality of their coffee	0.00	10.66	8.28	0.044**	3.57	0.79	1.29	0.2401	0.00	7.79	4.92	0.056*	0.93	6.13	4.84	0.029**
Farmers (%) who received a premium for their coffee quality	0.00	2.46	1.91	0.3521	0.00	0.00	0.00	n.a.	0.00	1.30	0.82	0.4469	0.00	1.23	0.92	0.2485
Farmers (%) with any certification	2.86	8.20	7.01	0.2782	0.00	2.36	1.94	0.4148	0.00	0.00	0.00	n.a.	0.93	3.99	3.23	0.1191
Total income (US$)	2324	4983	4390	0.015**	1209	2042	1892	0.2274	422	1312	984	0.056*	1242	2971	2540	0.000***
Agricultural Income (US$)	2029	4732	4121	0.0094	1124	1982	1820	0.2141	262	1290	916	0.028**	1065	2855	2403	0.000***
Non-agricultural income (US$)	295	311	307	0.9376	85	66	69	0.7457	146	23	67	0.009***	179	148	156	0.6818
Number of households	**35**	**120**	**155**		**28**	**120**	**148**		**44**	**77**	**121**		**107**	**317**	**424**	
Note: p-value in parenthesis, and differences in means between groups are significant at the 10% level (*), 5% level (**) or 1% level (***)																
*1 ha (hectare) = 10,000 square meters																

Table A 5. Coffee: MOCCA indicators by Honduras anchor firms and sex of household head, at baseline

Key indicators	BECAMO				COFFEE PLANET				RGC				Country			
	Female	Male	Total	p-value	Female	Male	Total	p-value	Female	Male	Total	p-value	Female	Male	Total	p-value
USDA indicators																
Yield (kg green coffee/ha)	715	843	805	0.1373	1002	819	853	0.1830	835	897	882	0.6114	850	822	829	0.6913
Coffee area (ha)	4.97	5.16	5.10	0.9047	1.49	1.81	1.75	0.3690	2.31	2.64	2.56	0.5522	3.04	3.00	3.01	0.9381
Farmers (%) with access to financing for agriculture	10.81	17.04	15.20	0.3795	0.00	1.88	1.54	0.4169	13.04	5.71	7.53	0.2525	7.36	7.14	7.19	0.9409
Value of annual coffee sales (US$)	7277	7068	7130	0.8994	3439	3986	3888	0.5774	4923	6080	5794	0.4421	5306	5200	5225	0.8895
Annual amount of coffee sold (kg green coffee)	3043	2547	2695	0.4029	1036	1338	1283	0.3517	1663	2538	2317	0.2323	1974	1938	1946	0.9033
Farmers (%) with access to improved markets thru MOCCA's anchor firms	2.70	0.00	0.80	0.1235	20.00	16.23	17.00	0.5941	43.48	45.45	44.94	0.8715	18.94	17.53	17.86	0.7537
Anchor firm indicators																
Farmers (%) who know the quality of their coffee	13.51	25.00	21.60	0.1568	11.43	18.75	17.44	0.3036	4.35	10.00	8.60	0.4071	10.52	18.50	16.62	0.0681*
Farmers (%) who received a premium for their coffee quality	8.10	9.09	8.80	0.8609	0.00	5.63	4.62	0.1524	0.00	0.00	0.00	n.a.	3.15	4.87	4.46	0.4812
Farmers (%) with any certification	56.75	54.54	55.2	0.8222	31.43	24.38	25.64	0.3893	8.70	21.43	18.28	0.1741	35.78	32.79	33.49	0.5895
Total income (US$)	7961	7507	7641	0.7886	3984	3983	3976	0.9691	5078	6544	6182	0.3364	5784	5572	5622	0.7865
Household income (US$)	7278	7070	7132	0.9004	3439	3684	3638	0.7696	4974	6114	5832	0.4493	5306	5204	5228	0.8939
Non-agricultural income (US$)	683	437	509	0.2315	509	298	338	0.2962	104	430	349	0.2487	137	96	105	0.1933
Number of households	**37**	**88**	**125**		**35**	**150**	**185**		**23**	**70**	**93**		**95**	**308**	**403**	
Note: p-value in parenthesis, and differences in means between groups are significant at the 10% level (*), 5% level (**) or 1% level (***)																
*1 ha (hectare) = 10,000 square meters																

Table A 6. Coffee: MOCCA indicators by Nicaragua anchor firms and sex of household head, at baseline

Key indicators	ALDEA GLOBAL				ECOM				FDL				MERCON-TNS			
	Female	Male	Total	p-value	Female	Male	Total	p-value	Female	Male	Total	p-value	Female	Male	Total	p-value
USDA indicators																
Yield (kg green coffee/ha)	546	776	743	0.086*	357	623	571	0.079*	824	695	716	0.4033	923	632	651	0.2147
Coffee area (ha)	2.59	3.57	3.43	0.3497	3.59	3.43	3.46	0.8777	3.35	5.30	4.99	0.1038	2.67	4.86	4.71	0.4746
Farmers (%) with access to financing for agriculture	47.37	51.35	50.77	0.7506	7.69	16.00	14.29	0.4538	7.14	26.02	22.98	0.1269	50.00	39.29	40.00	0.6789
Value of annual coffee sales (US$)	4531	8473	7897	0.1916	3258	4871	4538	0.4362	5186	8924	8323	0.2700	6172	10070	6384	0.9507
Annual amount of coffee sold (kg green coffee)	2302	3233	3097	0.1506	1980	2049	2035	0.9350	2448	2894	2822	0.5682	2425	2886	2854	0.7689
Farmers (%) with access to improved markets thru MOCCA's anchor firms	94.74	95.50	95.38	0.8853	9.09	14.58	13.56	0.6383	14.28	17.80	17.24	0.7527	100.00	90.74	91.23	0.5890
Anchor firm indicators																
Farmers (%) who know the quality of their coffee	0.00	1.80	1.54	0.559	0.00	4.00	3.17	0.4717	0.00	2.73	2.29	0.5364	0.00	1.79	1.67	0.7918

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Farmers (%) who received a premium for their coffee quality	0.00	0.00	0.00	n.a.	0.00	0.00	0.00	n.a.	0.00	0.00	0.00	n.a.	0.00	0.00	0.00	n.a.
Farmers (%) with any certification	57.89	37.84	40.77	0.1017	30.77	40.00	38.10	0.5490	57.14	24.65	29.88	0.014**	0.00	5.36	5.00	0.6417
Total income (US$)	4875	8608	8062	0.2172	3768	4987	4736	0.5531	5688	9162	8603	0.3023	6256	10370	6639	0.7759
Household income (US$)	4549	8504	7926	0.1907	3280	4873	4535	0.4423	5363	9023	8434	0.2797	6256	10208	9945	0.7848
Non-agricultural income (US$)	326	103	136	0.0557*	488	115	192	0.0235	325	140	169	0.2246	0	162	151	0.4773
Number of households	**19**	**111**	**130**		**13**	**50**	**63**		**14**	**73**	**87**		**4**	**56**	**60**	
Note: p-value in parenthesis, and differences in means between groups are significant at the 10% level (*), 5% level (**) or 1% level (***)																
*1 ha (hectare) = 10,000 square meters																

Table A 6. Continued

Key indicators	MERCON COHORT 2				Country			
	Female	Male	Total	p-value	Female	Male	Total	p-value
USDA indicators								
Yield (kg green coffee/ha)	1059	1174	1155	0.795	666	754	741	0.3204
Coffee area (ha)	3.10	3.31	3.28	0.8448	3.07	4.13	3.97	0.0851*
Farmers (%) with access to financing for agriculture	57.14	44.44	46.51	0.5488	29.82	37.42	36.29	0.2722
Value of annual coffee sales (US$)	6261	7729	7490	0.5934	4729	8214	7695	0.0954*
Annual amount of coffee sold (kg green coffee)	2572	3271	3157	0.5844	2312	2923	2833	0.1238
Farmers (%) with access to improved markets thru MOCCA's anchor firms	85.71	83.33	83.72	0.8795	52.63	62.88	61.35	0.1433
Anchor firm indicators								
Farmers (%) who know the quality of their coffee	0.00	2.77	2.32	0.6646	0.00	2.45	2.08	0.2331
Farmers (%) who received a premium for their coffee quality	0.00	0.00	0.00	n.a.	0.00	0.00	0.00	n.a.
Farmers (%) with any certification	71.42	58.33	60.46	0.5281	49.12	31.9	34.46	0.011**
Total income (US$)	7176	7948	7822	0.7782	5202	8406	7929	0.1246
Household income (US$)	6262	7740	7499	0.5918	4790	8272	7753	0.0958*
Non-agricultural income (US$)	914	208	323	0.014**	412	135	176	0.000***
Number of households	**7**	**36**	**43**		**57**	**326**	**383**	

Table A 7. Coffee: MOCCA indicators by Peru anchor firms and sex of household head, at baseline

Key indicators	MIDAGRI				OLAM/NESPRESSO				RGC				Country			
	Female	Male	Total	p-value	Female	Male	Total	p-value	Female	Male	Total	p-value	Female	Male	Total	p-value
USDA indicators																
Yield (kg green coffee/ha)	1048	786	837	0.049**	462	350	368	0.094*	493	532	515	0.4614	788	657	687	0.1151
Coffee area (ha)	2.55	2.81	2.76	0.2319	2.01	2.22	2.18	0.5103	2.18	2.27	2.23	0.7038	2.36	2.62	2.56	0.0867*
Farmers (%) with access to financing for agriculture	7.5	11.21	10.48	0.3322	0.00	3.51	2.96	0.3873	0.00	0.00	0.00	n.a.	4.02	8.13	7.19	0.0885*
Value of annual coffee sales (US$)	6028	7042	6844	0.1923	4031	5042	4890	0.2861	4955	5760	5401	0.3125	5407	6438	6203	0.047**
Annual amount of coffee sold (kg green coffee)	1812	2046	2000	0.2001	1106	1425	1376	0.2219	1653	2035	1865	0.1049	1664	1906	1850	0.0587*
Farmers (%) with access to improved markets thru MOCCA's anchor firms	28.75	34.24	33.17	0.3504	19.05	34.82	32.33	0.1585	97.96	70.97	82.88	0.000***	50.33	38.88	41.50	0.0127
Anchor firm indicators																
Farmers (%) who know the quality of their coffee	63.75	63.93	63.90	0.9748	57.14	56.14	56.30	0.9328	16.33	30.65	24.32	0.082*	46.97	58.13	55.58	0.016**
Farmers (%) who received a premium for their coffee quality	17.50	16.06	16.34	0.7555	0.00	5.26	4.44	0.2856	4.08	9.68	7.21	0.2617	10.73	12.89	12.40	0.4833
Farmers (%) with any certification	73.75	86.06	83.65	0.007***	71.43	85.96	83.70	0.0988	81.63	87.10	84.68	0.4319	75.83	86.11	83.76	0.002***

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Total income (US$)	6118	7147	6946	0.1859	4118	5127	4975	0.2856	5212	5866	5574	0.4129	5551	6539	6314	0.0572*
Agricultural Income (US$)	6028	7045	6846	0.191	4031	5050	4897	0.2822	4976	5772	5417	0.3181	5414	6443	6208	0.047**
Non-agricultural income (US$)	89	102	100	0.7497	87	77	79	0.8726	236	94	157	0.1180	137	96	105	0.1933
Number of households	**80**	**330**	**410**		**20**	**113**	**133**		**49**	**61**	**110**		**149**	**504**	**653**	

Note: p-value in parenthesis, and differences in means between groups are significant at the 10% level (*), 5% level (**) or 1% level (***)

*1 ha (hectare) = 10,000 square meters

Table A 8. Coffee: list of MOCCA-promoted practices,* and practices evaluated

Module #	Practice #	Practice detail	Adoption level according to MOCCA curricula		Included in evaluation?
			Well	Optimal	
2	1	Fertilizes based on nutritional deficiencies	Uses table of visible symptoms	Uses soil analysis	Yes
2	2	In young non-productive plants: frequency of fertilization	3 times/year	4 times/year	Yes
2	3	In productive plants: frequency of fertilization	2 times/year	3 times/year	Yes
2	4	Dosis of fertilizer	Applied partial amount required	Applied full amount required	Yes
2	5	In young non-productive plants: fertilizer applied at right time	Fertilized in june, september and november	Fertilized in june, september and november	Yes
2	6	In productive plants: fertilizer applied at right time	Fertilized between may-june and july-september	Fertilized between may-june, july-september and sept-oct	Yes
2	7	Place of fertilizer application	Randomly spread close to roots (al voleo)	Under the treetop (bajo la copa) or in fertilization band (banda de abonamiento)	Yes
2	8	Uses methods to reduce fertilization costs	Applies organic fertilizer prepared with farm waste, OR dilutes fertilizer	Applies organic fertilizer prepared with farm waste, AND dilutes fertilizer	Yes
3	1	Implements any pest & disease monitoring system	If yes	Applies a standardized sampling protocol	Yes

3	2	Uses methods to control pests	Uses at least one method for each pest identified	Uses more than one method for each pest identified	Yes
3	3	Uses methods to control diseases	Uses at least one method for each disease identified	Implements a strategy according to the disease identified	Yes
3	4	Did field evaluation for berry borer (Broca), and <10% incidence	If yes	Has a standardized protocol	Yes, level good only as no data collected for level optimal

Table A 8. Continued

Module #	Practice #	Practice detail	Adoption level according to MOCCA curricula		Included in evaluation?
			Well	Optimal	
4	1	Existing coffee shadow system	25% shadow, OR if have not planted shadow trees recently (few years ago)	Considers farm location and environmental conditions to regulate shadow, AND (adequate shadow, OR if have not planted shadow trees recently)	Yes
4	2	Coffee shadow management	Does shadow management/pruning	Does shadow management/pruning after harvest (before rains)	Yes
5	1	Does soil conservation practices	Does at least one MOCCA-recommended practice	Does 2 or more MOCCA-recommended practices	Yes
5	2	Implements cost-saving practices to control weeds	Does at least one practice	Does 2 or more practices	Yes
6	1	Coffee harvest practices	Selective harvest according to field sample indicating 75% of ripped berries	Selective harvest according to field sample indicating 85% of ripped berries AND implements repela and pepena practices to reduce risk of berry borer	Yes
6	2	Coffee cherry pulp removal	Removed pulp same day it was harvested	Removed pulp without water and transported the pulp not using water (i.e., dry method)	Yes

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6	3	Coffee fermentation	Coffee fermented for ≤12 hrs	Coffee fermented for more than 12 hrs	Yes
6	4	Coffee beans drying	Dried in a patio (no infrastructure)	Dried using an infrastructure	Yes
6	5	Coffee beans moisture measurement	12% moisture, measured using touch and visual methods	12% moisture, measured using an instrument	Yes
7	1	Seed selection	Selected from outstanding, highly-productive plants, OR purchases genetic material from a certified/verified nursery	Selected plants considering environmental factors, pests and diseases incidence, and market demand	Yes

