Pilot data analysis & methodological insights on labor measurement

Transforming Education in Cocoa Communities Program| TRECC



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INNOVATIONS FOR POVERTY ACTION

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About Innovations for Poverty Action

Innovations for Poverty Action (IPA) is a research and policy non-profit that discovers and promotes effective solutions to global poverty problems. IPA brings together researchers and decision-makers to design, rigorously evaluate, and refine these solutions and their applications, ensuring that the evidence created is used to improve the lives of the world's poor.
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Introduction

Objectives

This report provides an analysis of the data from the agricultural pilot research, which took place between June and August 2016. It is complementary to IPA's October 2016 Pilot Report, which offered a detailed account of the tasks accomplished, as well as key lessons learnt on the research protocols adopted in the field.

More specifically, this report has a threefold purpose:

- Present key descriptive statistics from the main survey on household characteristics, including demographics and education, plot characteristics, cocoa production and credits taken.
- Offer insights into survey data quality, and, based on that, provide recommendations on survey structure, phrasing of questions and enumerator training.
- Comparing data collected from GPS trackers and self-reported activity logs (as well as survey data) to measure household time allocation and draw evidence about how measurement changes across each of those instruments.

To whom is this report addressed?

This report is addressed to researchers, policy practitioners, donors and NGOs engaged in the cocoa sector and with an interest in measuring productivity of cocoa plots and household allocation of time across agricultural, domestic and remunerated work. One of the overarching goals of the study was indeed to measure the impact of productivity shocks on household decision-making, notably on decisions about sending children to school as opposed to asking them to participate in various forms of labor[1].

IPA's pilot had two key points of interest from a measurement standpoint:

a. How to collect rigorous and disaggregated information (at the individual-, plot-, crop-, season-level) on production inputs, and notably on labor, in order to relate inputs to outputs and effectively estimate a production function.

b. How to measure labor (agricultural and domestic) and household time allocation through a mix of self-reported and innovative measurement tools, i.e. a multi-disciplinary survey, activity logs and GPS trackers.

Structure

The report is structured into two parts, as follows:

PART A provides an **overview of field activities** and **descriptive statistics**. It is structured in the following sections:

Section 1 provides an overview of the activities accomplished and of the research tools that have been deployed, including how these were conceived and their complementarity.

Section 2 presents a range of household-level characteristics. It aims to give a portrait of the typical household in the villages that hosted the pilot, describing its education level, composition and occupation.

[1] More precisely, the research aimed, among others, to study how households dynamically adjust household labor demand, including child labor, as a result of variations (notably increases) in plot-level productivity.

Section 3 revolves around plot characteristics and agricultural practices in our villages, first for all crops and then for cocoa. Section 4 focuses more specifically on cocoa production, yields and related revenues.

Section 5 presents data on the credits taken by households, including their amounts and purposes.

PART B focuses on the measurement of household labor through GPS trackers vs. self-reported tools (i.e. survey and activity logs). It is composed of the following sections:

Sections 6-8 are dedicated to labor, in this order: agricultural, domestic and remunerated labor. They provide in turn initial statistics on the amount and intensity (frequency) of work done by individuals and households in our sample.

Section 9 compares labor data across the three measurement tools that IPA has piloted, i.e. survey, GPS trackers and activity logs. It provides some suggestions as to the reliability of each measurement tool as well as on how these could be combined to achieve higher-quality data.

Each of the sections mentioned above ends with some remarks on data quality, and, based on those, offers some recommendations for structuring the survey and training enumerators.

In addition, the main report is accompanied by **two annexes:**

- **Annex 1:** provides evidence on the actual utilization of GPS trackers and activity logs among participating households. Measuring utilization of these devices is the first indispensable step in assessing the feasibility of these measurement tools for collecting information on households' time allocation.
- **Annex 2** lists all relevant figures and data, some of which were not included in the present report for analytical purposes and readability.

Finally, the research tools piloted, which have been designed by Prof. Andrew Dillon – the survey and the activity logs – can also be made available upon request.

PART A

Overview and descriptive statistics

1. Overview of pilot activities

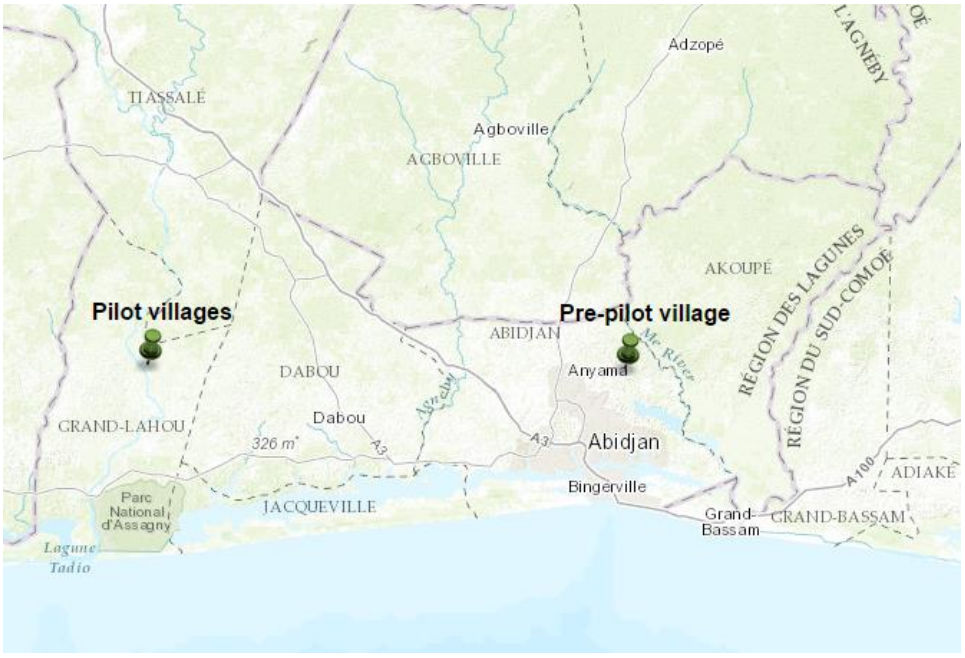


Figure 1. Map of pre-pilot and pilot villages.

The research pilot was structured **in two phases**: a pre-pilot and an actual one.

The aim of the **pre-pilot** was to conduct a first round of testing of our tools and protocols, train our enumerators in the field and pilot the logistics of the mission. The pre-pilot took place over 4 days (18, 20-22 June 2016) in the village of Ahoué, situated 45 minutes outside Abidjan, off the highway to Alépé – see Figure 1. Data collected during this pilot was not used.

The **full-blown pilot** took place across two villages – Ahouanou and Ahougnanfoutou – in the Grand-Lahou Region, from July 25 to July 29 2016. In addition, 4 follow-up missions were organized on a weekly basis to monitor utilization of trackers and the filling in of the activity logs. The last visit took place on August 31st.

The pilot's objective has been to test 4 main research instruments:

1. **Survey**

A survey, which lasted from 2 to 4 hours per household depending on its size and number of cultivated plots, was administered by IPA-trained enumerators at each household's premises. The survey was structured around the following modules:

Table 1. Structure of the questionnaire.