Table A 8. Continued

Module #	Practice #	Practice detail	Adoption level according to MOCCA curricula		Included in evaluation?
			Well	Optimal	
7	2	Substrate mix for the establishment of seed germinators	Mix has at least 30% sand	Uses MOCCA-recommended mix (50% sand, 30% org. matter, 20% soil)	Yes
7	3	Substrate mix disinfection	Disinfects substrate mix	Follows MOCCA recommendations (solarization or boiling water)	Yes
7	4	Plant selection for transplant (renovation or replacement)	Follows 2 criteria: chooses plants free of pests and diseases AND chooses vigorous/robust plants	Follows 3 criteria: chooses plants free of pests and diseases AND chooses vigorous/robust plants AND plants have 4-6 pairs of leaves	Yes
8	1	Does renovation & rehabilitation in the farm	Does pruning and/or renovation	Does pruning and/or renovation based on farm diagnosis	Yes
9	1	Knows varieties planted	Knows varieties planted	Acquires variety from a certified provider	Yes
9	2	Coffee planting density	Planted according to variety need	Planted according to variety need as recommended by MOCCA	Yes

9	3	Plantation design and establishment	Renovates sick and unproductive (>20 yr old) trees	Established crop considering land location, water and soil conservation practices, and sick and unproductive (>20 yr) trees	No, as no data collected
10	1	Uses a production/farm diagnosis to decide whether to prune coffee trees	Does at least 1 type of pruning	Does >1 types of pruning and has a farm diagnosis	Yes
11	1	Application of MOCCA-recommended nutritional formulas	Applies at least 1 of these: organic fertilizer, compost, diluted fertilization	Applies 2 or more of these: organic fertilizer, compost, diluted fertilization	Yes
11	2	Applies correct dosis of MOCCA-recommended nutritional formulas	Applies partial dosis per plant	Applies full dosis per plant	No, as no data collected
13	1	Systematically registers costs of production	If uses any tool to register costs	Uses cost information to make farming decisions	Yes, level good only as no data collected for level optimal
15	1	Same as Module 6, practice 1			Yes

Table A 8. Continued

Module #	Practice #	Practice detail	Adoption level according to MOCCA curricula		Included in evaluation?
			Well	Optimal	
15	2	Classification of coffee cherries after harvest	Coffee was classified (separated good from low-quality cherries)	Coffee was classified (separated good from low-quality cherries)	Yes
15	3	Same as Module 6, practice 3			Yes
15	4	Same as Module 6, practice 4			Yes
16	1	Same as Module 6, practice 2			Yes
16	2	Waste water treatment	Does any waste water treatment	Has a protocol (or recipe) to treat waste water	Yes
16	3	Pulp treatment	If manages (treats) the pulp	Has infrastructure to make pulp compost	Yes

16	4	Treatment of waste water from wet milling	If manages (treats) the water from wet milling	Has a protocol to manage waste water from milling AND has infrastructure on farm for this	Yes
17	1	Coffee buyers			Yes
17	2	Form how coffee was sold (cherry, wet, dry, etc.)			Yes
17	3	Received price premium due to coffee quality?			Yes
18	1	Knows cup grade (taza)			Yes
18	2	Received feedback about their cup grade			No, as no data collected
18	3	Knows which production and post-harvest practices affect cup grade			Yes
20	1	Farm certifications			Yes
***Taken from MOCCA training curricula**					

Table A 9. Coffee: overall adoption of MOCCA-promoted practices at baseline

MOCCA-promoted practices*	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) adopting any practice (out of 33 total)	100	100	100	100	100	100
Farmers (%) adopting <10 practices	56.32	45.49	38.17	13.74	11.37	29.64
Farmers (%) adopting >10-19 practices	43.03	41.32	53.16	73.69	68.38	57.77
Farmers (%) adopting >20 practices	0.63	13.19	8.66	12.55	20.23	12.58
# of practices adopted, and…:	10.01	12.18	12.54	14.89	15.97	13.58
# practices adopted at level good	5.03	6.98	6.77	8.02	8.15	7.15
# practices adopted at level optimum	4.85	5.13	5.53	6.68	7.57	6.25
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**
*Levels well or optimally as defined by MOCCA's criteria (see training curriculum for details)						

Table A 10. Coffee: managing of seed beds and nurseries at baseline

Seed beds and nursery characteristics	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Seed bed						
Farmers (%) managing a coffee seed bed in their farms, and...:	0.63	95.77	8.49	40.28	26.77	35.85
Amount (kg) of seed planted	0.34	2.15	2.29	3.13	1.89	2.44
For farmers with seed beds or acquiring coffee seed, source (%):						
Purchased	16.66	28.78	21.95	8.12	17.98	15.98
Free seed	33.33	28.78	12.19	7.61	13.15	13.19
Selected from outstanding trees in their farm	16.66	37.87	60.97	67	61.40	60.03
Selected from any tree in their farm	0	6.06	0	20.3	9.64	12.26
Obtained from NGO or government program	16.66	3.03	7.31	1.52	0.43	1.85
Obtained from other sources	16.66	3.03	2.43	0.50	0.87	1.30
For farmers buying coffee seed:						
% who know where they can acquire certified or verified planting material	0	21.53	45.23	17.76	22.36	22.11
% purchasing certified seed	0	13.63	40	25	12.19	17.77
Amout (kg) of seed purchased	2.27	2.21	4.23	3	8.58	5.70
Price paid per kg	4.54	3.44	1.79	0.89	8.46	4.53
% stating the seed quality was well or excellent	57.14	75.8	88.37	82.32	85.26	82.95
Nursery						
Farmers (%) managing a coffee nursery in their farms, and...:	0.95	10.44	8.25	37.44	29.73	19.41
# seedlings (plants)	666.66	5572.34	3644.34	4129.77	3461.33	3918.20
For farmers with nurseries or acquiring coffee seedlings, % reporting:						
Seedlings coming from own seedbeds	4.34	42.7	57.37	87.36	79.31	68.73
Buying the seedlings	0.00	51.04	39.34	6.04	12.64	18.11
Obtaining seedlings for free (NGO, relatives, friends, etc.)	67.39	3.12	3.27	6.59	2.68	8.51
Obtaining seedlings from other sources	28.26	4.16	0	1.64	5.74	5.41
For farmers buying coffee seedlings, % reporting this source:						
Neighbor	4.34	42	32	75	45.45	32.09
Certified nursery	4.34	12	12	0	30.30	12.96
Non-certified nursery	65.21	44	20	25	21.21	40.74
Other source	26.08	2	36	0	3.03	14.19

Table A 10. Continued

Seed beds and nursery characteristics	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
For farmers not buying from certified nurseries, % who know where to acquire certified or verified plants	2.27	22	36.84	14.45	19.48	17.91
For farmers buying coffee seedlings:						
Amount (#) of seedlings purchased	200	1740	1843.87	964.94	1477.30	1571.51
Price paid per unit	0.00	0.30	0.14	0.60	0.50	0.36
% stating the seedlings quality was well or excellent	76.08	76.76	88.52	82.60	80.93	81.14
Seed bed & nursery						
For farmers buying either seed or seedlings, % willing to pay more for a certified or verified genetic material	50	43.39	57.50	22.56	68.94	49.16
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**

Table A 11. Coffee: characteristics of farms in the baseline year

Farm characteristics	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Total farm area (ha), and area (ha) under…:	4.23	1.56	3.84	7.90	3.51	4.03
Coffee	3.34	1.07	2.91	3.94	2.54	2.74
Cacao	0.03	0.11	0.1	0.54	0.06	0.16
Temporary (short cycle) crops	0.18	0.02	0.01	0.52	0.02	0.13
Permanent crops	0.03	0.01	0.02	0.14	0.04	0.04
For grazing or forage	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Rented out	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Fallow (>1 year unused)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Non-agricultural (house, warehouse, etc.)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Forest	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other uses	1	0.34	0.79	2.74	0.84	1.08
Households with more than one farm (%)						
# of plots with (all) crops	1.25	1.63	1.80	2.55	1.77	1.82
Households (%) with…:						
One coffee plot	91.11	68.69	62.2	50.23	54.2	62.88
Two coffee plots	7.91	18.91	19.48	27.96	30.42	22.58
Three or more coffee plots	0.94	12.38	18.3	21.8	15.36	14.52
Farmers (%) doing a diagnosis of their farm or coffee crop	6.36	30.50	22.22	25.53	33.49	25.39
Farmers (%) not pruning coffee trees in the 2019-2020 ag. year, and main reason (%) for not pruning:	56.01	44.59	42.58	31.59	26.22	37.99
Don't know how to do it	2.84	18.75	13.06	4.06	9.65	10.20
Does not consider this relevant	4.54	16.66	7.95	13	2.27	8.77
Too costly	21.59	2.08	1.70	8.13	3.97	7.35
Coffee trees did not need pruning	47.72	57.81	63.06	64.22	58.52	57.88
Did not have time	18.18	8.85	9.65	9.75	24.43	14.35
No resources (human or financial)	8.52	5.72	7.95	8.94	10.79	8.30
Other reason	0.31	0	0.93	0.23	0.14	0.30
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**
*1 ha (hectare) = 10,000 square meters						

Table A 12. Coffee: use of fertilizers, pesticides and herbicides during the baseline year

Input use characteristics	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) applying fertilizers in baseline year, and % farmers…:	90.48	92.00	94.93	86.54	77.09	88.21
Applying only chemical fertilizers	84.56	88.89	69.08	96.70	6.72	65.01
Applying only organic fertilizers	11.23	1.69	3.74	0.27	50.1	15.4
Applying chemical and organic fertilizers	4.21	9.42	27.18	3.02	43.18	19.59
Most commonly used fertilizer according to the amount applied, and…:	Triple 15	18-16-12	Nutricafe	20-5-20	Guano de Isla	Guano de Isla
% farmers applying this fertilizer	22.46	28.81	12	33.70	26.12	6.56
# times it was applied during the agricultural year	1.90	1.76	1.70	1.55	1.54	1.54
Farmers (%) applying pesticides (insects or diseases) in baseline year	89.02	91.32	40.93	78.18	1.07	46.53
Main insect pests or diseases affecting the coffee crop (% farmers):						
Berry borer	60.72	16.85	63.26	42.85	68.79	51.45
Leaf rust	90.68	85.45	78.10	21.3	38.71	58.19
Anthracnose (muerte descendente)	1.21	16.16	1.94	10.65	4.87	13.65
Coffe spot/berry blotch/brown eye spot (mancha de hierro)	6.88	18.24	14.07	25.42	5.48	7.26
Leaf spot (gotera)	0.00	0.46	0.00	12.59	5.94	4.30
Fumagina (ants)	0.40	6.00	2.43	0.72	2.89	2.73
Other	2.83	11.77	1.45	47.21	22.83	18.92
For the first insect pest, % farmers…:						
Doing field evaluation	44.67	56.16	46.15	53.67	44.25	47.03
Reporting <10% incidence	44.00	43.9	75.00	59.13	62.31	59.77
Reporting 11-30% incidence	46.00	36.59	21.09	33.91	28.16	31.30
Reporting 31-50% incidence	10.00	12.2	3.91	4.35	6.65	6.78
Reporting >50% incidence	0.00	7.32	0.00	2.61	2.88	2.15
Not controlling it	5.33	4.88	8.59	8.70	21.73	14.58
Using cultural control	11.33	4.88	38.28	14.78	61.86	41,13
Using biological control	3.33	0.00	3.13	1.74	7.54	5.08
Using chemical control	76.67	87.80	25.78	53.04	0.44	27.91
Using etological control	0.67	2.44	4.69	3.48	0.89	1.81
Using other control methods	2.67	0.00	19.53	18.26	7.54	9.49

Table A 12. Continued

Input use characteristics	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
For the second insect pest, % farmers…:						
Doing field evaluation	100.00	61.54	30.00	33.33	47.37	50.85
Reporting <10% incidence	0.00	43.75	100.00	100.00	84.21	68.29
Reporting 11-30% incidence	100.00	56.26	0.00	0.00	15.79	31.71
Reporting 31-50% incidence	0.00	0.00	0.00	0.00	0.00	0.00
Reporting >50% incidence	0.00	0.00	0.00	0.00	0.00	0.00
Not controlling it	0.00	6.25	0.00	0.00	31.58	17.07
Using cultural control	0.00	0.00	66.67	50.00	47.37	29.27
Using biological control	100.00	0.00	0.00	0.00	10.53	7.32
Using chemical control	0.00	93.75	33.33	50.00	10.53	46.34
Using etological control	0.00	0.00	0.00	0.00	0.00	0.00
Using other control methods	0.00	0.00	0.00	0.00	0.00	0.00
For the first disease, % farmers…:						
Doing field evaluation	34.82	56.49	46.11	47.73	31.10	44.23
Reporting <10% incidence	43.30	36.19	71.95	50.00	53.15	50.00
Reporting 11-30% incidence	44.20	36.67	23.17	26.79	37.01	35.57
Reporting 31-50% incidence	11.16	17.14	4.88	16.07	6.69	10.46
Reporting >50% incidence	1.34	10.00	0.00	7..14	3.2	3.96
Not controlling it	5.80	6.19	8.54	10.71	29.53	13.33
Using cultural control	9.82	3.33	34.76	5.36	54.72	25.11
Using biological control	5.8	0.00	3.66	0.00	2.36	2.75
Using chemical control	76.34	90.00	35.37	76.79	0.79	50.99
Using other control methods	2.24	0.48	17.68	7.15	12.59	7.82
For the second disease, % farmers…:						
Doing field evaluation	30.00	56.45	29.41	52.94	53.85	45.24
Reporting <10% incidence	23.53	20.51	66.67	56.63	53.03	48.7
Reporting 11-30% incidence	55.94	56.41	27.78	37.35	34.85	38.86
Reporting 31-50% incidence	11.76	17.95	5.56	3.61	6.06	9.33
Reporting >50% incidence	11.76	5.13	0.00	2.41	6.06	3.11
Not controlling it	11.76	10.26	16.67	12.05	21.21	17..10
Using cultural control	0.00	5.13	33.33	15.66	59.09	21.24
Using biological control	0.00	0.00	11.11	0	1.52	1.55
Using chemical control	88.24	84.62	38.39	65.06	0	56.48
Using other control methods	0.00	0.00	0.00	7.23	18.19	3.63
Farmers (%) applying herbicides in the 2019-2020 agricultural year, and…:	19.3	32.22	19.2	75.12	98.38	26.40
Applying it focalized/using screen	68.69	48.36	68.91	56.19	n.a.	57.46
Farmers (%) using weed-wacker	12.97	41.11	27.4	16.39	67.06	37.80
Farmers (%) scheduling weed control	29.75	34.89	30.68	45.50	31.91	34.47
Farmers (%) making selective weed control	6.33	21.78	22.95	33.41	8.42	18.06