Module	Type of data collected
1. Composition of household	Demographic and basic socio-economic information about each household member.
2. Agricultural information	General information on the number of plots being exploited, the period of exploitation, the main crops and the land rights held.
3. Production	Granular information on production and sales, by season-plot-crop.
4. Use of fertilizers	Use of fertilizers and other inputs, by season-plot-crop.
5. Cocoa fields	Detailed data on agricultural practices being adopted on cocoa fields.
6. Work in the fields	Plot-level data on number of men, women and children/day deployed during the last agricultural season, disaggregated by activity type (e.g. land preparation, planting, harvesting, etc.).
7. Non-domestic work	Nature, remuneration and seasonality of paid and unpaid work undertaken by each household member, during the last 12 months.
8. Domestic work	Time allocated to conducting domestic activities, such as cooking, fetching water or going to the market, by household member engaged in these activities.
9. Credit	Number, amount and purpose of credits taken over the last 12 months, by household member.

2. Activity logs

Activity logs are dairies where farmers and their children enter their daily activities, including farming, domestic activities such as housework and cooking, and leisure time. These have been conceived to be as much user-friendly as possible (anticipating substantial illiteracy rates in rural farming areas). Activity logs constitute another self-reported assessment of time allocation, which complements survey data by *providing high-frequency data on recurring activities of interest*, as opposed to one-off responses to an enumerator.

3. Tracking devices

Selected household were asked to wear GPS tracking devices for a 4-week period. Trackers would be a complementary solution to self-reported data (i.e. survey data and activity log data) to study household-level allocation of time between domestic and farming activities. The logics is to distribute trackers, verify actual utilization and match tracking data with GPS of certain locations of interest, such as family plots, school, house, the local market, etc. This would allow to estimate the actual time spent doing such activities, without relying on self-reported information that may sometimes be characterized by recall flaws or other respondent bias.

Another key objective of the pilot was to compare data across the three instruments described so far (survey, activity logs and trackers) and analyze how outcomes differed (or not) from one another.

Table 2. Distribution of trackers and activity logs among households.

	Gender	
Age	Men	Women
Adult	10	10
Children	8	11
Total	**18**	**21**

Trackers and activity logs were distributed to the same households for ease of comparability. Eventually, 39 trackers and an equal number of activity logs were distributed to the same 10 households (5 per village). Within each household, the two instruments were given to the head of household, his spouse and two of their children aged 8-15 years. The table below describes distribution of trackers and activity logs:

4. Community evaluators

Community evaluators were village residents tasked with helping the household that were selected to wear trackers and fill out activity logs. Their role consisted of reminding and assisting individuals to fill in the logs, recharging tracker batteries and detecting when a device was not properly functioning, answer questions about the rationale of the two instruments and collect information as to what practical difficulties people encountered.

A pool of potential candidates was trained by IPA staff on a one-day workshop, at the end of which 2 community evaluators (one per village) were recruited based on performance in a written test.

The following table summarizes the targets attained during the main pilot.

Table 3. Pilot key results.

Activity	**Ahouanou**	**Ahougnanfoutou**	**Total**
Households surveyed	11	10	**21**
Trackers & activity logs distributed	19	20	**39**
Community-evaluators trained	2	3	**5**
Community-evaluators recruited	1	1	**2**

Box 1. Selection of pilot villages

Villages were selected based on four main criteria:

1. Cocoa represents a main source of income for a sufficient number of households;
2. The distance between the village and Abidjan would allow frequent monitoring visits, notably to monitor tracker and activity log use;
3. The two villages
4. Local authorities support IPA's mission and are willing to mobilize their community for the purposes of research.

Ahouanou is a large village of approximately 20,000 inhabitants that is easily accessible through an unpaved road off the "Route de Grand-Lahou", in the South-Center region of the country. The village is connected to the electric grid but has no running water. There is a primary school and a newly opened college, as well as a dispensary which also serves as hospital/first aid facility. A cocoa producers' cooperative is currently being established. Ahougnanfoutou is a smaller village (approximately 1,000 inhabitants), situated 10 kilometers away. While easily accessible, the village is not electrified and power comes mostly from isolated solar panels. Running water is not provided either. The village houses a primary school. Most of everyday goods are sourced from the local market and boutiques of Ahouanou. In both villages, cocoa growing is one of the main sources of income for a number of households, alongside other cash crops such as rubber tree.

2. Household characteristics

Before focusing on agricultural practice, cocoa production and labor, it is worth presenting the typical characteristics of households in Ahouanou and Ahougnanfoutou, in terms of demographics, education and occupation.

The definition of household that has been employed builds onto three inclusion criteria:

1. Household members share living spaces (at least at one point in the year);
2. They share resources (financial, produce, etc.) to meet essential needs;
3. They are subjected to the authority of a member of the household, i.e. the household's head.

2.1 Demographics

The average household counts 12 members. There is however a gap between the two villages, with Ahouanou, the larger among them, housing bigger households – on average 17 members v. 7 members in Ahougnanfoutou.

In both villages, the household head is always a man - aged on average 54.

The typical household has 2.7 girls (0-14 years old) and 3.2 boys of the same age cohort. All households had at least 1 child (male or female) in the 0-14 age cohort.

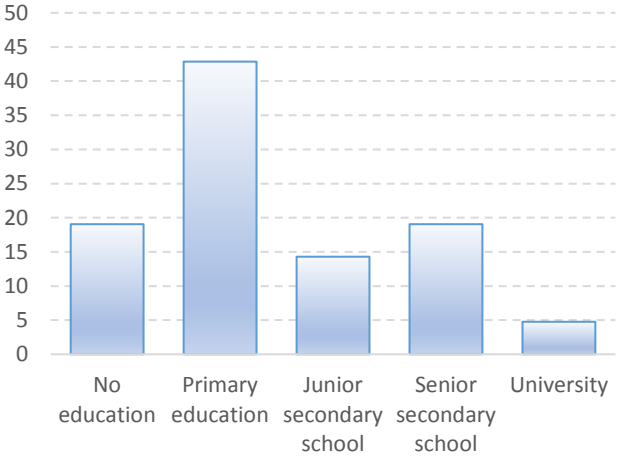
Most households (81% of total) have at least 1 child in the primary school official age range (6-11 years old); and more than half had at least 2 children in primary school age.

Most often (76% of all households), heads of households are married through religious or customary ceremonies.

2.2 Education

Figure 2 offers a breakdown of the level of education achieved by household heads. **In most cases (43% of all households), the head has attained a primary education level.** 14% went on to junior secondary school and a higher percentage (19%) completed senior secondary school.

Figure 2. Education level of household heads.



The share of heads **who did not attend school stands at 19%.**

Women's access to education appears to be substantially **lower than men's**, across all age ranges. Among children aged 6-14 (Figure 3), girls appear to be less likely to go to primary school and are more likely to drop out before completing junior secondary school than boys.

In the 15-24 age cohort (Figure 4), only 3.4% of boys are reported to have never been in school, whereas the percentage rises to almost 15% for girls. Although overall a higher fraction of girls than men holds at least a secondary degree, completion of more advance studies (i.e. of senior secondary and higher education) is more frequent for boys than for girls.

Among people aged older than 25 (Figure 5), 41.5% of women declare to have never been at school, while the same statistic for men drops to 25%; in addition, less than 5% of women completed junior secondary school, as opposed to more than 30% of men.