Number of households	**316**	**455**	**427**	**422**	**677**	**2297**

Table A 13. Coffee: access to products of coffee research at baseline

Details	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) who reported ever receiving information about coffee research products	45.55	12.72	13.58	16.58	7.1	16.44
Source of this information (%):						
Internet	2.09	12.28	48.27	10.00	16.66	14.09
Neighbor or relative	2.79	21.05	5.17	14.28	4.16	8.24
NGO	74.12	42.1	12.06	47.14	12.50	46.80
Government or extensionist	20.27	19.29	32.75	8.57	60.41	25.00
Other	0.69	5.26	1.72	20.00	6.25	5.85
Farmers (%) reporting this information cost them	9.09	5.55	19.29	24.28	8.51	12.93
Farmers (%) using this information to make farming decisions	97.9	83.33	84.21	72.85	91.48	88.14
If did not use this information, why not? (%):						
Was not useful	0.00	33.33	44.44	63.15	25.00	44.44
Difficult to understand	0.00	33.33	22.22	5.26	50.00	17.77
Could not implement the recommendations	75.00	33.33	11.11	15.78	0.00	22.22
None of the recommendations were needed in my farm	0.00	0.00	22.22	15.78	26.00	13.33
Other reason	25.00	0.00	0.00	0.00	0.00	2.22
When in need of technical advice for coffee, farmers (%) contacting...:						
No one	10.86	30.13	35.68	30.16	19.67	25.43
A relative	10.86	28.79	14.78	13.06	22.48	18.95
A neighbor with a coffee farm	22.04	29.91	17.37	10.21	15.82	18.69
NGO technician	54.95	12.94	23.70	38.47	14.79	25.96
Government technician	16.61	1.33	1.17	1.18	4.14	4.20
Other	1.27	3.34	13.38	12.11	33.87	15.58
For farmers contacting a technician, most common way to contact them (%):						
Visit to their office	1.05	7.69	1.90	10.77	24.24	8.96
Call over cellular	77.24	60.00	87.61	65.26	56.06	69.90
E-mail	1.05	0.00	0.00	0.00	0.00	0.30
Wait for them to visit me	20.10	27.69	10.47	23.35	18.18	19.75
Other	0.05	4.61	0.00	0.59	1.51	1.06
For farmers contacting no one to seek technical advice, % who...:						
Never clarify their doubts	17.14	38.4	51.29	35.87	47.4	41.98
Ask a relative/neighbor/friend for advise	20	26.08	16.23	29	32.59	25.29
Go to agro-dealer	60	33.33	30.51	25.19	14.81	28.16

Clarify doubts using other means	2.85	2.17	1.94	9.92	5.18	4.55
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**

Table A 14. Coffee: family and hired labor in coffee plots, at baseline

Use of labor/ha details	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Nursery activities						
Households (%) with members working on this activity, and...:	0.63	7.47	3.74	31.99	27.47	16.23
# people/ha	1.50	3.59	3.13	0.87	1.15	1.38
# of days worked in total/ha	10.50	25.97	10.52	3.02	4.32	5.93
Households (%) hiring labor to work on this activity, and...:	0.31	2.85	1.63	15.16	5.46	5.31
# people/ha	0.75	0.68	0.62	0.28	0.23	0.32
# of days worked in total/ha	1.50	17.99	3.89	1.81	2.10	3.67
Land preparation for planting						
Households (%) with members working on this activity, and...:	2.53	20.21	7.72	31.99	24.51	18.89
# people/ha	1.16	1.91	0.59	0.54	0.79	1.06
# of days worked in total/ha	3.45	28.26	5.55	2.74	4.82	9.25
Households (%) hiring labor to work on this activity, and...:	3.48	19.34	5.62	27.01	16.10	15.06
# people/ha	1.01	1.83	0.27	0.42	0.62	0.90
# of days worked in total/ha	5.07	35.82	5.83	3.16	22.14	17.77
Coffee planting (includes renovation)						
Households (%) with members working on this activity, and...:	4.11	5.93	2.34	21.32	16.39	10.92
# people/ha	1.60	1.52	0.95	1.05	1.27	1.21
# of days worked in total/ha	4.86	10.84	4.23	2.61	3.60	4.16
Households (%) hiring labor to work on this activity, and...:	3.16	5.71	3.27	17.53	8.56	7.92
# people/ha	1.50	1.39	0.94	0.74	0.58	0.82
# of days worked in total/ha	3.69	13.14	5.14	2.57	2.48	4.26
Weeding						
Households (%) with members working on this activity, and...:	55.69	61.09	51.05	72.03	82.57	66.82
# people/ha	1.82	3.89	1.57	1.03	1.50	1.96
# of days worked in total/ha	5.41	18.72	6.42	4.06	10.85	9.77
Households (%) hiring labor to work on this activity, and...:	48.73	55.60	63.70	61.37	61.89	59.07
# people/ha	1.72	3.65	2.41	0.81	1.69	2.07
# of days worked in total/ha	6.89	18.43	5.51	4.45	10.11	9.31
Coffee pruning (includes rehabilitation)						
Households (%) with members working on this activity, and...:	18.03	27.25	18.03	45.73	56.42	36.26
# people/ha	0.67	2.15	1.05	0.77	0.86	1.06
# of days worked in total/ha	2.49	12.95	3.13	2.74	3.82	4.77
Households (%) hiring labor to work on this activity, and...:	22.46	27.91	22.71	30.80	19.35	24.20
# people/ha	0.90	2.28	1.38	0.46	0.34	0.84

# of days worked in total/ha	3.30	16.76	2.81	2.82	3.20	6.13

Table A 14. Continued

Use of labor/ha details	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Fertilizer application						
Households (%) with members working on this activity, and...:	54.11	68.13	55.26	68.00	62.92	62.25
# people/ha	1.70	4.71	1.86	0.90	1.36	2.12
# of days worked in total/ha	6.17	12.89	3.71	2.14	4.03	5.78
Households (%) hiring labor to work on this activity, and...:	51.89	48.35	61.82	52.13	41.94	50.15
# people/ha	1.75	2.32	2.06	0.62	0.87	1.45
# of days worked in total/ha	6.29	12.08	2.86	2.22	3.39	5.12
Coffee milling/processing						
Households (%) with members working on this activity, and...:	2.21	32.30	22.71	71.80	75.18	46.27
# people/ha	0.74	4.05	2.60	1.20	1.28	1.85
# of days worked in total/ha	13.82	35.22	13.01	14.32	9.88	15.76
Households (%) hiring labor to work on this activity, and...:	1.26	25.93	14.51	37.44	16.83	19.85
# people/ha	0.74	4.18	4.29	2.44	0.47	2.00
# of days worked in total/ha	9.90	39.41	17.30	28.99	5.93	24.36
Coffee harvesting						
Households (%) with members working on this activity, and...:	69.62	72.30	66.74	75.11	93.50	77.66
# people/ha	2.02	9.52	6.28	2.29	3.22	4.70
# of days worked in total/ha	5.87	23.12	14.92	15.92	24.23	18.31
Households (%) hiring labor to work on this activity, and...:	66.77	60.43	80.79	87.91	85.52	77.53
# people/ha	2.71	9.08	9.78	8.16	4.85	6.92
# of days worked in total/ha	8.42	38.35	20.26	44.84	29.47	29.51
Other crop management activities						
Households (%) with members working on this activity, and...:	10.75	30.76	21.31	27.25	21.71	22.94
# people/ha	1.24	2.50	1.01	0.58	0.96	1.41
# of days worked in total/ha	8.46	33.12	6.38	4.95	5.31	12.92
Households (%) hiring labor to work on this activity, and...:	9.81	20.00	18.02	19.90	7.53	14.54
# people/ha	1.53	1.09	0.49	0.47	0.26	0.66
# of days worked in total/ha	2.92	14.75	1.98	5.72	3.78	6.74
Wage per day ("jornal"), US$/day	6.56	6,16	6,37	4.32	8.80	6.69
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**
*1 ha (hectare) = 10,000 square meters						

Table A 15. Other main two crops grown (according to the quantity produced) by coffee farmers at baseline

Other main two crops grown in the baseline year	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) reporting growing crops other than coffee	13.6	15.38	11.47	23.22	6.94	13.36
Number of other crops grown	0.73	1.31	0.44	0.90	0.33	0.60
Farmers (%) providing complete information about other crops	40.19	29.54	26.61	38.46	33.48	34.50
Most commonly reported crop 1	Plantain (52,13)	Maize (71,59)	Maize (60,00)	Maize (42,86)	Plantain (45,33)	Maize (37,48)
Most commonly reported crop 2	Maize (23,40)	Peanut (14,77)	Plantain (16,92)	Plantain (26.37)	Yuca (26,17)	Plantain (32,35)
Total area (ha) under these two crops	0.42	0.38	0.10	0.91	0.47	0.46
Farmers (%) reporting selling part of the harvest of these two crops	72.54	39.77	24.61	76.37	17.97	46.33
Share (%) of production sold	56.26	28.8	19.75	53.61	10.54	33.56
Income (US$) from sales from these two crops	694.09	158.01	120.11	236.33	142.48	334.87
Number of households	**316**	**455**	**288**	**266**	**256**	**1265**
*1 ha (hectare) = 10,000 square meters						

Table A 16. Coffee: household and home characteristics, and household income at baseline

Household and home details	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Household (HH) characteristics						
Households with two heads (%):	51.14	20	50	60.9	68.53	51.75
If >1 head, average age of household heads (yrs)	51.1	52.55	44.89	42.13	44.59	46.65
% HHs where at least one member migrated within last 6 months:	12.46	8.00	10.09	8.29	10.04	9.65
# members who migrated	1.74	1.61	1.34	1.40	1.95	1.65
% HHs with at least one member migrating to another country	94.87	86.11	83.72	60.0	2.94	57.46
% HHs receiving remittances		9.89	9.02	6.77	5.47	8.14
% HHs receiving subsidy from the government or NGOs	11.21	12.47	18.50	5.68	48.96	22.94
Effect of COVID19 pandemic to your HH (%), cohort 1 farmers:						
Has had no effect	0.00	41.52	68.4	84.53	28.63	54.14
Effect 1		Affected my income (46.88)	Affected my income (21.88)	Affected my income (13.58)	Affected my income (55.29)	Affected my income (35.83)
Effect 2		Shortage of labor for crop managemen t (14.51)	Shortage of labor for crop managemen t (14.93)	Shortage of labor for crop management (3.02)	Shortage of labor for crop managem ent (52.16)	Shortage of labor for crop management (19.82)
Effect 3		Received lower price (4.02)	Received lower price (0.69)	Received lower price (0)	Received lower price (15.69)	Received lower price (4.78)
Other effect		1.12	0.69	0	1.57	0.88
Effect of COVID19 pandemic to your HH (%), cohort 2 farmers:						
Has had no effect	25.15	n.a.	20.14	45.16	15.23	23.44
Effect 1	Inputs more expensive (40.12%)	n.a.	Shortage of labor for crop managemen t (65.58%)	Inputs more expensive (41.93%)	Shortage of labor for harvest (63.09%)	Inputs more expensive (38.71%)
Effect 2	Received higher price (32.8%)	n.a.	Shortage of labor for harvest (41%)	Shortage of labor for harvest (16.12%)	Shortage of labor for crop managem	Shortage of labor for harvest (37.41%)

					ent (39.76%)	
Effect 3	Shortage of labor for crop managemen t (16.97%)	n.a.	Inputs more expensive (37.41%)	Shortage of labor for crop management (13.54%)	Inputs more expensive (36.9%)	Shortage of labor for crop management (31.9%)
Other effect	0.63	n.a.	0.00	1.93	1.90	1.26
Home characteristics						
Has water source within home (% yes)	92.01	90.88	90.84	74.82	95.41	89.41
If not, minutes walking to water source	19.81	18.46	8.25	7.39	6.60	11.48
Index of home assets	0.28	-0.17	0.47	-0.39	-0.18	0
Index of transportation assets	-0.15	0.21	0.19	-0.34	-0.17	0
Index of productive assets	-1.41	-0.45	-0.12	0.38	0.73	0
Household income						
Total income ($)	2490.54	2592.63	5715.94	7921.47	6279.26	5246.35
Agricultural income ($)	1747.50	2424.66	5300.73	7745.71	6176.16	4974.39
Non-agricultural income ($)	743.03	167.96	415.20	175.76	103.10	271.95
Number of households**	**298**	**439**	**408**	**411**	**673**	**2229**
Number of households	**316**	**455**	**427**	**422**	**677**	**2297**

** A total of 68 observations (18, 16, 19, 11 and 4 in El Salvador, Guatemala, Honduras, Nicaragua and Peru, respectively) were excluded for these variables because presented extreme values (much larger than 3 standard deviations above the mean, when estimating income from coffee sales/ha)

Table A 17. Coffee: descriptive statistics of variables included in the renovation & rehabilitation regressions

Variables	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Did renovation (1=yes)	0.383	0.619	0.149	0.436	0.791	0.670
	[0.488]	[0.4862]	[0.357]	[0.496]	[0.406]	[0.470]
Did rehabilitation (1=yes)	0.383	0.485	0.592	0.699	0.792	0.670
	[0.488]	[0.620]	[0.492]	[0.459]	[0.405]	[0.470]
Sex of HH head (1=male)	58.647	77.286	80.456	85.552	76.896	77.99
	[49.433]	[41.96]	[39.718]	[35.207]	[42.187]	[41.446]
HH head age (years)	53.752	52.537	46.609	43.252	45.7.14	47.355
	[13.738]	[53.513]	[13.558]	[12.438]	[13.535]	[26.908]
Joint decision (spouses) on purchase of coffee inputs (1=yes)	18.045	4.424	10.423	12.747	44.092	21.54
	38.602	[20.595]	[30.606]	[33.398]	[49.694]	[41.124]
Coffee area (ha)	3.399	1.114	3.003	3.985	2.560	2.713
	[4.605]	[1.560]	[4.666]	[4.363]	[1.600]	[3.430]
Number of coffee trees	3477.3	5892.5	12252.78	17714.79	11388	11143
	[4340.5]	[9394.3]	[15890.0]	[21650.34]	[8366.5]	[14296]
Number MOCCA practices implemented	9.849	12.782	12.338	14.988	15.915	13.976
	[3.175]	[5.609]	[4.933]	[3.949]	[4.287]	[4.936]
Sold thru MOCCA's anchor firms (1=yes)	0	0.153	0.123	0.609	0.446	0.328
	[0]	[0.360]	[0.329]	[0.488]	[0.497]	[0.469]
HH member migrated within last 6 months (1=yes)	20.301	9.144	10.749	7.648	10.758	10.54
	[40.376]	[28.867]	[31.024]	[26.615]	[31.013]	[30.71]
Received remittances (1=yes)	14.29	8.85	11.73	5.1	8.82	9.0
	[35.125]	[28.443]	[32.225]	[22.029]	[28.381]	[28.634]
Number of coffee varieties	1.511	1.649	1.830	1.280	2.111	1.748
	[0.681]	[0.908]	[1.101]	[0.557]	[1.100]	[0.992]
Distance to closest town (hours)	1.318	0.665	0.628	1.015	1.416	1.033
	[0.927]	[0.493]	[0.396]	[0.752]	[1.143]	[0.899]
Altitude (m.a.s.l.)	985.55	1539.8	1287.84	824.55	1577.1	1314.7
	[221.73]	[549.05]	[244.61]	[211.86]	[245.54]	[442.36]
Obtained information of coffee research products from NGOs or government (1=yes)	38.346	8.529	7.166	9.915	4.2328	9.48
	[48.807]	[27.973]	[25.834]	[29.928]	[20.151]	[29.297]
Coffee age	6.176	8.605	6.786	4.745	5.650	6.298
	[4.1023]	[4.836]	[3.181]	[1.951]	[2.875]	[3.616]
Access to credit (1=yes)	0.751	5.014	6.514	38.526	12.522	14.42
	[8.671]	[21.857]	[24.718]	[48.734]	[33.126]	[35.14]
% of coffee trees under a variety susceptible to leaf rust	12.723	41.88	3.597	3.513	16.17	16.129
	[25.978]	[44.917]	[14.650]	[15.910]	[25.406]	[30.967]
Has shade crop with coffee (1=yes)	50.376	54.572	75.570	77.337	52.734	62.15
	[50.188]	[49.864]	[43.037]	[41.924]	[49.969]	[48.515]
Index of productive assets	-1.381	-0.452	-0.144	0.448	0.695	0.100
	0.659	1.647	[1.662]	[1.406]	[1.242]	[1.543]
Observations	**133**	**339**	**307**	**353**	**567**	**1699**

Standard deviations in brackets

Table A 18. Coffee: descriptive statistics of variables included in the yields regression

Variables	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Yield_oro	222.78	690	847.54	744.99	689.38	698.65
	[303.28]	[460.9]	[648]	[721.18]	[943.62]	[745.63]
Sex of HH head (1=male)	61.261	77.015	80.066	85.919	76.732	78.29
	[48.936]	[42.137]	[40.016]	[34.832]	[42.292]	[41.242]
HH head age (years)	54.901	49.716	46.664	43.19	45.72	46.791
	[13.765]	[14.391]	[13.608]	[12.40]	[13.547]	[13.841]
Joint decision (spouses) on purchase of coffee inputs (1=yes)	18.919 [39.344]	4.477 [20.712]	10.631 [30.875]	12.356 [32.955]	44.05 [49.689]	22 [41.237]
Number of coffee trees/ha	2882.2	5792	5277.34	4652.01	4601.7	4860.3
	[9791.4]	[5166.4]	[4094.26]	[1650.59]	[2569.9]	[4253.4]
Family labor: # members in all coffee activities	1.956	1.413	1.677	2.293	2.525	2.059
	[1.471]	[1.782]	[1.592]	[2.935]	[3.375]	[2.666]
HH member migrated within last 6 months (1=yes)	16.216	8.955	10.631	7.758	10.835	10.13
	[37.027]	[28.597]	[30.875]	[26.790]	[31.11]	[30.185]
Received remittances (1=yes)	14.414	8.656	11.627	5.172	8.881	8.893
	[35.283]	[28.162]	[32.109]	[22.178]	[28.472]	[28.521]
Number MOCCA practices implemented	10.288 [2.992]	12.872 [5.625]	12.289 [4.903]	14.994 [3.967]	15.963 [4.261]	14.079 [4.901]
Number of coffee varieties	1.558	1.647	1.847	1.281	2.115	1.761
	[0.683]	[0.913]	[1.105]	[0.558]	[1.102]	[0.998]
% of coffee trees under a variety susceptible to leaf rust	13.604	42.201	3.336	3.564	16.001	16.225
	[26.216]	[44.998]	[13.699]	[16.019]	[25.163]	[30.94]
Distance to closest town (hours)	1.3284	0.668	0.628	1.021	1.408	1.031
	[0.9198]	[0.495]	[0.396]	[0.754]	[1.140]	[0.897]
Number of certifications	0	0.032	0.521	0.413	1.616	0.737
	0	[0.194]	[0.918]	[0.603]	[1.199]	[1.074]
Altitude (m.a.s.l.)	992.96	1542.14	1287.57	826.45	1576.1	1320.5
	[230.85]	[551.74]	[244.019]	[209.308]	[245.98]	[442.91]
Has shade crop with coffee (1=yes)	50.45	54.328	75.747	77.586	52.931	62
	[50.225]	[49.887]	[42.932]	[41.761]	[49.958]	[48.462]
Coffee age	10.811	8.555	6.777	4.739	5.673	6.299
	[40.497]	[4.837]	[3.176]	[1.961]	[2.868]	[3.581]
Access to credit (1=yes)	0.9009	5.074	6.312	39.080	12.611	14,72
	[9.491]	[21.981]	[24.358]	[48.863]	[33.227]	[35.43]
Obtained information of coffee research products from NGOs or government (1=yes)	41.441	8.656	6.644	10.057	4.262	9.29
	[49.485]	[28.162]	[24.947]	[30.119]	[20.22]	[29.036]
Index of productive assets	-1.372	-0.443	-0.148	0.458	0.703	0.126
	[0.6805]	[1.654]	[1.653]	[1.408]	[1.245]	[1.543]
Observations	**111**	**335**	**301**	**348**	**563**	**1658**

Standard deviations in brackets

Table A 19. Cacao: MOCCA indicators by Ecuador anchor firms and sex of household head, at baseline

Key indicators	ANECACAO				APECAP				APEOSAE				Fortaleza			
	Female	Male	Total	p-value	Female	Male	Total	p-value	Female	Male	Total	p-value	Female	Male	Total	p-value
USDA indicators																
Yield (kg dry/ha)	430.47	346.94	364.17	0.1806	310.87	409.82	398.83	n.a.	129.53	326.77	298.5	n.a.	293.29	266.02	273.19	0.4347
Area cacao (ha)	5.70	6.43	6.27	0.6683	1.50	1.00	1.04	n.a.	2.00	1.63	1.66	n.a.	1.51	1.84	1.75	0.5247
Farmers (%) with access to financing for agriculture	7.14	6.00	6.25	0.878	0.00	0.00	0.00	n.a.	0.00	0.00	0.00	n.a.	5.00	7.01	6.49	0.7566
Value of annual cacao sales (US$)	5410.53	6199.25	6026.71	0.721	240.00	664.16	631.16	n.a.	433.50	479.36	474.7	n.a.	940.75	899.89	910.50	0.8694
Annual amount of cacao sold (kg dry)	2716.12	1872.78	2046.80	17.26	409.05	531.76	518.13	n.a.	259.06	574.18	529.1	n.a.	401.55	437.94	428.36	0.7675
Anchor firm indicators																
Farmers (%) who consider their cacao of good quality	78.57	80.00	79.68	0.908	100.00	91.66	92.3	n.a.	100.00	88.88	90.00	n.a.	100.00	100.00	100.00	n.a.
Farmers (%) with any certification	14.28	42.00	35.93	0.057*	100.00	91.66	92.3	n.a.	100.00	77.77	80.00	n.a.	100.00	96.49	97.4	0.4027
Total income (US$)	5763.73	6487.26	6337.26	0.754	7560.00	1765.58	2211.30	n.a.	433.50	1296.0	1209.8	n.a.	5218.62	3637.25	4070.50	0.3987
Household income (US$)	5763.73	6487.26	6337.26	0.754	240.00	765.58	725.15	n.a.	433.50	529.36	519.7	n.a.	3832.62	1891.67	2423.44	0.2376
Non-agricultural income (US$)	0.00	0.00	0.00	n.a.	7320.00	200.00	747.69	n.a.	0.00	766.66	690.0	n.a.	474.00	721.05	656.88	0.6645
Number of households	**14**	**50**	**64**		**1**	**12**	**13**		**1**	**9**	**10**		**20**	**57**	**77**	

Table A 19. Continued

Key indicators	OLAM-Cohorte 1				UNOCACE				Country			
	Female	Male	Total	p-value	Female	Male	Total	p-value	Female	Male	Total	p-value
USDA indicators												
Yield (kg dry/ha)	23.56	713.96	627.66	0.1848	209.49	267.95	256.54	0.1497	302.78	337.25	329.25	0.4192
Area cacao (ha)	1.24	2.31	2.20	0.4596	3.16	4.98	4.61	0.2950	3.07	3.72	3.58	0.3611
Farmers (%) with access to financing for agriculture	0.00	17.64	0.157	0.544	0.00	0.00	0.00	n.a.	4.25	5.55	5.28	0.7242
Value of annual cacao sales (US$)	1662.80	2511.8	2422.41	0.7200	2375.44	5361.45	4750.68	0.3113	2665.34	3594.59	3398.27	0.3437
Annual amount of cacao sold (kg dry)	636.30	1217.5	1149.08	0.5629	558.01	1374.84	1215.46	0.2021	1105.49	1128.02	1123.26	0.9299
Anchor firm indicators												
Farmers (%) who consider their cacao of good quality	100.00	100.00	100.00	n.a.	100.00	97.14	97.72	0.6178	93.61	92.77	92.95	0.8422
Farmers (%) with any certification	50.00	76.47	73.68	0.4496	100.00	97.14	97.72	0.6178	72.34	78.33	77.05	0.3863
Total income (US$)	1662.80	3583.9	3381.70	0.5151	3253.77	5602.62	5122.18	0.4268	4780.52	4434.98	4507.56	0.7579
Household income (US$)	1662.80	3160.4	3002.75	0.5734	2853.77	5602.62	5040.36	0.3525	3940.52	3756.28	3794.98	0.8651
Non-agricultural income (US$)	0.00	423.52	378.94	0.7421	266.66	0.00	54.54	0.047**	408.51	320.32	338.32	0.7223
Number of households	**2**	**17**	**19**		**9**	**35**	**44**		**47**	**180**	**227**	
Note: p-value in parenthesis, and differences in means between groups are significant at the 10% level (*), 5% level (**) or 1% level (***)												
*1 ha (hectare) = 10,000 square meters												

Table A 20. Cacao: MOCCA indicators by El Salvador anchor firms and sex of household head, at baseline

Key indicators	Independent farmers			
	Female	Male	Total	p-value
USDA indicators				
Yield (kg dry/ha)	69.42	96.25	88.87	0.457
Area cacao (ha)	3.07	3.72	3.58	0.361
Farmers (%) with access to financing for agriculture	0.00	1.31	0.97	0.554
Value of annual cacao sales	59.50	104.30	92.56	0.410
Annual amount of cacao sold (kg dry)	90.48	86.22	87.42	0.918
Anchor firm indicators				
Farmers (%) who consider their cacao of good quality	62.96	75.00	71.84	0.236
Farmers (%) with any certification	0.00	0.00	0.00	n.a.
Total income (US$)	84.32	1122.1	850.06	0.310
Household income (US$)	84.32	674.08	519.48	0.507
Non-agricultural income (US$)	0.00	508.41	362.16	0.279
Number of households	**27**	**76**	**103**	
Note: p-value in parenthesis, and differences in means between groups are significant at the 10% level (*), 5% level (**) or 1% level (***)				
*1 ha (hectare) = 10,000 square meters				

Table A 21. Cacao: MOCCA indicators by Guatemala anchor firms and sex of household head, at baseline

Key indicators	Cacao Verapaz			
	Female	Male	Total	p-value
USDA indicators				
Yield (kg dry/ha)	299.32	370.59	350.96	0.323
Area cacao (ha)	0.77	1.12	1.02	0.122
Farmers (%) with access to financing for agriculture	0.00	3.84	2.73	0.369
Value of annual cacao sales(US$)	354.49	561.24	501.76	0.316
Annual amount of cacao sold (kg dry)	201.59	499.42	417.41	0.340
Anchor firm indicators				
Farmers (%) who consider their cacao of good quality	90.47	92.3	91.78	0.799
Farmers (%) with any certification	76.19	73.07	73.97	0.787
Total income (US$)	385.02	1506.39	1183.80	0.098*
Household income (US$)	385.02	997.97	821.64	0.232
Non-agricultural income (US$)	0.00	442.10	326.21	0.334
Number of households	**21**	**52**	**73**	
Note: p-value in parenthesis, and differences in means between groups are significant at the 10% level (*), 5% level (**) or 1% level (***)				
*1 ha (hectare) = 10,000 square meters				

Table A 22. Cacao: MOCCA indicators by Honduras anchor firms and sex of household head, at baseline

Key indicators	Fenaprocacaho			
	Female	Male	Total	p-value
USDA indicators				
Yield (kg dry/ha)	130.52	209.03	190.91	0.049**
Area cacao (ha)	1.28	1.67	1.56	0.243
Farmers (%) with access to financing for agriculture	0.00	6.34	4.59	0.211
Value of annual cacao sales (US$)	247.39	608.74	509.06	0.132
Annual amount of cacao sold (kg dry)	184.47	381.66	335.44	0.051*
Anchor firm indicators				
Farmers (%) who consider their cacao of good quality	91.66	96.82	95.40	0.310
Farmers (%) with any certification	50.00	71.42	65.51	0.061*
Total income (US$)	2194.91	2074.60	2107.78	0.878
Household income (US$)	792.55	1237.53	1114.78	0.526
Non-agricultural income (US$)	1301.34	554.87	760.79	0.037**
Number of households	**24**	**63**	**87**	
Note: p-value in parenthesis, and differences in means between groups are significant at the 10% level (*), 5% level (**) or 1% level (***)				
*1 ha (hectare) = 10,000 square meters				

Table A 23. Cacao: MOCCA indicators by Peru anchor firms and sex of household head, at baseline

Key indicators	Agrotec				APPCACAO			
	Female	Male	Total	p-value	Female	Male	Total	p-value
USDA indicators								
Yield (kg dry/ha)	271.42	185.77	194.59	0.443	346.69	368.37	362.57	0.598
Area cacao (ha)	1.05	1.04	1.04	0.9808	2.05	3.01	2.75	0.3844
Farmers (%) with access to financing for agriculture	10.00	22.36	20.93	0.372	1.78	2.01	1.95	0.917
Value of annual cacao sales (US$)	607.44	357.14	386.24	0.293	2,294.99	2,789.9	2,654.70	0.616
Annual amount of cacao sold (kg dry)	657.59	521.93	537.71	0.745	2733.85	2747.00	2743.37	0.986
Anchor firm indicators								
Farmers (%) who consider their cacao of good quality	100.00	94.73	95.34	0.463	96.42	97.31	97.07	0.739
Farmers (%) with any certification	60.00	60.52	60.46	0.975	30.35	30.20	30.24	0.983
Total income (US$)	657.59	521.93	537.71	0.745	2733.85	2747.00	2743.37	0.986
Household income (US$)	607.44	372.67	399.97	0.323	2296.83	2717.38	2601.36	0.556
Non-agricultural income (US$)	50.14	36.15	37.78	0.678	185.27	29.23	71.85	0.078*
Number of households	**10**	**76**	**86**		**56**	**149**	**205**	

Table A 23. Continued

Key indicators	ECOM				Country			
	Female	Male	Total	p-value	Female	Male	Total	p-value
USDA indicators								
Yield (kg dry/ha)	659.33	759.58	716.94	0.352	493.24	434.75	451.84	0.244
Area cacao (ha)	2.43	2.65	2.55	0.463	2.15	2.42	2.34	0.603
Farmers (%) with access to financing for agriculture	12.06	12.50	12.31	0.940	7.25	9.83	9.09	0.401
Value of annual cacao sales (US$)	2,811.20	3,545.17	3,236.69	0.304	2,400.35	2,381.80	2,387.16	0.973
Annual amount of cacao sold (kg dry)	1459.19	1833.56	1674.31	0.302	1296.8	1187.80	1219.6	0.658
Anchor firm indicators								
Farmers (%) who consider their cacao of good quality	100.00	100.00	100.00	n.a.	98.38	97.37	97.66	0.531
Farmers (%) with any certification	5.17	5.00	5.07	0.964	20.96	31.14	28.2	0.034
Total income (US$)	2817.1	3545.88	3239.59	0.308	2605.36	2399.83	2459.51	0.638
Agricultural Income (US$)	2811.20	3545.88	3237.10	0.304	2401.18	2348.01	2363.45	0.902
Non-agricultural income (US$)	0.00	0.00	0.00	n.a.	87.71	23.28	41.91	0.125
Number of households	**58**	**80**	**138**		**124**	**305**	**429**	
Note: p-value in parenthesis, and differences in means between groups are significant at the 10% level (*), 5% level (**) or 1% level (***)								
*1 ha (hectare) = 10,000 square meters								