A comparison of Figure 4 and 5 also suggests that educational attainment has improved for the new generations, with decreasing levels of fully uneducated individuals (from above 33% down to 9%) and increasing levels of junior secondary completion, the largest gain being achieved by women.

Figure 3. Education of girls and boys, 6 to 14 years old.

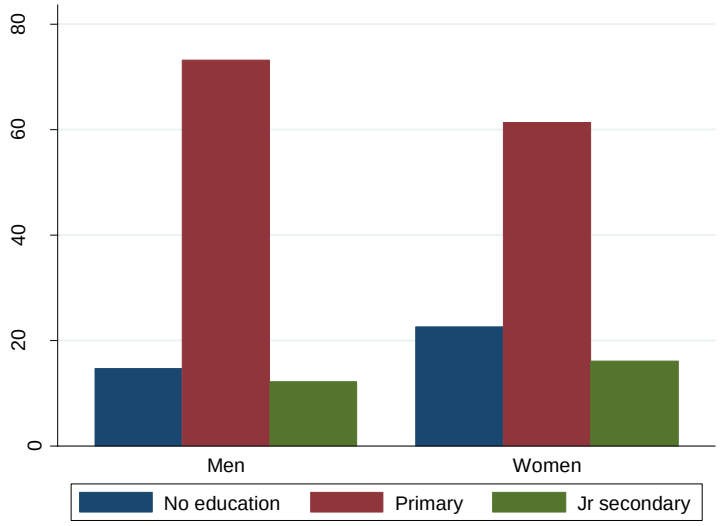


Figure 4. Education among individuals aged 15-24.

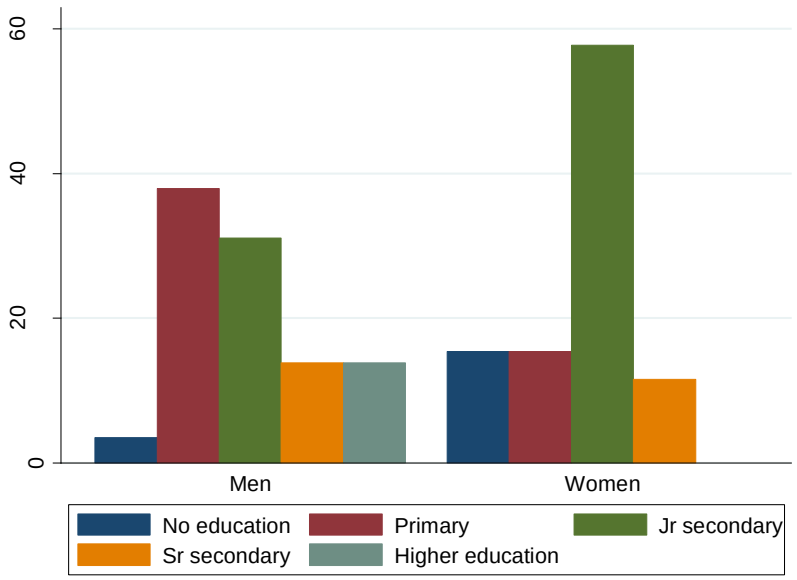
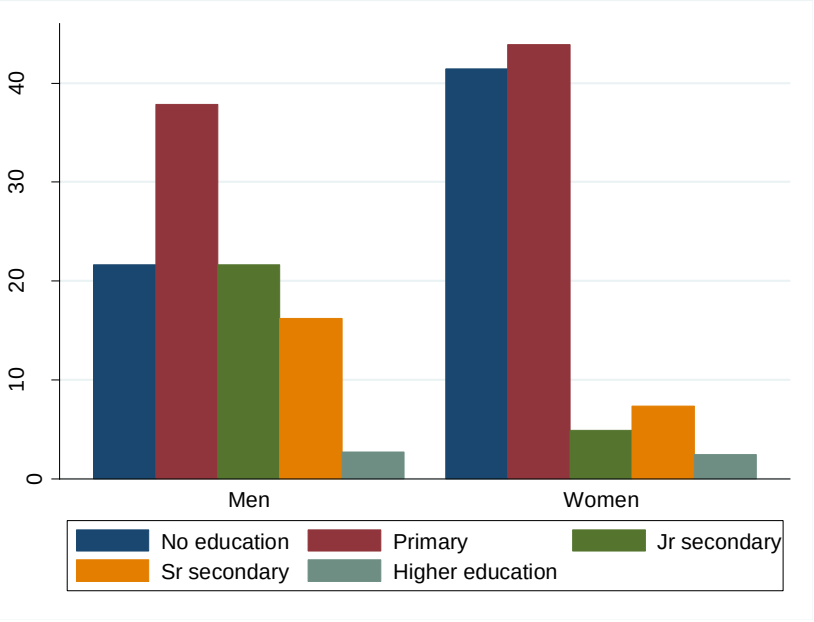


Figure 5. Education, individuals aged 25+.



Finally, pre-school does not seem to be common among children (girls and boys) younger than 5. Only 4.6% of girls are reported to be enrolled in pre-school, while no boys appear to be enrolled.

2.3 Occupation

A large majority of the households interviewed (almost 80%) depend on agriculture and livestock for their living. Small-scale trade is the second most important source of revenues, although it remains a marginal activity relatively to farming. In a few cases, households who reported living off agriculture and farming also had a second activity, linked to small-scale trade.

Further details about employment are provided in section 7.

2.4 Insights on data quality & recommendations

Although our sample is not intended to be representative of the population of cocoa farmers across Cote d'Ivoire, data on rural areas demography (Open Data for Africa database, 2010 census), education and occupation (Project Mondelez Cocoa Life study) appear to be broadly in line with the information gathered in the pilot villages.

As far as this first census module is concerned, a key determinant for data quality has been the adoption of a definition of "household" that is tailored to context and well communicated to the household being surveyed. In this respect, IPA's field team ascertained that the definition used, based on its 3 inclusion criteria, was well understood by farmers and their households. *It would be therefore recommended to follow this definition and to insist on framing it within the 3 inclusion criteria during enumerators' training.*

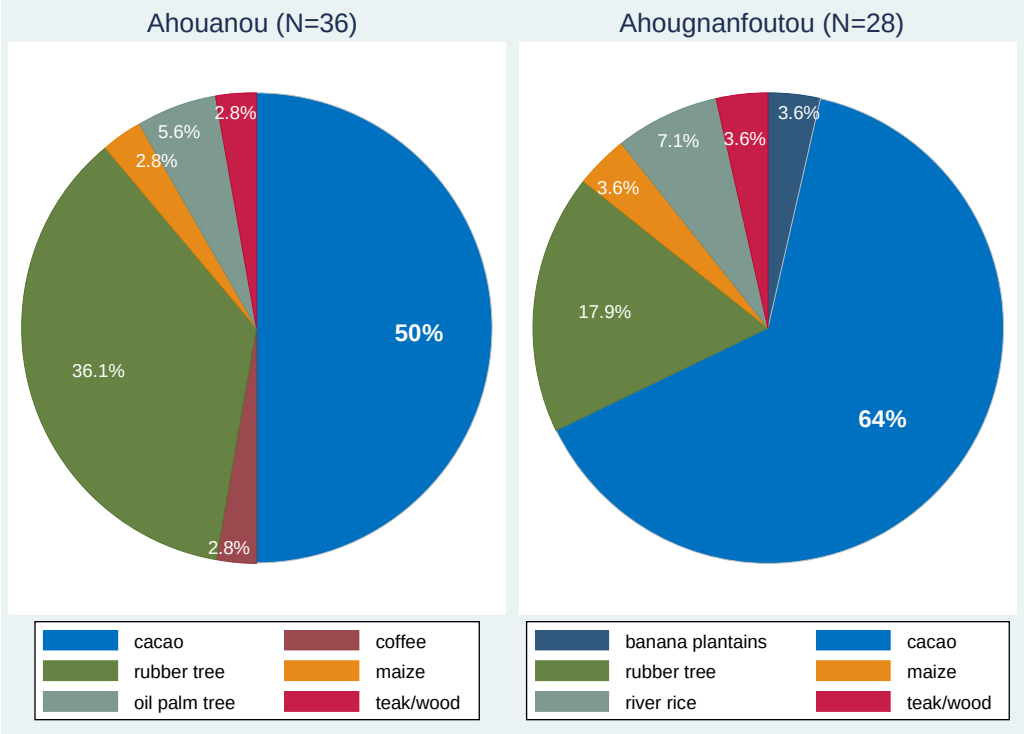
3. Plot characteristics

3.1. All plots

This section provides an overview of *all* plots (i.e. dedicated to cocoa and all other crops) belonging or being exploited by our sample households. The 21 households surveyed exploited or held a total of **67 plots**. Of these, 64 were at the time of the survey being cultivated, 2 were recently inherited and not yet cultivated, and 1 was rented out[2].

CROPS CULTIVATED

In both villages, **cocoa was the dominant crop**, being the main crop on 50% of all fields in one village, and on over 64% in the other. Rubber tree was also frequently grown as a rent crop, especially in Ahouanou, where it was the main crop in over a third of the fields.



Other main crops grown included: coffee, maize and teak (wood) in both villages; oil palms in Ahouanou only; river rice and banana plantains in Ahougnanfoutou only. Figure 6 offers a visualization of the main crops, by village.

Figure 6. Main crops grown across both villages.

On average, **a farmer grows 2 crops on each plot**. When cocoa is the main crop, there is typically an associated crop, which is most often banana plantains (used as shade tree to protect young cocoa trees). Other less commonly associated crops are cassava and rubber tree.

LAND HOLDINGS

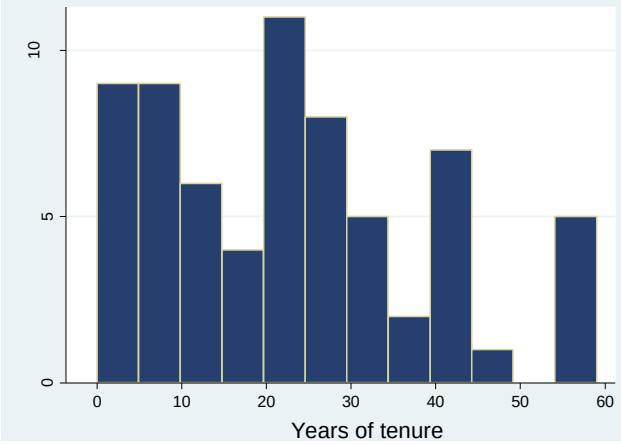


Figure 7. Duration of plot tenure (years), N=67.

On average, each household grows 3 plots (slightly more in Ahouanou than in Ahougnanfoutou).

Farmers most frequently inherited the plots from their parents (almost 80% of plots were inherited – see Figure 2, Annex 2).

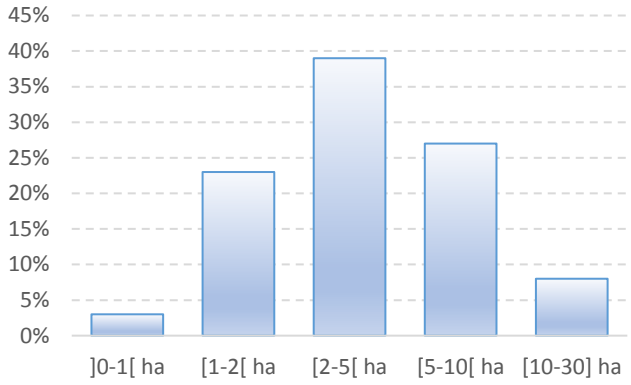
The second most common mode of acquisition was through gift, although its occurrence is much lower, at less than 15%. Only a little fraction of fields has been rented in or purchased (3% respectively).

[2] Based on the "Aboussouan" mode of sharecropping, where farmers renting in and working on the plot must typically pay 2/3 of production to the land owner.

On average, farmers have owned their fields for 22 years. The distribution of the years of ownership is however rather irregular, as represented in Figure 7. Relatively 'young' fields constitute an important share of the pie, as shown in the left-hand end of the distribution.

GEOGRAPHY OF PLOTS

A relative majority of fields were situated on a plateau (35%); crops were also grown on hilly (27%) and plain terrains (28%) – see Figure 3, Annex 2. The most frequent type of soil found is clay, followed by sand and mixed soil (Figure 4, Annex 2).



In terms of **plot size**, most fall in the **2-5 hectares (ha)** region; the distribution of plot sizes, as displayed in Figure 8, follow a normal distribution around this value. It is important to underline that this is the self-reported size of plots. There exists some degree of difference in plot size across villages: in Ahouanou, average plot size stands at 6.45 ha, whereas in Ahougnanfoutou it is at 3.84.

Figure 8. Plot size, all cultivated crops, N=64.

PROFILE OF PLOT MANAGERS

All plot managers in the surveyed households were male. Their average age was 51 years, the youngest being 21 and the oldest 69 years old. In 81% of cases the plot manager was the household head; in the remaining 19% of instances, he was the head's son.

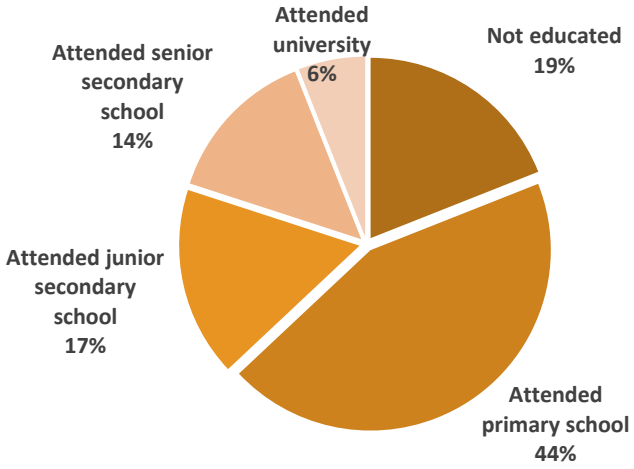


Figure 9 offers a breakdown of the plot manager's educational level:

- Almost 1 out of 5 has never completed primary school;
- A relative majority of 44% completed primary school only;
- Only 14% completed secondary school, while 6% went on to higher education.

Figure 9. Education level of plot managers, N=64.

INSIGHTS ON DATA QUALITY & RECOMMENDATIONS

Overall, questions on plot geography, land holding and tenure were easily understood by farmers (some exceptions concerning technical questions pertaining to the domain of agriculture are described in the cocoa section).