Table A 24. Cacao: MOCCA indicators by Nicaragua anchor firms and sex of household head, at baseline

Key indicators	APCA				CACAONICA R L				CACHERCAM RL			
	Female	Male	Total	p-value	Female	Male	Total	p-value	Female	Male	Total	p-value
USDA indicators												
Yield (kg dry/ha)	**n.a**	**304.15**	**n.a**	**n.a**	199.94	246.45	241.28	0.551	65.10	177.88	140.29	0.101
Area cacao (ha)	n.a	2.23	n.a	n.a	0.93	4.11	3.66	0.200	1.54	1.61	1.59	0.888
Farmers (%) with access to financing for agriculture	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
Value of annual cacao sales (US$)	**n.a**	**1132.46**	**n.a**	**n.a**	604.25	1594.61	1453.13	0.271	107.18	337.54	264.80	0.226
Annual amount of cacao sold (kg dry)	n.a	640.43	n.a	n.a	284.40	901.54	810.54	0.125	55.65	226.65	169.65	0.118
Anchor firm indicators												
Farmers (%) who consider their cacao of good quality	n.a	96.00	n.a	n.a	100.00	100.00	100.00	n.a	66.66	96.15	86.84	0.01**
Farmers (%) with any certification	n.a	100.00	n.a	n.a	100.00	100.00	100.00	n.a	8.33	11.53	10.52	0.772
Total income (US$)	n.a	1700.84	n.a	n.a	676.81	2006.30	1815.7	0.189	1082.5	975.11	1009.0	0.866
Agricultural Income (US$)	n.a	1304.79	n.a	n.a	671.81	1883.76	1710.6	0.22	354.46	834.33	682.79	0.183
Non-agricultural income (US$)	n.a	495.04	n.a	n.a	0.00	32.76	28.08	0.588	728.01	140.78	326.22	0.265
Number of households	**0**	**25**	**25**		**4**	**24**	**28**		**12**	**26**	**38**	

Note: p-value in parenthesis, and differences in means between groups are significant at the 10% level (*), 5% level (**) or 1% level (***)

*1 ha (hectare) = 10,000 square meters

Table A 24. Continued

Key indicators	APCA				CACAONICA R L			
	Female	Male	Total	p-value	Female	Male	Total	p-value
USDA indicators								
Yield (kg dry/ha)	**137.58**	**349.23**	**310.36**	**0.606**	**109.14**	**281.04**	**250.04**	**0.2544**
Area cacao (ha)	1.05	1.89	1.74	0.191	1.27	2.35	2.16	0.0560*
Farmers (%) with access to financing for agriculture	0.00	14.28	11.76	0.235	0.00	5.12	4.22	0.2504
Value of annual cacao sales (US$)	**215.41**	**393.54**	**362.11**	**0.343**	**225.67**	**785.36**	**686.82**	**0.0180****
Annual amount of cacao sold (kg dry)	188.82	3903.57	3269.57	0.599	135.96	1659.7	1385.7	0.4885
Anchor firm indicators								
Farmers (%) who consider their cacao of good quality	77.77	83.33	82.35	0.698	76.00	92.30	89.43	0.015**
Farmers (%) with any certification	11.11	33.33	29.41	0.191	24.00	56.41	50.70	0.003***
Total income (US$)	1158.9	836.59	893.47	0.312	1044.29	1313.14	1265.81	0.488
Agricultural Income (US$)	225.11	568.09	507.57	0.097*	358.67	1054.6	932.04	0.009***
Non-agricultural income (US$)	558.46	118.73	196.33	0.033**	550.49	186.40	250.50	0.175
Number of households	**9**	**42**	**51**		**25**	**117**	**142**	

Table A 25. List of MOCCA-promoted practices, and practices evaluated for cacao*

Module #	Practice #	Practice detail	Adoption level according to MOCCA curricula		Included in evaluation?
			Well	Optimal	
Cacao establishment					
1	1	Site selection	Renovates sick and/or low-yielding plants	Established crop considering different factors (land location, soil type, vegetation quality, water access, altitude)	Yes, level well only as no data collected for level optimal
1	2	Selection of varieties and planting material	Knows genetic materials (varieties or clones) in his/her farm	Uses genetic materials coming from elite trees OR registered/identified from a trusted source genetic material	Yes
1	3	Plant density and accompanying tree selection (timber and fruit trees)	Plants at a 3.5m x 3.5m distance between cacao plants	Plants at a 3.0m x 3.0m distance between cacao plants AND planted accompanying trees according to distances recommended in the CACAO MOVIL guide under agroforestry systems	Yes, partially for level optimally
1	4	Re-planting cacao/compacting cacao areas	Has 5 or fewer clones per hectare and/or does not know the name of the varieties, OR renovation done with 50% grafts and 50% from plants coming from seeds	Has 5 or more clones per hectare AND knows the name of the varieties, OR renovation done with 80% grafts and 20% from plants coming from seeds	Yes
1	5	Intercropping with other income-generating crops	Has cacao associated with at least one crop that can generate supplemental income (fruits, timber, banano/plantain, wood, honey, black pepper, pepper, cinnamom, cardamom, etc.)	Has cacao associated with 3 or more crops that can generate supplemental income (fruits, timber, banano/plantain, wood, honey, black pepper, pepper, cinnamom, cardamom, etc.)	No, as no data collected

Table A 25 Continued.

Module #	Practice #	Practice detail	Adoption level according to MOCCA curricula		Included in evaluation?
			Well	Optimal	
Cacao seedlings greenhouse production					
2	1	Seed selection and/or grafts	Selects seeds or plants/grafts from elite trees/mothers (highly productive, vigorous, disease and pest tolerant trees)	Selects seeds or grafts produced by greenhouses or clonal gardens with genetic materials coming from registered and/or identifiable and trustable sources **(does not apply to Guatemala and El Salvador as there are no regulations yet)**	Yes, except for Guatemala and El Salvador for level optimally
2	2	Substrate mix for greenhouse	Substrate mix contains at least one part of organic fertilizer (compost or bokashi)	Uses recommended substrate mix: 8 parts of loose dirt, 1 part of organic matter, 1 part mix of sand and lime	No, as no data collected
2	3	Substrate mix disinfection	Disinfects substrate mix with ash, boiling water or solarization (but not lime)	Disinfects substrate mix with boiling water, solarization and/or lime (to lower pH)	Yes, partially for both levels
2	4	Grafting techniques	Does any type of grafting in the greenhouse	Does lateral bud grafting in the greenhouse (benefits: produces more plants and is easier to expand within the farm)	Yes, level well only as no data collected for level optimal
2	5	Nutrition	Does at least 1 fertilizer application (either to the leaves or soil)	Does at least 2 fertilizer applications (either to the leaves or soil)	No, as no data collected
2	6	Pest management	Uses at least 1 control method for pests and diseases	Monitors pests and diseases in the greenhouse AND uses 2 or more control methods for pests and diseases	No, as no data collected

Table A 25. Continued

Module #	Practice #	Practice detail	Adoption level according to MOCCA curricula		Included in evaluation?
			Well	Optimal	
Fertility management (nutrition)					
3	1	Fertilizes based on nutritional deficiencies	Does visual evaluation of the nutrient deficiencies in the leaves AND does a nutrients balance based on actual and expected harvest (N, P, K) to determine fertilization needs	Does a nutrients balance based on expected harvest (N, P, K) AND/OR uses soil analysis results to determine fertilization needs	Yes, partially for both levels
3	2	Fertilization ("enmiendas") plan	Does at least 2 fertilizer applications (one every 6 months)	Has a nutritional plan based on the production system OR does at least 4 fertilizer applications (one every 3 months) applying 150 gr/plant every time	Yes, partially for level optimally
3	3	Soil acidity correction	Applies lime to correct the pH based on soil map	Applies correct dose of lime based on soil analysis recommendations	No, as no data collected
3	4	Preparation and application of organic fertilizers (compost, worm-compost, bocashi, others)	n.a.	Prepares and applies corrections/organic fertilizers according to the production system	Yes, partially for level optimal
Cacao pruning and management of accompanying trees					
4	1	Has a diagnosis of pruning needs (types: formation, maintainance, health)	Does at least 1 of the recommended pruning	Does 3 of the recommended pruning based on a farm diagnosis of the pruning needs for cacao and shadow trees	Yes, partially for level optimally
4	2	Cacao shadow management	Cacao field has at least 25% shade, OR shadow trees planted within the last 2 years	Does a diagnosis of the shade AND controls shade based on this diagnosis and the age of cacao trees	Yes, level well only as no data collected for level optimal

Table A 25. Continued

Module #	Practice #	Practice detail	Adoption level according to MOCCA curricula		Included in evaluation?
			Well	Optimal	
Integrated pest management					
5	1	Pest diagnosis (field evaluation)	n.a.	Does field evaluation of pests and/or diseases	Yes, level optimal only
5	2	Control of monilia, black pods, witches broom, pod worm, others	Does at least 1 control method for every pest/disease present AND incidence of pests/diseases decreases 10% from average incidence level determined at baseline	Does 2 or more control methods for every pest/disease present and at least 1 of these is ecological (no chemicals), AND incidence of pests/diseases decreases 20% from average incidence level determined at baseline, *AND integrated pests management is implemented according to an agro-ecological calendar*	Yes, partially for optima level
Floor management in cacao plantations					
6	1	Weeding or weed cutting	Does at least 1 weeding practice	Does selective weeding according to calendar of activities	Yes
6	2	Increase in dead or alive soil cover	Implements at least 1 soil cover crop (legumes, other crops)	Implements 1 soil cover crop AND 1 soil and water conservation method (live or dead barriers, contour planting)	Yes
6	3	Floor management method (live or dead barriers, cover crops, uses herbicides)	Implements at least 1 method to manage the floor	Implements 2 or more methods to manage the floor	Yes
6	4	Incorporation of organic matter that contains pods	*Incorporates organic matter in the trees (organic matter with harvested pods)*	Incorporates organic matter *in the trees and* between rows, AND prepares and applies organic fertilizers *according to local agronomic calendar*	Yes, level optimal only as no data collected for level well

Table A 25. Continued

Module #	Practice #	Practice detail	Adoption level according to MOCCA curricula		Included in evaluation?
			Well	Optimal	
Cacao harvest					
7	1	Harvest and pod selection	Pods harvested according to color and size (ripening), *AND harvest done weekly during peak harvest and bi-weekly or monthly after that*	Pods classified according to color, shape and size, *AND eliminated sick, damaged, over-riped, or green pods, AND harvest done weekly during peak harvest and bi-weekly or monthly after that*	Yes, partially for both levels
7	2	Harvested cacao grain selection	*Selects cocoa beans according to: over-riped beans, small beans, dirt, cocoa placenta*	*Selects cocoa beans according to: over-riped beans, small beans, dirt, cocoa placenta,* AND beans removed from pods within 3 days of harvest, AND beans transported to collecting centers within 6 hours *(in clean and appropriate containers)*	Yes, partially for level optimally only as no data collected for level well
Fermentation					
8	1	Level or degree of fermentation			No, as is applicable at organizational level
8	2	Fermentation method			No, as is applicable at organizational level
Drying					
9	1	Sun drying (markesina and oven)			No, as is applicable at organizational level
9	2	Warehouse drying			No, as is applicable at organizational level

Table A 25. Continued

Module #	Practice #	Practice detail	Adoption level according to MOCCA curricula		Included in evaluation?
			Well	Optimal	
Cacao commercialization					
10	1	Financial analysis at the organizational level			No, as is applicable at organizational level
10	2	Records for expenses/costs of production and harvest, post harvest, commercialization and sales	*Uses any type of format to register costs and sales*	*Uses records to estimate net income from cacao sales, AND has access to market and price information and/or information from their organization, AND meets minimum required standards for their certification (if certified)*	No, as no data collected
10	3	Access to information at the organizational level			No, as is applicable at organizational level
***Taken from MOCCA training curricula**					
NOTE: Under adoption levels, italics imply data not collected for the given criteria.					
n.a.=not applicable					

Table A 26. Cacao: additional information about Renovation & Rehabilitation

Considerations	Ecuador	El Salvador	Guatemala
Renovation			
Farmers (%) who renovated cacao trees in the base line year, and % who did it because…:	14.10	11.65	13.69
Sick trees	34.37	25.00	0.00
Low yielding trees	40.62	8.33	10.00
Farmers (%) who did cacao renovation prior to the year of reference, and %…:	14.10	6.80	16.44
With low to no knowledge about this practice	18.75	57.14	16.66
Who renovates cacao because of low yields	78.12	28.57	41.66
Who renovates cacao because of low plant health	56.25	0.00	25.00
Who renovates cacao because of dead plants	31.25	57.14	50.00
Who renovates cacao based on farm diagnosis	9.37	0.00	0.00
Who renovates cacao because of other reasons	0.00	14.28	0.00
Farmers (%) who think is important to renovate cacao in their farms, and…:	70.22	57.28	71.23
Reason 1 (and % farmers)	Yield increase (64.56)	Yield increase (77.97)	Yield increase (86.54)
Reason 2 (and % farmers)	Improve harvest quality (30.38)	Improve harvest quality (11.86)	Improve harvest quality (25.00)
Farmers (%) who don't think is important to renovate cacao in their farms, and…:	14.67	20.39	4.11
Reason 1 (and % farmers)	The price does not change (26.67)	It is not important (42.11)	Costly (66.67)
Reason 2 (and % farmers)	It is not important(17.14	Costly (15.79)	n.a.
Farmers (%) who consider there are limitations to adopt cacao renovation practices, and…:	71.56	66.02	20.55
Main reason (and % farmers)	Practice Knowledge (32.50)	Own economic resources (83.82)	Lack of time(53.33)
Second reason (and % farmers)	Own economic resources (30.00)	Access to financial services (66.18)	Technical Extension (13.33)
Rehabilitation			
Farmers (%) who consider there are limitations to adopt cacao rehabilitation practices, and…:	61.78	64.08	19.18
Main reason (and % farmers)	Practice Knowledge (32.61)	Own economic resources (80.30)	Lack of time (35.71)
Second reason (and % farmers)	Own economic resources (26.81)	Access to financial services (65.15)	Technical Extension (21.43)
Number of households	**225**	**103**	**73**