Two challenges nevertheless were encountered:

1. Defining harvest seasons. Because IPA's study aimed, among other things, to measure productivity *by season*, enumerators needed to follow a standardized way to label harvesting seasons. While this is not an issue for cocoa (where the labelling "big seasons" ("grande traite") v. "small season" ("petite traite") were universally understood, it may be so for other crops that have a less regular harvesting calendar. Different approaches have been piloted to standardize the labelling of harvest seasons.

Recommendation: *The most effective way to standardize harvesting times has been to simply ask farmers the months in which the crop was harvested during the last campaign.*

2. Plot & crop census. In a few cases, farmers did not mention all the plots or crops that were being exploited by the household. In particular, subsistence crops destined to own consumption rather than sale were sometimes left out. Because the survey aims to consider all sources of income *and* of consumption, it is important to list all crops.

Recommendation: *insist with enumerators that they need to clearly explain to farmers that we want to list all crops: not only those destined to sale but also those for own consumption.*

3.2. Cocoa plots

Listed households possess 40 cocoa plots in total. Among these, 2 fields were not put into production, leaving 38 currently exploited fields. Cocoa was the main crop on 36 fields; on the remaining 2 fields, it was reported as a secondary crop.

LAND HOLDING

Cocoa plots do not differ significantly from the aggregated picture depicted above: the large majority of cocoa fields (76%) have been inherited from family members (although a higher share than for all cultivated fields were received as gift, approximately 16%), average land ownership has lasted 22 years, and most fields are situated on plateaus, hills or plains. Figure 10 below and Figure 6-7 in Annex 2 cover these aspects.

Figure 10. Years of land ownership, cocoa plots, N=38.

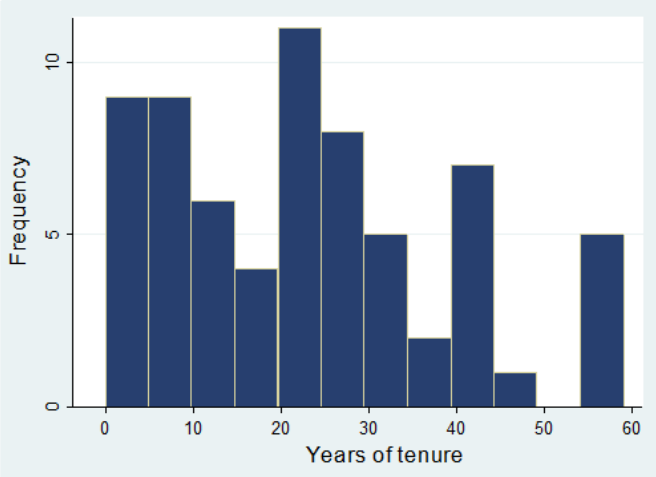


Figure 11. Date (year) when cocoa was planted for the first time on the plot.

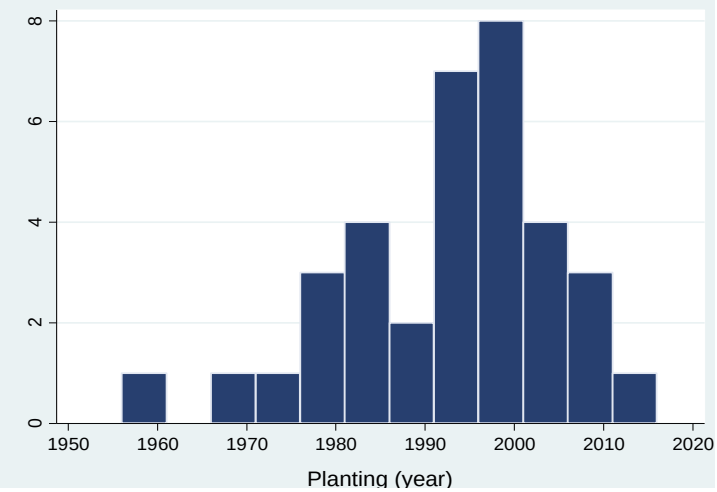
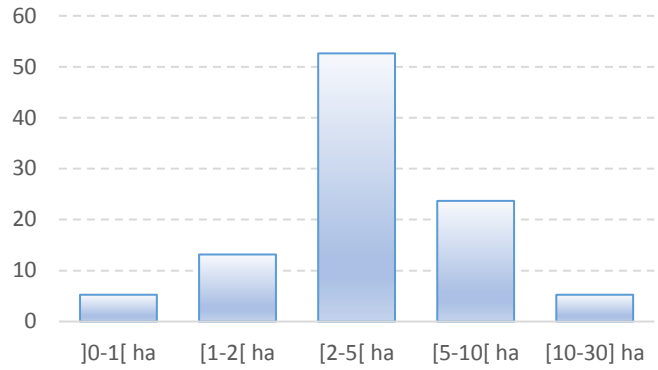


Figure 11 suggests that, while there are some old cocoa plots dating back to the 1960s, the majority was planted for the first time during the 1990s, with planting continuing in the 2000s.

It is worth noticing that the survey did not ask farmers the age of trees on each plot. Farmers do the replanting gradually, portion by portion of land. Therefore, it would be tricky to document the age of each of these portions of plot, for each field.

Figure 12. Plot size of cocoa crops, N=38.



GEOGRAPHY OF COCOA PLOTS[3]

The average size of cocoa plots is 6.13 ha, but most cocoa plots fall in the 2-5 ha region (Figure 12). Plot size is still normally distributed around this mean value and the distribution is slightly skewed towards the right-hand end.

Fields in the more populous village are of larger size than in the smaller one (7.7 ha vs. 4.5 ha respectively).

Clay soil prevails (34% of cocoa fields), followed by mixed soils (18%) and gravel (16%) – see Figure 8, Annex 2.

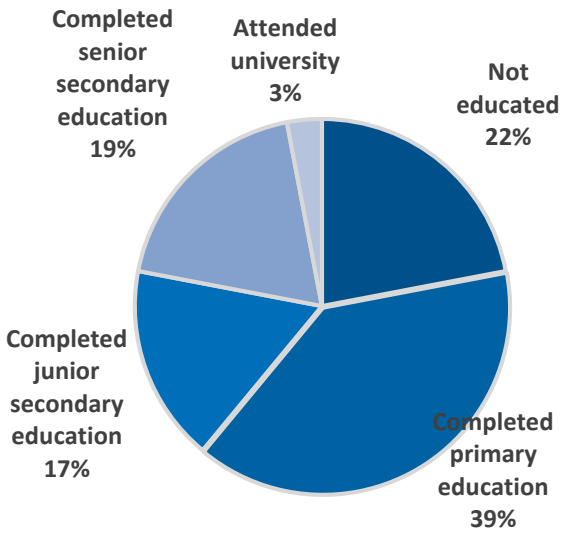
PROFILE OF COCOA PLOT MANAGERS

As indicated above, **all plot managers were male**. Most frequently, the plot manager is the household head (86% of cases), and to a lesser extent his son (remaining 14% of cases). The average age is still of 52 years old.

Figure 13 provides an overview of the educational level of cocoa plot managers. Data is broadly in line with the full sample: **the relative majority (39%) attended primary school**, 19% completed senior secondary school, and 3% have been in higher education.

22% have never been in school.