Table A 26. Continued

Considerations	Honduras	Nicaragua	Peru	All countries
Renovation				
Farmers (%) who renovated cacao trees in the base line year, and % who did it because…:	20.68	15.49	21.44	17.62
Sick trees	27.77	36.36	40.21	34.22
Low yielding trees	22.22	36.36	19.56	22.56
Farmers (%) who did cacao renovation prior to the year of reference, and %…:	8.05	9.15	20.75	15.08
With low to no knowledge about this practice	14.28	7.69	6.74	12.50
Who renovates cacao because of low yields	85.71	92.31	70.78	70.63
Who renovates cacao because of low plant health	28.57	23.08	52.80	45.63
Who renovates cacao because of dead plants	0.00	30.77	68.53	53.13
Who renovates cacao based on farm diagnosis	0.00	7.69	3.37	4.38
Who renovates cacao because of other reasons	0.00	0.00	1.12	1.25
Farmers (%) who think is important to renovate cacao in their farms, and…:	71.26	82.40	93.94	80.33
Reason 1 (and % farmers)	Yield increase (96.72)	Yield increase (91.26)	Yield increase (91.79)	Yield increase (91.50)
Reason 2 (and % farmers)	Improve harvest quality (45.90)	Improve harvest quality (38.83)	Improve harvest quality (19.15)	Improve harvest quality (25.51)
Farmers (%) who don't think is important to renovate cacao in their farms, and…:	20.69	17.60	1.63	9.98
Reason 1 (and % farmers)	It is not important (37.50)	Costly (31.82)	No yield increase (28.57)	It is no important (27.27)
Reason 2 (and % farmers)	Costly (31.25)	No yield increase (18.18)	Costly (14.29)	Costly (15.58)
Farmers (%) who consider there are limitations to adopt cacao renovation practices, and…:	50.57	57.04	28.67	46.46
Main reason (and % farmers)	Own economic resources (34.09)	Own economic resources (45.68)	Crop knowledge (32.52)	Own economic resources (37.68)
Second reason (and % farmers)	Farm characteristic (29.55)	Crop knowledge (25.0%)	Own economic resources (20.33)	Own economic resources(20.09)
Rehabilitation				
Farmers (%) who consider there are limitations to adopt cacao rehabilitation practices, and…:	37.93	51.41	24.94	40.79
Main reason (and % farmers)	Own economic resources (33.33)	Own economic resources (46.58)	Crop knowledge (35.51)	Own economic resources (35.50
Second reason (and % farmers)	High implementation costs (24.24)	Own economic resources (30.00)	Own economic resources (37.38)	Own economic resources (24.60)
Number of households	**87**	**142**	**429**	**1061**

*Levels well or optimally as defined by MOCCA's criteria (see training curriculum for details)

Table A 27. Cacao: adoption of nutritional and integrated pest management practices at baseline

Nutritional and Integrated Pest Management (N&IPM) MOCCA-promoted practices*	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) applying fertilizer base line year	27.11	86.40	19.17	19.54	17.60	45.45	37.86
Farmers (%) fertilizing based on nutritional deficiencies	18.94	28.15	9.58	6.89	2.11	11.42	12.91
Of farmers who apply fertilizer, those that do so based on nutritional deficiencies	83.72	86.21	14.29	66.67	100.00	42.86	65.69
Of farmers who apply fertilizer based on nutritional deficiencies, those who do so using soil analyses	16.28	13.79	85.71	33.33	0.00	57.14	34.31
Farmers (%) having a fertilization plan, and % farmers…:	13.21	57.28	5.47	2.29	7.04	5.59	12.15
Doing at least 2 fertilizer applications (one every 6 months)	96.67	96.61	100.00	100.00	100.00	100.00	97.67
Doing at least 4 fertilizer applications (one every 3 months)	3.33	3.39	0.00	0.00	0.00	0.00	2.33
Farmers (%) fertilizing the…:							
Partial amount required	38.46	16.87	0.00	40.00	60.87	18.06	24.76
Full amount required	61.54	83.13	0.00	60.00	39.13	81.94	75.24
Farmers (%) spreading the fertilizer…:							
Randomly close to roots	4.84	3.88	n.a.	2.29	n.a	0.93	2.28
Under the treetop or in fertilization band	13.65	41.74	n.a.	3.44	n.a	32.63	23.61
Farmers (%) implementing pest & disease monitoring systems	15.56	17.48	28.77	32.18	32.39	33.57	26.83
Farmers (%) reporting pests affected their crop	2.26	11.76	4.35	0			
Pests incidence (% farmers):					7.24	13.73	8.54
<10% incidence	1.80	11.76	7.24	0.00	2.17	15.66	8.54
11-30% incidence	1.35	11.76	7.24	0.00	2.17	3.61	2.18
>30% incidence	0.00	3.92	1.44	0.00	33.33	87.50	66.66
Farmers (%) using methods to control pests, and % farmers…:	20.00	7.14	27.27	0.00	100.00	100.00	100.00
Using 1 control method for each pest identified	100.00	100.00	100.00	0.00	0.00	0.00	0.00
Using more than one control method for each pest identified	0.00	0.00	0.00	0.00			
Farmers (%) reporting diseases affected their crop	98.19	58.82	91.30	100	68.11	56.49	55.00
Diseases incidence (% farmers):					28.98	61.77	48.64
≤10% incidence	48.86	19.60	75.36	45.45	10.14	13.46	15.93

11-30% incidence	53.33	29.41	14.49	40.90	77.95	79.95	72.51
>30% incidence	23.98	15.68	4.34	28.78	94.95	99.69	96.19
Farmers (%) using methods to control diseases, and % farmers…:	59.90	33.33	76.19	71.21	5.05	0.31	3.81
Using 1 control method for each diseases identified	97.69	90.00	95.83	72.34	17.60	45.45	37.86
Using more than one control method for each diseases identified	2.31	10.00	4.17	27.66	2.11	11.42	12.91
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	**1061**
*Levels well or optimally as defined by MOCCA's criteria (see training curriculum for details)							

Table A 28. Cacao: floor management & harvest (FM&H) practices

Floor management & harvest (FM&H) MOCCA-promoted practices*	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) doing weeding practices, and % farmers…:	13.65	62.13	46.57	17.24	22.53	28.43	28.08
Doing at least 1 weeding practice	35.48	12.50	61.76	6.67	3.13	54.1	36.24
Doing selective weeding according to calendar activities	64.52	87.50	38.24	93.33	96.88	45.90	63.76
Farmers (%) implementing dead or alive soil cover practices, and % farmers…:	7.48	6.79	6.84	45.52	21.12	27.03	19.98
Implementing at least 1 soil cover crop	35.29	42.86	0.00	8.11	20.00	12.07	15.09
Implementing 1 soil cover crop and 1 soil and water conservation method	64.71	57.14	100.00	91.98	80.00	87.93	84.91
Farmers (%) implementing floor management methods, and % farmers…:	61.23	59.22	60.27	86.20	73.23	89.74	76.15
Implementing at least 1 method to manage floor	49.64	60.66	43.18	32.00	60.58	41.82	46.16
Implementing 2 or more methods to manage floor	50.35	39.34	56.82	68.00	39.42	58.18	53.84
Farmers (%) harvesting cacao	94.67	39.81	94.52	74.71	91.55	94.17	87.06
Farmers (%) doing selective cacao harvest, and % farmers…:	92.07	39.80	94.52	67.81	90.84	85.54	82.37
Doing according to color and size (ripening), (harvest done weekly during peak harvest and bi-weekly or monthly after that)	33.49	63.41	23.19	28.81	44.96	48.50	41.76
Doing according to color, shape and size, and eliminated sick, damaged, over-riped, or green pods (harvest done weekly during peak harvest and bi-weekly or monthly after that)	66.51	36.59	76.81	71.19	55.04	51.50	58.24
Farmers (%) removing cacao beans from pods within 3 days after harvest	95.77	67.50	72.46	82.81	90.76	90.84	89.02
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	**1061**
*Levels well or optimally as defined by MOCCA's criteria (see training curriculum for details)							

Table A 29. Cacao: fermenting and drying cacao beans at baseline

Post-harvest practices	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) fermenting cacao in the farm	15.85	5.82	0.00	1.14	2.81	44.98	22.62
For farmers not fermenting cacao:							
Average time (hrs) between bean removal from pods and delivery to collecting centers	0.18	0.07	0.27	0.19	0.20	0.19	0.19
Farmers (%) transporting beans to collecting centers within 6 hours of removal from pods	n.a.	n.a.	n.a.	n.a.	n.a	n.a.	n.a.
For farmers fermenting cacao in the farm:							
Time (hrs) between bean removal from pods and the start of fermentation	1.26	0.81	n.a.	0.80	0.90	3.06	2.66
Farmers (%) using:							
Boxes or trays to ferment	11.11	50.00	n.a.	100.00	25.00	7.25	9.17
Crates in stair-like arrangement	16.67	16.67	n.a.	0.00	0.00	4.66	7.08
Other fermentation methods	72.22	33.33	n.a.	0.00	75.00	88.08	83.75
# of days the cacao is fermented for	4.14	5.50	n.a.	2.00	2.75	6.43	6.06
Farmers (%) who cover cacao (plantain leaves or jute/burlap sacks) to improve the fermentation	69.44	83.33	n.a.	0.00	0.00	82.38	79.41
# of times the cacao is turned during fermentation	1.88	5.66	n.a.	1.00	6.00	2.88	2.84
Farmers (%) who during fermentation:							
Control the temperature daily	38.39	66.67	n.a.	0.00	25.00	6.22	12.92
Control the temperature less frequent	2.78	-	n.a.	0.00	25.00	8.81	7.92
Do not control the temperature	58.33	33.33	n.a.	100.00	50.00	84.97	79.17
Farmers (%):							
Drying cacao beans using the sun	100.00	100.00	n.a.	100.00	100.00	99.48	99.58
Drying cacao beans using oven	16.66	0.00	n.a.	0.00	0.00	0.51	2.89
Not drying cacao beans	97.23	100.00	n.a.	100.00	100.00	100	99.59

Using other method for drying cacao	2.77	0.00	n.a.	0.00	0.00	0.00	0.41
Farmers (%) verifying cacao moisture, and % verifying moisture...:	2.77	0.00	n.a.	0.00	0.00	1.03	1.23
Doing tests with special equipment	14.09	2.91	0.00	0.00	1.40	44.06	21.30
By visual evaluation of the color of the beans	6.25	33.33	n.a.	n.a.	n.a.	1.58	2.65
Testing if the beans break	1.25	66.66	n.a.	n.a.	50.00	74.07	65.04
Using other method	90.62	0.00	n.a.	n.a.	100.00	97.35	95.13
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	**1061**

Table A 30. Cacao: quality and farm certifications at baseline

Cup quality and certifications	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) who consider their cacao of well quality, and % stating this is because…:	93.77	71.84	91.78	96.51	89.43	97.66	92.72
Uniform grain	41.23	28.37	74.62	33.73	37.79	39.61	40.77
Healthy grain	21.80	12.16	23.88	39.75	26.77	19.09	21.55
Variety planted	36.49	50.00	1.49	22.89	35.43	40.57	35.57
Other reason	0.47	9.45	0.00	3.61	0.00	0.07	1.42
Farmers (%) who can identify physical characteristics that affect cacao quality, and:	62.22	31.06	38.35	56.47	54.92	65.03	57.23
% who know three or more of these characteristics	25.71	15.53	7.14	24.13	19.01	43.58	27.23
Farmers (%) with farm certifications, and % farmers with…:	77.77	0.00	73.97	67.05	51.40	28.67	45.60
Organic certification	84.57	0.00	100.00	10.00	39.72	95.93	84.23
Fair trade certification	20.00	0.00	0.00	49.12	23.28	22.76	22.40
FLO certification	43.42	0.00	0.00	10.52	21.91	2.43	20.95
FLO-organic certification	2.28	0.00	0.00	26.31	1.36	4.87	5.39
UTZ certification	13.14	0.00	0.00	0.00	57.53	0.81	13.69
CLAC certification	45.14	0.00	0.00	0.00	1.36	0.00	16.59
Other certifications	0.00	0.00	0.00	0.00	1.32	1.62	0.62
Farmers (%) whose main cacao buyer is…:							
Intermediary	26.76	12.29	4.34	15.38	40.76	50.99	35.24
Local market	1.40	51.21	0.00	4.61	5.38	1.48	4.33
Cooperative or farmer organization	57.74	9.75	91.30	70.76	73.84	38.61	52.92
Other buyers	2.34	19.51	1.44	0.00	0.76	0.74	1.95
Farmers (%) selling cacao in these forms:							
Wet	78.77	15.63	89.86	82.81	4.61	0.99	2.27
Dry cacao beans	20.28	84.38	10.14	14.06	55.38	24.25	48.91
Mixed	0.94	0.00	0.00	3.13	21.53	12.87	9.32
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	**1061**

Table A 31. Cacao: characteristics of farms in the baseline year

Knowledge about cacao quality	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Total farm area (ha), and area (ha) under…:	8.11	2.93	4.33	3.01	15.40	8.92	7.13
Cacao	3.58	1.58	1.02	1.56	2.16	2.34	2.44
Coffee	0.34	1.21	0.00	0.00	1.13	0.11	0.27
Temporary (short cycle) crops	1.09	0.09	0.67	0.25	2.74	0.32	0.50
Permanent crops	0.20	0.09	0.44	0.28	0.55	0.10	0.17
For grazing or forage	1.69	0.23	0.05	0.64	n.a.	2.76	1.77
Rented out	0.04	0.00	0.01	0.00	n.a.	0.73	0.04
Fallow (>1 year unused)	0.23	0.18	1.78	0.10	n.a.	1.61	0.98
Non-agricultural (house, warehouse, etc.)	0.24	0.02	0.16	0.9	n.a.	0.13	0.14
Forest	0.69	0.10	0.57	0.6	n.a.	1.73	1.00
Households with more than one farm (%)	38.05	19.41	24.65	26.43	8.82	n.a	n.a
# of plots with (all) crops	1.70	1.11	1.78	1.2	16.90	19.11	23.86
Households (%) with…:					1.34	1.19	1.36
One cacao plot	71.36	96.12	84.93	81.60			
Two cacao plots	25.11	1.94	9.58	16.09	90.14	90.90	85.95
Three or more cacao plots	2.20	1.94	5.47	2.29	7.74	7.92	11.78
Land tenure (% HH):					0.00	0.93	1.60
Owning land with deed	81.49	96.11	65.75	51.72			
Owning land without deed	16.74	3.88	34.24	41.37	65.49	22.61	53.44
Not owning land	3.52	0.97	0.00	6.89	19.71	27.03	23.27
Farmers (%) doing a diagnosis of their farm or cacao crop	25.67	12.62	22.53	34.48	16.19	50.81	24.12
Farmers (%) not pruning cacao trees in the 2019-2020 ag. year, and main reason (%) for not pruning:	25.55	30.09	5.47	1.14	25.71	32.68	27.70
Don't know how to do it	32.75	3.22	100.00	0.00	11.97	9.32	14.23
Does not consider this relevant	12.06	3.22	0.00	0.00	17.64	35.00	25.82
Too costly	10.34	6.45	0.00	0.00	17.64	7.50	9.27
Cacao trees did not need pruning	15.51	29.03	0.00	100.00	11.76	2.50	7.28
Did not have time	17.24	12.9	0.00	0.00	17.64	20.00	19.86
No resources (human or financial)	24.13	9.67	0.00	0.00	35.29	27.50	20.52
Other reason	0.00	0.00	0.00	0.00	17.64	10.00	15.89
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	**1061**

*1 ha (hectare) = 10,000 square meters							

Table A 32 Cacao: use of fertilizers, pesticides and herbicides during the baseline year

Characteristics	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) applying fertilizers in baseline year, and % farmers…:	27.11	86.41	19.18	19.54	17.61	45.45	37.87
Applying only chemical fertilizers	54.10	60.67	0.00	23.53	80.00	58.97	56.36
Applying only organic fertilizers	16.39	6.74	100.00	70.59	8.00	26.15	23.69
Applying chemical and organic fertilizers	29.51	32.58	0.00	5.88	12.00	14.87	19.95
Most commonly used fertilizer according to the amount applied, and…:	Completo	15-15-15	Ferticomsa	Compostaje	Ferticacao	NPK	NPK
% farmers applying this fertilizer	23.33	71.91	71.43	37.5	20.83	48.97	23.93
# times it was applied during the agricultural year	1.71	1.81	1.60	1.00	1.40	1.24	1.24
Farmers (%) applying pesticides (insects or diseases) in baseline year	3.21	34.88	0.00	0.00	7.03	2.17	4.01
Main insect pests or diseases affecting the cacao crop (% farmers):							
No insect or diseases affected	1.81	50.49	5.48	24.14	2.82	3.26	10.58
Monilia (Monilia roreri E)	90.95	17.64	78.26	84.85	82.73	78.61	79.17
Black pods (Phytopthora)	16.74	54.90	82.61	93.94	78.26	15.63	37.19
Witches broom (Crinipellis perniciosa)	70.14	1.96	0.00	0.00	0.00	33.89	30.94
Pod worm (mazorquero)	0.45	1.96	4.35	0.00	0.72	9.62	4.79
Other	1.80	9.80	0.00	0.00	0.00	13.70	6.87
For the first insect pest, % farmers…:							
Doing field evaluation	100.00	50.00	33.33	n.a.	0.00	32.50	70.59
Reporting <10% incidence	100.00	0.00	66.67	n.a.	100.00	25.00	17.65
Reporting 11-30% incidence	0.00	100.00	33.33	n.a.	0.00	62.50	39.22
Reporting 31-50% incidence	0.00	0.00	0.00	n.a.	0.00	12.50	35.29
Reporting >50% incidence	0.00	0.00	0.00	n.a.	0.00	0.00	7.84

Not controlling it	100.00	0.00	33.33	n.a.	0.00	5.00	1.96
Using cultural control	0.00	0.00	33.33	n.a.	0.00	80.00	94.12
Using biological control	0.00	100.00	33.33	n.a.	0.00	0.00	1.96
Using chemical control	0.00	0.00	0.00	n.a.	0.00	0.00	0.00
Using other control methods	0.00	0.00	0.00	n.a.	0.00	12.50	1.96

Table A 32. Continued

Characteristics	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
For the second insect pest, % farmers…:							
Doing field evaluation	75.00	100.00	n.a.	n.a.	n.a.	2.86	100.00
Reporting <10% incidence	25.00	0.00	n.a.	n.a.	n.a.	17.14	32.61
Reporting 11-30% incidence	0.00	50.00	n.a.	n.a.	n.a.	28.57	56.52
Reporting 31-50% incidence	75.00	50.00	n.a.	n.a.	n.a.	42.86	10.87
Reporting >50% incidence	0.00	0.00	n.a.	n.a.	n.a.	11.43	0.00
Not controlling it	100.00	100.00	n.a.	n.a.	n.a.	0.00	8.70
Using cultural control	0.00	0.00	n.a.	n.a.	n.a.	90.91	73.91
Using biological control	0.00	0.00	n.a.	n.a.	n.a.	0.00	2.17
Using chemical control	0.00	0.00	n.a.	n.a.	n.a.	4.55	2.17
Using etological control	0.00	0.00	n.a.	n.a.	n.a.	4.55	10.87
Using other control methods	0.00	0.00	n.a.	n.a.	n.a.	0.00	2.17
For the first disease, % farmers…:							
Doing field evaluation	18.91	46.43	44.44	70.97	48.70	63.61	49.34
Reporting <10% incidence	21.39	25.00	75.93	30.65	59.13	25.69	33.20
Reporting 11-30% incidence	44.78	50.00	16.67	35.48	26.96	51.99	42.91
Reporting 31-50% incidence	21.89	17.86	7.41	19.35	10.43	16.82	16.67
Reporting >50% incidence	11.94	7.14	0.00	14.52	3.48	5.50	7.22
Not controlling it	27.36	17.86	9.26	8.06	0.87	0.61	9.06
Using cultural control	54.23	50.00	62.96	85.48	87.83	90.83	77.56
Using biological control	1.49	0.00	5.56	0.00	1.74	2.14	1.97
Using chemical control	3.48	32.14	0.00	0.00	0.87	1.22	2.36
Using other control methods	13.43	0.00	22.22	6.25	9.57	5.20	9.06
For the second disease, % farmers…:							
Doing field evaluation	15.75	100.00	33.33	71.15	45.37	0.00	28.28
Reporting <10% incidence	45.81	22.22	88.89	26.79	59.86	15.38	18.52
Reporting 11-30% incidence	23.87	66.67	11.11	37.50	26.06	64.62	51.18
Reporting 31-50% incidence	14.84	11.11	0.00	19.64	9.86	15.38	20.54
Reporting >50% incidence	0.00	0.00	0.00	16.07	4.23	4.62	9.76

Not controlling it	29.03	0.00	0.00	10.71	1.85	0.00	15.15
Using cultural control	50.32	33.33	66.67	83.93	79.63	90.77	69.02
Using biological control	1.29	0.00	11.11	0.00	1.85	4.62	2.02
Using chemical control	2.58	66.67	0.00	0.00	7.41	3.08	1.68
Using other control methods	16.77	0.00	22.22	5.36	9.26	1.54	12.12
Farmers (%) applying herbicides in the 2019-2020 ag. year, and…:	16.37	5.83	0.00	0.00	7.80	10.72	9.44
Applying it focalized/using screen	45.94	66.66	0.00	0.00	54.54	84.44	67.04
Farmers (%) using mower	76.55	47.57	73.97	13.79	9.22	82.28	69.83
Farmers (%) scheduling weed control	7.08	38.83	38.36	31.03	33.33	27.97	25.16
Farmers (%) making selective weed control	8.85	53.37	17.81	16.09	21.99	13.05	17.32
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	**1061**

Table A 33. Cacao: genetic planting materials in nurseries, and grafting at baseline

Nurseries and grafting in baseline year	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Nursery							
Farmers (%) managing a cacao nursery in their farms, and…:	3.11	4.85	6.84	3.44	13.38	18.41	10.79
# seedlings (plants)	1271.42	480.00	615.00	184.00	551.66	884.82	803.44
For farmers with nurseries or acquiring cacao seedlings, % reporting:							
Seedlings coming from own seedbeds	58.69	35.00	9.67	30.76	80.76	73.45	58.23
Buying the seedlings	10.86	15.00	74.19	30.76	11.53	23.00	25.70
Obtaining seedlings for free (NGO, relatives, friends, etc.)	17.39	55.00	6.45	38.46	11.53	4.42	13.65
Obtaining seedlings from other sources	0.00	5.00	0.00	0.00	0.00	0.88	0.80
For farmers buying cacao seedlings, % reporting this source:							
Neighbor	0.00	0.00	40.00	0.00	33.33	19.23	11.43
Certified nursery	68.97	66.67	0.00	75.00	33.33	26.92	47.14
Non-certified nursery	20.69	33.33	40.00	25.00	33.33	46.15	32.86
Other source	10.34	0.00	20.00	0.00	0.00	7.69	8.57
For farmers not buying from certified nurseries, % who know where to	30.76	22.22	18.75	100.00	0.00	36.44	34.35

acquire certified or verified plants							
For farmers buying cacao seedlings:	56.52	15.00	6.45	30.77	80.77	23.01	33.73
Amout (#) of seedlings purchased	3249.40	323.33	565.00	284.25	133.33	618.73	1665.43
Price paid per unit	0.04	0.01	0.02	0.02	0.12	0.17	0.09
% stating the seedlings quality was well or excellent	93.48	95.00	93.75	92.21	77.78	84.07	87.65
For farmers buying seedlings, % willing to pay more for a certified or verified genetic material	66.66	66.67	50.00	100.00	31.81	79.16	61.90

Table A 33. Continued

Nurseries and grafting in baseline year	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Grafting							
Farmers (%) doing grafting in their cacao plantations, and...:	4.00	22.33	26.02	9.19	0.70	21.44	14.35
% farmers grafting seedlings	22.22	0.00	0.00	0.00	0.00	7.61	5.96
% farmers grafting grown trees	77.78	100.00	100.00	100.00	100.00	90.22	92.72
Most common variety/clone grafted (and % farmers)	CCN-51 (33.33)	Trinitario (43.48)	UF (42.11)	ICS - 95 (75.00)	n.a.	CCN-51 (43.48)	CCN-51 (33.78)
Total plants grafted (#)	718.33	395.95	482.36	22.75	50	451.35	437.46
% farmers paying to get this service in their farms, and...:	33.33	4.35	10.53	0.00	100.00	57.61	38.82
For farmers grafting, % considering this is:							
Very important	55.56	52.17	63.16	100.00	0.00	55.43	58.28
Important	33.33	47.83	36.84	0.00	100.00	43.48	40.40
Neutral	11.11	0.00	0.00	0.00	0.00	1.09	1.32
Less important	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Not important	0.00	0.00	0.00	0.00	0.00	0.00	0.00
For farmers grafting, % reporting they learned this from:							
NGO, training by any institution	55.56	95.65	73.68	87.50	87.50	38.04	54.97
Neighbor	22.22	0.00	10.53	0.00	0.00	22.83	16.56
Relative	11.11	0.00	10.53	0.00	0.00	15.22	11.26
Other source	11.11	4.35	5.26	12.50	12.50	23.91	17.22
Farmers (%) considering their knowledge about grafting is:							
High	55.56	13.04	5.26	0.00	0.00	30.43	24.34
Medium	33.33	78.26	94.74	100.00	0.00	45.65	58.55
Low	11.11	8.70	0.00	0.00	100.00	19.57	14.47
Non existent	0.00	0.00	0.00	0.00	0.00	4.35	2.63
Number of households	**227**	**103**	**73**	**97**	**142**	**429**	**1061**

Table A 34. Cacao: access to products of cacao research at baseline

Details	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) who reported ever receiving information about cacao research products	26.22	25.24	26.02	33.33	32.39	17.71	24.07
Source of this information (%):							
Internet	3.39	0.00	0.00	3.45	0.00	2.63	1.96
Neighbor or relative	5.08	0.00	0.00	0.00	19.57	5.26	6.27
NGO	25.42	76.92	78.95	89.66	69.57	39.47	54.12
Government or extensionist	35.59	23.08	15.79	6.9	6.52	35.53	24.31
Other	30.51	0.00	5.26	0.00	4.35	17.11	13-33
Farmers (%) reporting this information cost them	6.90	0.00	5.26	31.03	15.56	15.79	13.04
Farmers (%) using this information to make farming decisions	88.14	96.15	89.47	89.66	91.11	97.37	92.52
If did not use this information, why not? (%):							
Was not useful	12.50	0.00	0.00	0.00	0.00	50.00	10.00
Difficult to understand	25.00	0.00	100.00	0.00	25.00	50.00	30.00
Could not implement the recommendations	12.50	100.00	0.00	66.67	50.00	0.00	30.00
None of the recommendations were needed in my farm	25.00	0.00	0.00	0.00	25.00	0.00	15.00
Other reason	25.00	0.00	0.00	33.33	0.00	0.00	15.00
When in need of technical advice for cacao, farmers (%) contacting...:							
No one	20.09	1.94	46.48	5.75	47.18	4.90	16.38
A relative	18.75	2.91	5.63	27.59	11.27	21.45	17.14
A neighbor with a cacao farm	4.46	0.00	0.00	8.05	7.75	1.63	3.31
NGO technician	27.68	96.12	46.48	74.71	33.80	26.57	39.87
Government technician	20.09	0.97	0.00	3.45	1.41	39.16	20.74
Other	20.09	0.00	1.41	12.64	16.32	16.32	12.03
For farmers contacting a technician, most common way to contact them (%):					-	-	-
Visit to their office	9.28	1.01	24.24	2.99	2.00	7.06	6.50

Call over cellular	63.92	63.64	42.42	49.25	48.00	17.47	39.51
E-mail	0.00	0.00	0.00	0.00	2.00	0.00	0.16
Wait for them to visit me	26.80	35.35	33.33	47.76	48.00	75.46	58.32
Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00
For farmers contacting no one to seek technical advice, % who...:							
Never clarify their doubts	22.92	50	87.88	42.86	68.66	47.62	56.18
Ask a relative/neighbor/friend for advise	47.92	0.00	12.12	57.14	29.85	19.05	30.90
Go to agro-dealer	18.75	50.00	0.00	0.00	0.00	19.05	7.87
Clarify doubts using other means	10.42	0.00	0.00	0.00	1.49	14.29	5.06
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	**1061**

Table A 35. Cacao: genetic materials most commonly grown (main 3 cacao varieties)

Details of cacao varieties	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Density #tress/ha	819	762	890	722	615	1064	887
Age (yr) of cacao trees:	21.15	3.46	12.42	13.38	10.84	9.29	11.72
# of trees planted							
Variety 1	1648.15	998.81	764.82	942.56	965.57	2388.35	2813.00
Variety 2	3899.61	547.20	816.91	277.58	1574.61	1893.44	1790.29
Variety 3	967.04	1141.40	588.70	1676.00	804.41	995.00	1606.28
# of trees planted/ha:							
Variety 1	365.91	888.29	437.09	375.35	645.56	557.65	538.75
Variety 2	492.52	468.79	465.55	405.87	603.26	501.93	498.88
Variety 3	397.04	836.29	375.93	302.97	654.22	435.02	370.34
% of productive trees:							
Variety 1	87.07	34.95	83.47	73.69	762.11	88.44	90.35
Variety 2	92.88	11.69	71.76	69.39	1394.94	81.88	80.33
Variety 3	66.73	21.26	91.67	84.12	582.47	88.94	87.14
Age (yr) of cacao trees:							
Variety 1	35.2	3.66	15.65	13.51	7.33	6.37	8.03
Variety 2	12.24	3.26	8.47	3.39	12.92	12.49	11.92
Variety 3	15.86	3.58	10.10	22.07	8.79	9.60	33.56
Distance (m x m) between trees:							
Variety 1	3x3	3x3	4x4	3.5x3.5	3x3	3x3	3x3
Variety 2	3x3	3x3	3x3	3.5x3.5	3x3	3x3	3x3
Variety 3	3x3	3x3	4x4	4x4	4x4	3x3	3x3
% trees renovated by grafting or by seeds							
Variety 1	12.15	0.20	0.00	0.95	1.89	1.25	1.59
Variety 2	2.46	0.20	5.06	1.70	2.06	3.45	3.18
Variety 3	1.22	4.16	0.14	0.00	0.34	1.29	11.46
% trees renovated by grafting adult trees i							
Variety 1	0.80	0.85	0.00	0.23	0.18	0.43	0.60
Variety 2	0.60	0.00	2.31	0.32	0.34	1.31	1.19
Variety 3	0.00	0.00	0.14	0.00	0.00	6.46	0.81
% trees that need to be renovated:							
Variety 1	22.03	2.44	17.12	19.47	9.84	4.93	4.70
Variety 2	4.06	5.31	12.9	4.27	12.89	15.36	14.62
Variety 3	24.23	4.81	7.75	19.67	17.85	4.21	20.89
% farmers who pruned trees							
Variety 1	57.53	77.97	91.18	100.00	83.33	86.01	84.75
Variety 2	81.44	80.00	87.50	96.77	94.87	91.01	90.31
Variety 3	72.73	80.00	100.00	85.71	80.56	80.00	59.97
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	**1061**