Figure 13. Education levels of plot managers, cocoa plots, N=36.

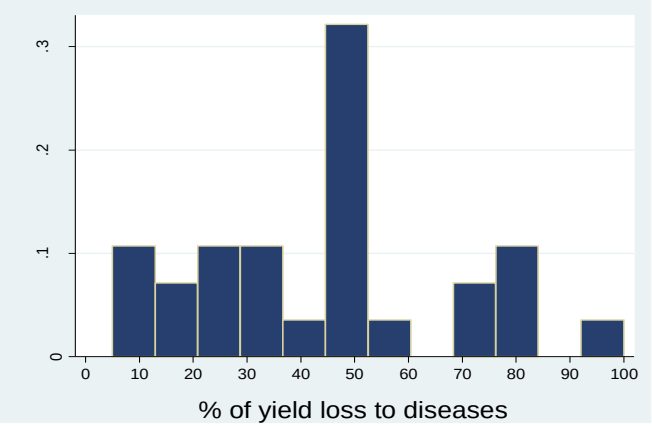


COCOA TREE DISEASES AND LOSS INCURRED

80% of cocoa fields had been reportedly attacked by various diseases during the last 12 months before the survey. In terms of yield lost to these pathologies, over a third of farmers reported between 45% and 55% of lost yield. The average loss was 42% (dropping one outlier).

It is worth mentioning that responses to this question are characterized by a certain degree of variability, as shown in Figure 14. The reasons may be due to respondent's difficulty at estimating percentages or to respondent bias (potential interest in over-reporting losses in expectations of compensation).

Figure 14. Percentage of losses on yields to cocoa tree disease.



[3] All figures pertaining to size are reported by farmers (no GPS-based verification).

EXECUTION OF SPECIFIC TASKS AND SEASONALITY

IPA's field team asked cocoa farmers if they were performing some select agricultural tasks (at least once a year), and, if so, at which annual frequency:

Table 4. Select agricultural tasks for cocoa growing: adoption and frequency. N=35.

Task	% of cocoa plots concerned	Annual frequency
Pruning (trimming overgrown, dead or unwanted branches)	65%[4]	2.3 times in a year
Manual weeding	97%	2.3 times
Chemical weeding (applying herbicides)	40%	1.6 times
Application of pesticides	54%	1.8 times

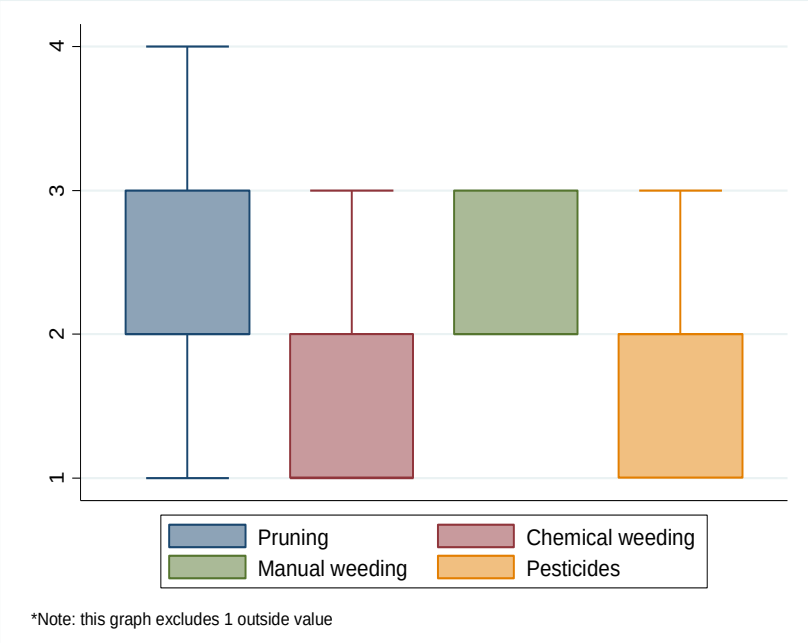


Figure 15 shows the distribution of the annual frequencies of the above tasks across both villages. Except for one outlier (for the pruning variable), the variable appears to be rather stable (low variability across responses for each task).

Figure 15. Annual frequency of selected agricultural tasks, cocoa fields.

INSIGHTS ON DATA QUALITY & RECOMMENDATIONS

The main issue encountered in administering cocoa plot-related modules has been with those questions that required some basic agricultural expertise to be correctly asked and verified. These are for instance the questions relating to pathologies which the plot has suffered from, the use of chemical and natural fertilizers, and the adoption of soil management techniques.

Two orders of problem emerged:

1) Enumerators who did not have much understanding of agricultural practice struggled to clearly communicate and, above all, to respond to clarification questions posed by farmers.

Recommendation: *prepare a glossary of technical terms for enumerators, with guidance from the Principal Investigator, and rigorously test their familiarity with it. Insist especially on the difference between fertilizers (chemical v. natural), pesticides and herbicides. During pre-field training, run practice sessions around these terms as well as with a set of common questions farmers may ask.*

[4] 1 outlier dropped (N=34).

2) Enumerators did not have the knowledge to verify responses from farmers. For instance, most farmers did not report any pathologies suffered in their plots. However, subsequent visits to their fields have at times shown that some disease did affect their plots. For some questions, we therefore had to rely on self-reported answers that may have required some technical verification.

Recommendation: *train enumerators on more common pathologies affecting cocoa trees, what causes them and what form their effects take in practice. Prepare some printed or electronic (to be shown on tablets) fiches, which enumerators may show to farmers, displaying how these pathologies manifest themselves. This would represent a more effective reference for farmers to answer questions.*

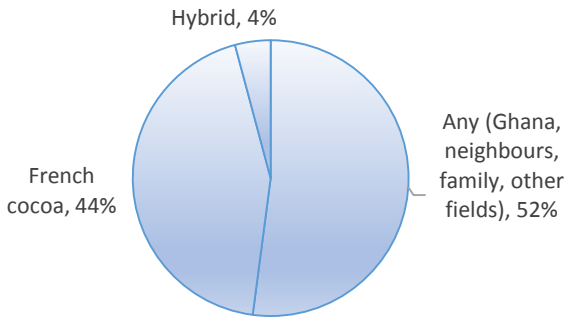
Low data variability and overlap with common agricultural practice suggests instead that the agricultural tasks we inquired upon (pruning, manual/chemical weeding and applying pesticides) were well understood by farmers.

Finally, a last recommendation is to include a set of question on farmer's affiliation to a producer cooperative (year of affiliation, percentage of cocoa sales to the coop, perceived advantages and disadvantages, etc.) and on production of cocoa certified beans. These elements may be factors correlated with higher productivity and revenues, so it would be worthwhile studying more closely how they contribute to those.

4. Cocoa production

Seeds and rehabilitation of trees

Figure 16. Types of cocoa seeds used.



As indicated in Figure 16, the majority of cocoa fields (52%) was grown using any type of cocoa seed that was available (from family, neighbors, other fields, etc.).

A share of almost 44% used instead French cocoa (variety name: "Amelonado"), whereas around 4% adopted a hybrid variety supplied by public extension services.

Figure 17 offers an overview of where farmers sourced their seeds. For over a third of cocoa fields, seeds were provided by neighbors, while 28% plots were cultivated using seeds from the same own field. On a more limited share of 15% of cocoa fields, seeds from the public extension services were adopted.