Table A 36. Cacao: family and hired labor in cacao plots, at baseline

Use of labor details	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Nursery activities							
Households (%) with members working on this activity, and...:	3.08	2.91	4.10	2.29	9.15	16.55	9.33
# people/ha	1.05	3.09	1.00	0.28	1.83	1.57	1.54
# of days worked in total/ha	9.32	6.66	5.55	0.28	16.09	9.98	10.29
Households (%) hiring labor to work on this activity, and...:	0.88	0.97	2.73	1.14	5.63	2.56	2.35
# people/ha	0.19	0.17	2.32	0.14	0.58	0.15	0.29
# of days worked in total/ha	15.33	0.00	13.31	0.28	2.17	7.2	6.81
Land preparation for planting							
Households (%) with members working on this activity, and...:	27.31	26.21	30.13	3.44	9.85	23.77	21.67
# people/ha	0.46	1.43	2.02	0.48	2.48	0.74	0.82
# of days worked in total/ha	4.93	8.77	6.05	18.19	12.92	4.05	5.48
Households (%) hiring labor to work on this activity, and...:	20.70	32.03	28.76	17.24	9.50	12.12	28.55
# people/ha	0.31	1.67	1.86	0.45	0.78	0.36	0.52
# of days worked in total/ha	5.01	13.93	6.83	8.17	9.98	3.89	6.25
Cacao planting (includes renovation)							
Households (%) with members working on this activity, and...:	1.32	1.94	4.10	1.14	7.04	10.25	5.93
# people/ha	0.85	0.42	4.67	2.85	1.21	1.05	1.26
# of days worked in total/ha	1.98	4.28	2.18	2.85	2.51	3.56	3.31
Households (%) hiring labor to work on this activity, and...:	0.00	2.91	2.73	1.14	3.52	2.33	1.97
# people/ha	0.00	5.17	1.94	2.85	0.32	0.23	0.56
# of days worked in total/ha	0.00	10.30	4.34	2.85	1.14	0.66	2.13
Weeding							
Households (%) with members working on this activity, and...:	70.48	50.48	73.97	63.21	50.70	63.63	52.21
# people/ha	1.30	2.49	4.43	2.05	1.58	1.02	1.43

# of days worked in total/ha	4.88	8.39	8.06	9.37	4.58	6.83	5.97
Households (%) hiring labor to work on this activity, and...:	50.22	65.04	54.79	39.08	18.30	39.39	32.89
# people/ha	0.72	3.49	3.86	1.02	0.39	0.75	0.87
# of days worked in total/ha	5.49	9.22	6.21	5.31	2.24	5.82	4.68

Table A 36. Continued

Use of labor details	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Cacao pruning (includes rehabilitation)							
Households (%) with members working on this activity, and...:	32.59	37.86	73.97	48.27	9.15	40.32	29.12
# people/ha	0.93	3.19	4.35	1.92	0.94	1.41	1.36
# of days worked in total/ha	2.89	8.41	7.86	6.48	2.52	3.19	2.90
Households (%) hiring labor to work on this activity, and...:	27.31	39.80	47.94	18.39	9.15	11.88	14.04
# people/ha	0.56	1.67	2.48	0.74	0.74	0.15	0.28
# of days worked in total/ha	3.16	4.86	4.05	4.94	2.35	2.38	2.16
Fertilizer application							
Households (%) with members working on this activity, and...:	22.46	46.60	17.80	12.64	6.33	0.46	1.69
# people/ha	0.99	3.22	2.77	1.33	1.93	0.50	1.10
# of days worked in total/ha	1.87	6.35	3.74	2.17	2.38	1.00	1.91
Households (%) hiring labor to work on this activity, and...:	9.69	52.42	5.47	5.74	0.70	0.93	2.54
# people/ha	0.23	1.77	0.48	0.40	22.22	0.08	4.63
# of days worked in total/ha	0.98	4.52	2.09	1.14	0.00	0.66	1.50
Pesticides application							
Households (%) with members working on this activity, and...:	0.88	4.85	0.00	0.00	2.11	43.58	21.48
# people/ha	0.40	2.71	0.00	0.00	0.51	0.65	0.71
# of days worked in total/ha	0.76	6.92	0.00	0.00	1.53	6.83	7.04
Households (%) hiring labor to work on this activity, and...:	0.44	20.38	0.00	0.00	0.00	12.58	6.22
# people/ha	0.01	0.65	0.00	0.00	0.00	0.29	0.27

# of days worked in total/ha	0.05	3.43	0.00	0.00	0.00	3.80	3.36
Post-harvest (fermenting, drying) activities					9.15	40.32	29.12
Households (%) with members working on this activity, and...:	14.53	4.85	0.00	0.00	0.94	1.41	1.36
# people/ha	1.40	0.36	0.00	0.00	2.52	3.19	2.90
# of days worked in total/ha	9.08	6.00	0.00	0.00	9.15	11.88	14.04
Households (%) hiring labor to work on this activity, and...:	3.52	3.88	0.00	0.00	0.74	0.15	0.28
# people/ha	0.07	0.07	0.00	0.00	2.35	2.38	2.16
# of days worked in total/ha	1.65	1.15	0.00	0.00			

Table A 36. Continued

Use of labor details	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Cacao harvesting							
Households (%) with members working on this activity, and...:	82.37	19.41	84.93	68.96	71.12	90.20	77.00
# people/ha	7.85	0.88	4.83	5.62	1.25	6.24	1.90
# of days worked in total/ha	1.96	0.84	16.55	1.56	12.39	1.84	7.21
Households (%) hiring labor to work on this activity, and...:	34.36	22.33	46.57	32.18	26.76	41.49	35.72
# people/ha	0.94	1.15	2.76	3.11	1.11	1.78	0.90
# of days worked in total/ha	0.67	0.66	4.66	0.60	0.35	0.93	1.84
Other crop management activities							
Households (%) with members working on this activity, and...:	44.05	12.62	32.87	22.98	4.22	48.95	35.15
# people/ha	0.48	0.70	0.81	0.42	1.57	0.50	0.53
# of days worked in total/ha	2.69	20.25	4.68	3.92	7.84	8.08	6.03
Households (%) hiring labor to work on this activity, and...:	22.90	20.38	28.76	12.64	0.70	5.12	12.06
# people/ha	0.25	0.65	3.07	0.21	0.00	0.06	0.42
# of days worked in total/ha	2.91	4.79	8.26	2.40	0.00	7.29	4.63
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	**1061**
*1 ha (hectare) = 10,000 square meters							

Table A 37. Other main two crops grown (according to the quantity produced) by cacao farmers at baseline

Other crops details for the baseline year	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
Farmers (%) reporting growing crops other than cacao	25.55	0.97	38.35	20.68	72.53	5.59	14.04
Number of other crops grown	1.58	6.00	1.65	1.46	4.90	2.10	3.13
Farmers (%) providing complete information about other crops, and…:	42.96	19.23	25.71	10.71	61.16	13.55	40.94
Most commonly reported crop 1 (and % farmers)	Orange (33.33)	Plantain (38.46)	Corn (40.00)	Plantain (38.39)	Beans(58. 88)	Plantain (45.76)	Plantain (32.60)
Most commonly reported crop 2 (and % farmers)	Plantain (61.67)	Other crop (80.00)	Other crop(90.00)	Corn (46.15)	Corn (77.94(	Plantain (33.33)	Plantain (46.39)
Total area (ha) under these two crops	2.58	0.22	2.96	0.53	2.26	0.18	1.20
Farmers (%) reporting selling part of the harvest of these two crops	84.44	84.61	82.85	67.85	89.32	64.40	80.66
Share (%) of production sold	69.10	85.47	68.51	61.38	67.53	67.70	68.86
Income (US$) from sales from these two crops	561.6	399.54	23.19	23.42	171.75	122.70	232.68
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	**1061**

Table A 38. Cacao: household and home characteristics, and household income at baseline

Details	Ecuador	El Salvador	Guatemala	Honduras	Nicaragua	Peru	All countries
HH characteristics							
HH with two heads (%):	5.82	2.73	34.48	79.57	32.86	34.46	88.68
If >1 head, age of hh heads (yrs)	54.87	48.23	41.5	46.14	45.61	45.05	48.22
House size	2.06	**1.22**	1.20	1.93	4.16	1.89	2.12
Dependency rate	31.53	19.02	21.23	24.48	35.27	18.14	24.11
% HHs where at least one member migrated within last 12 months:	3.58	0.97	4.11	3.45	4.22	13.51	7.97
# members who migrated	1.75	2	1	1	1.50	2.05	1.93
% HHs with at least one member migrating to another country	25.00	100.00	100.00	33.33	50.00	12.07	15.07
% HHs receiving subsidy from the government or NGOs	6.67	15.15	12.33	2.30	2.82	34.50	20.70
Effect of COVID19 pandemic to your HH (%):							
Has had no effect	33.33	42.35	76.71	93.75	85.11	53.27	52.81
Effect 1	Higher prices (52.89)	Labor lack for crop management(34.12)	Higher prices (9.59)	Harvest lost (2.5)	Lower price (9.93)	Higher prices (27.34)	Lower price (28.99)
Effect 2	Lost the harvest (4.89)	Harvest lost (12.94)	Harvest lost (6.85)	Labor lack for crop management (1.25)	Labor lack for crop management (2.84)	Harvest lost (6.31)	Labor lack to harvest (6.74)
Effect 3	Labor lack to harvest (2.22)	Labor lack to harvest (4.71)	Lower price (4.11)	n.a.	Labor lack to harvest (0.71)	Labor lack to harvest (5.84)	Harvest lost (4.49)
Other effect	6.67	2.35	2.74	2.50	1.42	7.24	6.97
Home characteristics							
Has water source within home (% yes)	85.46	92.23	67.12	97.70	73.94	78.08	82.48
If not, minutes walking to water source	18.70	12.00	8.37	11.00	6.52	7.97	10.36
Index of home assets	0.93	1.31	-0.60	0.13	-0.82	-0.78	0.00
Index of transportation assets	0.57	0.63	0.05	0.24	-0.51	-0.53	0.00

Index of productive assets	0.55	0.45	0.02	0.49	0.55	-0.48	0.00
Household income							
Total income ($)	4,507.56	850.06	1,183.80	2,107.78	1265.81	2,459.51	2,634.45
Agricultural income	3,794.82	519.48	821.64	1,114.78	932.04	2,363.45	2,256.07
Non-agricultural income	338.32	326.21	362.16	760.79	250.50	41.91	240.48
Number of households	**227**	**103**	**73**	**87**	**142**	**429**	1061

Table A 39. Cacao: descriptive statistics of variables included in the renovation & rehabilitation regressions

Variables	Central America	Ecuador	Peru	All countries
Did renovation (1=yes)	0.175	0.142	0.215	0.185
	[0.380]	[0.349]	[0.411]	[0.388]
Did rehabilitation (1=yes)	0.894	0.676	0.878	0.835
	[0.309]	[0.469]	[0.328]	[0.372]
Sex of HH head (1=male)	0.747	0.785	0.704	0.737
	[0.436]	[0.411]	[0.457]	[0.441]
HH head age (years)	49.777	56.881	47.756	50.570
	[15.301]	[14.403]	[13.563]	[14.772]
Joint decision (spouses) on purchase of cacao inputs (1=yes)	0.024	0.064	0.117	0.075
	[0.153]	[0.245]	[0.322]	[0.264]
Cacao area (ha)	1.575	3.598	2.371	2.410
	[1.480]	[4.350]	[5.097]	[4.156]
Number MOCCA practices implemented	5.349	4.913	6.169	5.610
	[1.279]	[1.532]	[1.473]	[1.521]
HH member migrated within last 6 months (1=yes)	0.031	0.041	0.139	0.082
	[0.173]	[0.199]	[0.347]	[0.274]
Received remittances (1=yes)	0.110	0.018	0.022	0.049
	[0.313]	[0.134]	[0.147]	[0.216]
Number of cacao varieties	1.568	1.315	1.154	1.324
	[1.115]	[0.555]	[0.536]	[0.791]
Distance to closest town (hours)	1.026	0.382	0.631	0.697
	[0.975]	[0.395]	[0.560]	[0.733]
Altitude (m.a.s.l.)	312	163	589	398
	[237]	[329]	[375]	[387]
Obtained information of cacao research products from NGOs or government (1=yes)	0.260	0.164	0.130	0.179
	[0.440]	[0.371]	[0.336]	[0.384]
Cacao age	8.25	21.15	7.76	11.48
	[7.310]	[18.421]	[6.164]	[12.524]
Access to credit (1=yes)	0.432	0.160	0.222	0.274
	[0.496]	[0.367]	[0.416]	[0.446]
Has shade crop with cacao (1=yes)	0.904	0.721	0.347	0.613
	[0.295]	[0.449]	[0.477]	[0.487]
Observations	**292**	**219**	**409**	**920**

Table A 40. Cacao: descriptive statistics of variables included in the yields regression

Variables	Central America	Ecuador	Peru	All countries
Cacao yields (kg dry/ha)	230.596	330.775	462.162	360.796
	[205.835]	[254.910]	[464.249]	[69.529]
Sex of HH head (1=male)	0.761	0.784	0.701	0.739
	[0.427]	[0.413]	[0.459]	[0.439]
HH head age (years)	50.42	57.04	47.98	50.94
	[15.683]	[14.570]	[13.546]	[14.898]
Joint decision (spouses) on purchase of cacao inputs (1=yes)	0.024	0.063	0.115	0.075
	[0.153]	[0.243]	[0.319]	[0.263]
Family labor: # members in all coffee activities	1.542	1.403	1.579	1.524
	[1.362	[1.380]	[1.482]	[1.423]
Cacao area (ha)	1.573	3.598	2.371	2.410
	[1.480]	[4.350]	[5.097]	[4.156]
Number MOCCA practices implemented	5.498	4.957	6.266	5.714
	[1.178]	[1.530]	[1.417]	[1.482]
HH member migrated within last 6 months (1=yes)	0.032	0.043	0.130	0.079
	[0.176]	[0.204]	[0.337]	[0.271]
Received remittances (1=yes)	0.096	0.019	0.021	0.043
	[0.295]	[0.138]	[0.143]	[0.202]
Number of cacao varieties	1.442	1.317	1.154	1.280
	[0.980]	[0.561]	[0.531]	[0.711]
Distance to closest town (hours)	1.094	0.357	0.641	0.706
	[1.001]	[0.362	[0.572]	[0.745]
Altitude (m.a.s.l.)	309	163	577	398
	[243]	[329]	[370]	[387]
Obtained information of cacao research products from NGOs or government (1=yes)	0.251	0.168	0.133	0.177
	[0.434]	[0.375]	[0.340]	[0.382]
Cacao age	8.599	21.603	7.891	11.485
	[6.561]	[18.126]	[6.011]	[11.986]
Owns land (1=yes)	0.920	0.966	0.456	0.720
	[0.271]	[0.181]	[0.499]	[0.449]
Number of certifications	0.880	1.644	0.391	0.846
	[1.013]	[1.203]	[0.696	[1.064]
Access to credit (1=yes)	0.426	0.163	0.224	0.269
	[0.496]	[0.371]	[0.417]	[0.444]
Has shade crop with cacao (1=yes)	0.896	0.740	0.341	0.605
	[0.305]	[0.439]	[0.475]	[0.489]
Observations	**193**	**230**	**228**	**973**

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