The "other" category comprises instances of inheritance of seeds from family members or "gift from the French"; to a limited extent farmers also purchased the seeds from private retailers.

Figure 17. Sources of cocoa seeds.

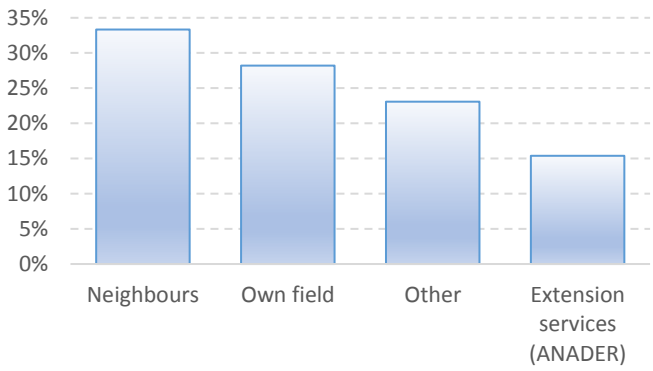
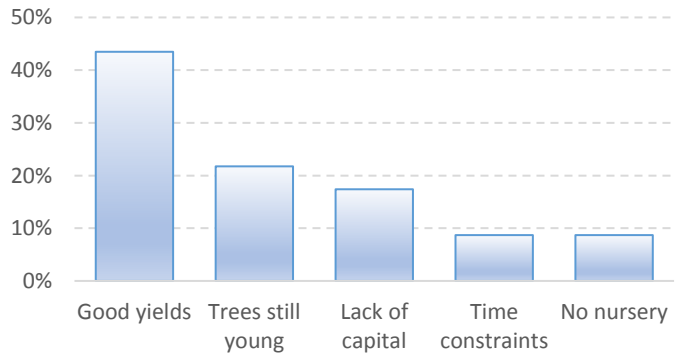


Figure 18 summarizes the reasons given by farmers as to why cocoa plot rehabilitation was not carried out on any of their plots. The perception that the fields already generated good yields has been the main reason reported by farmers.

Figure 18. Reasons why rehabilitation was not conducted (N=23).



According to more than 20% plot managers, trees were considered too young to need rehabilitation.

Lack of capital and time constraints were also reported, albeit less frequently, as barriers to rehabilitating.

Finally, a few farmers affirmed that the lack of nursery facilities and planting materials had prevented them from replanting.

Table 5. Rehabilitation status by age of plantation. Replanting occurred in the period 2011-2016 (last 5 years preceding the time of the survey).

Age of plantation	Total no. of plot per age range	% of fields that were replanted
]0-10[years	4	0%
[10-20[years	9	11.1%
[20-30[years	12	66.7%
[30-40[years	7	28.6%
40+ years	3	0%
Total	**35**	**31.4%**

Table 5 suggests the plantations who have been replanted (in the last 5 years) are most often those aged 20-30 years.

Plantations that are aged 30+ were not frequently replanted in the last 5 years (perhaps because replanted before?). Less than 30% of plantations aged 30-40 and no plantations older than 40 were replanted. However, it is important to underline that no data on replanting patterns before this 5-year period has been gathered.

4.1 Agricultural practices

Table 24 in Appendix 2 offers an overview of agricultural practices followed by farmers on their cocoa plots. Some key highlights:

- Around a third of farmers had cocoa nurseries;
- Farmers used shade trees in almost all cocoa plots (91.5%);
- Farmers made use of at least one soil conservation technique on less than half of all cocoa plots – composting being the most common method (applied on 34% of plots). It is worth noticing however that sometimes farmers did not fully grasp these conservations techniques, which meant that in some cases they reported not to use any of them whilst they were doing it without knowing it (for instance, in most cases fields we subsequently visited were covered in vegetal materials, naturally composting);
- Among the cocoa plots that were reportedly affected by some pathologies (80% of total), the majority were not treated;
- Cocoa beans were dried on floors raised off the ground (in compliance with agronomic recommendations) or on covered soils; in some 6% of cases, cocoa beans were dried directly on the soil, however;
- Use of chemicals was limited, with more than half of cocoa fields not being treated; farmers who did use them frequently stored them at a warehouse at home;
- Only 3 households (working on a total of 5 plots) reported to use any safety equipment material.

In addition, semi-structured discussions with the farmers interviewed highlighted that all the farmers IPA interviewed produced standard cocoa beans, and not certified cocoa.

4.2 Use of fertilizers

Adoption of chemical fertilizers on cocoa plots was rather limited. **Chemical fertilizers were applied in less than 20% of cocoa plots** (7 plots only). Farmers reported an **even lower use of manure** and similar natural fertilizers – with application on only 11% of cocoa fields.

Table 6. Use of chemical fertilizer on cocoa plots.

	No. of plots	Percent
Used fertilizer on cocoa plot		
No	29	81%
Yes	7	19%
Total	36	100%
Type of fertilizer		
NPK	4	67%
Gramophone Super	2	33%
Total	6	100%

Table 7. Use of manure on cocoa plots.

	No. of plots	Percent
Used manure on cocoa plot		
No	32	89%
Yes	4	11%
Total	36	100%
Source of manure		
Own preparation	2	50%
Purchase	1	25%
Composting	1	25%
Total	4	100%

4.3 Production

In Ahouanou, average cocoa production for the 2015-16 campaign amounted to over 2,150 kg, whilst in Ahougnanfoutou it achieved almost 1,375 kg. Figure 19 provides the distribution of cocoa production by village. This data appears to be consistent with larger plot size in Ahouanou as well as the overall better living conditions of this larger village.

During the main (or **big) season** (October to Mars), production in both villages attained an average of over **1,225 kg**; during the **small season**, which runs from April to August, production levels attained approximately **440 kg**. The distribution of cocoa production data (kg) by harvesting season is visualized in Figure 20.

Figure 19. Production of cocoa (Kg) during the 2015-2016 harvesting season (small season + big season). Ahouanou: N=18; Ahougnanfoutou: N=17.

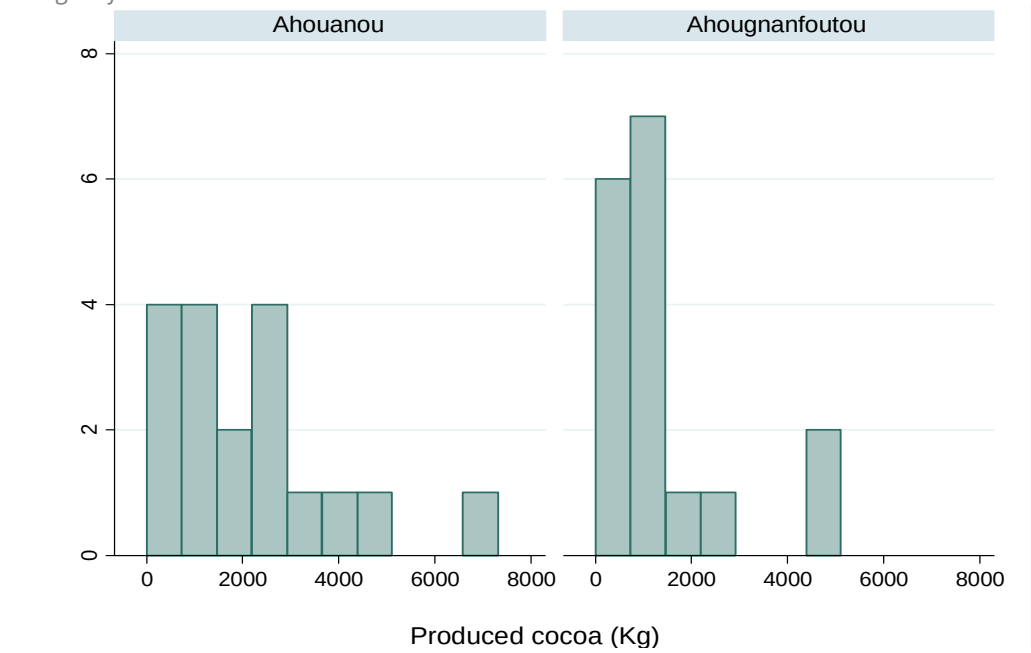
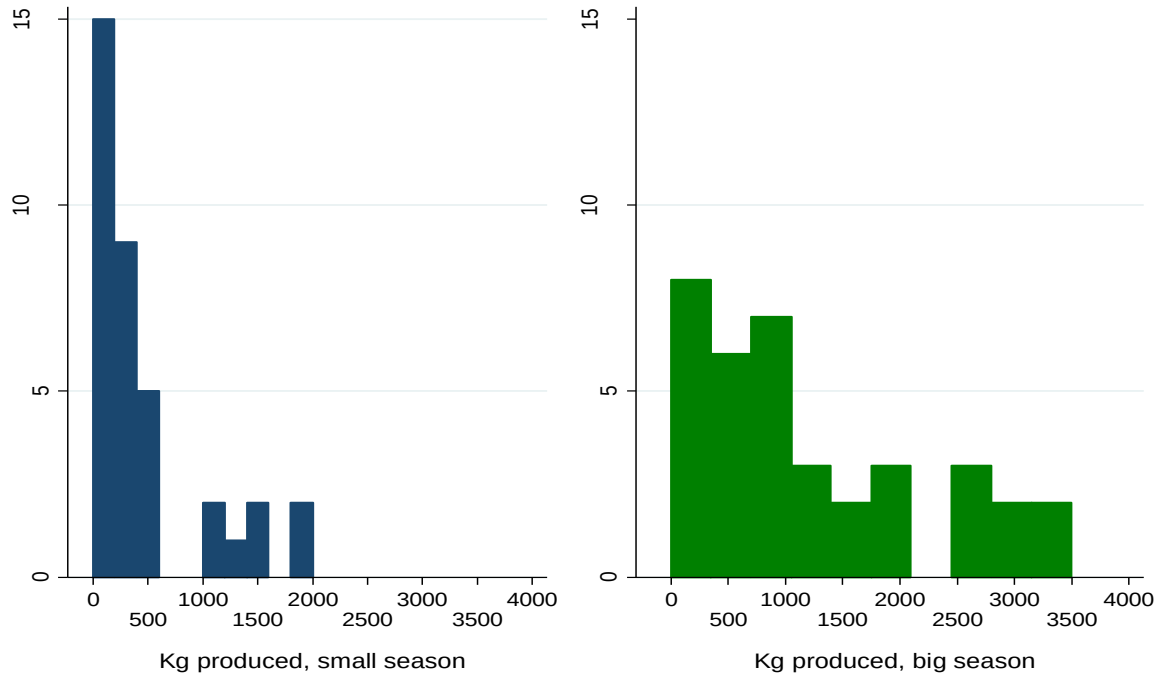
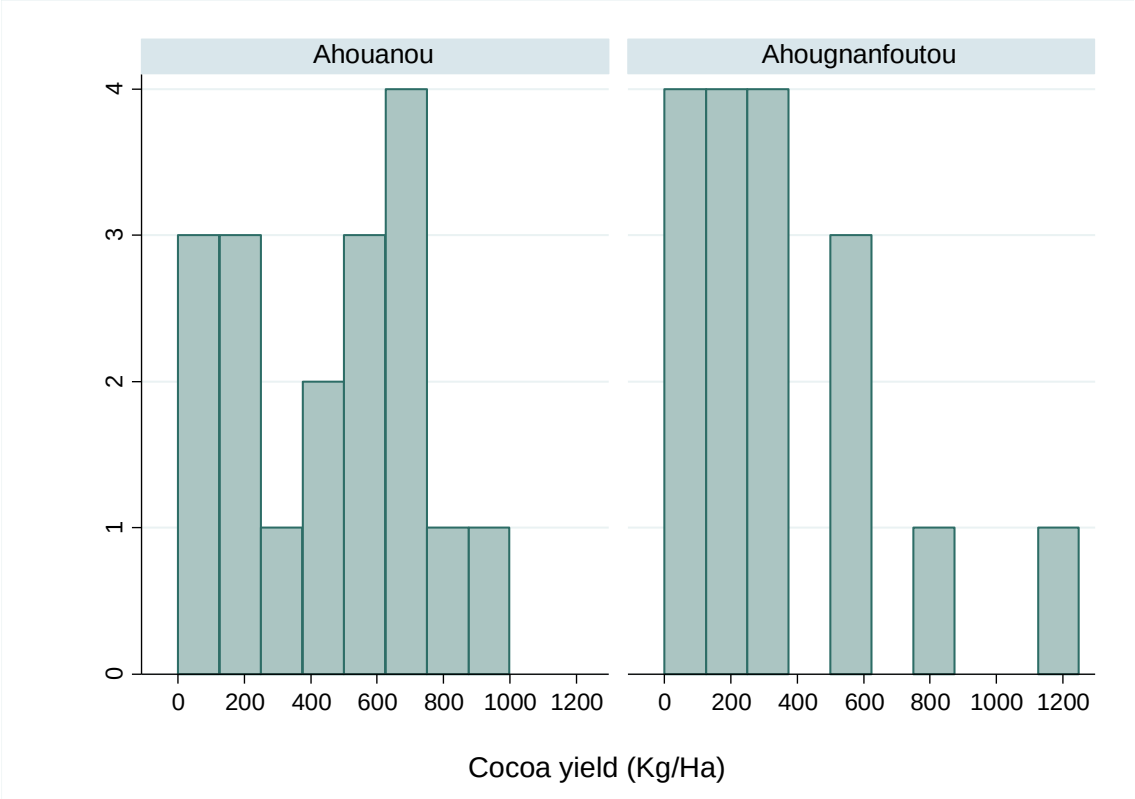


Figure 20. Cocoa production (kg), by harvest season (small season vs. big season). Period: 2015-16 campaign, N=35.



We can now turn to a fundamental metrics of productivity, that is the annual yield, which relates production to plot size. **In the larger village, cocoa yields achieved an average of 456 kg/ha, while in the second one they stopped at 348 kg/ha**. Figure 21 shows the distribution of cocoa yields, by village, which highlights how yields are concentrated in the left-hand side of the distribution in Ahougnanfoutou.

Figure 21. Cocoa yield (Kg/Ha) during the 2015-2016 harvest (small season + big season), by village. Ahouanou: N=18; Ahougnanfoutou: N=17. Yields have been computed by IPA based on total production (reported by farmer) and plot size (also reported by farmer).

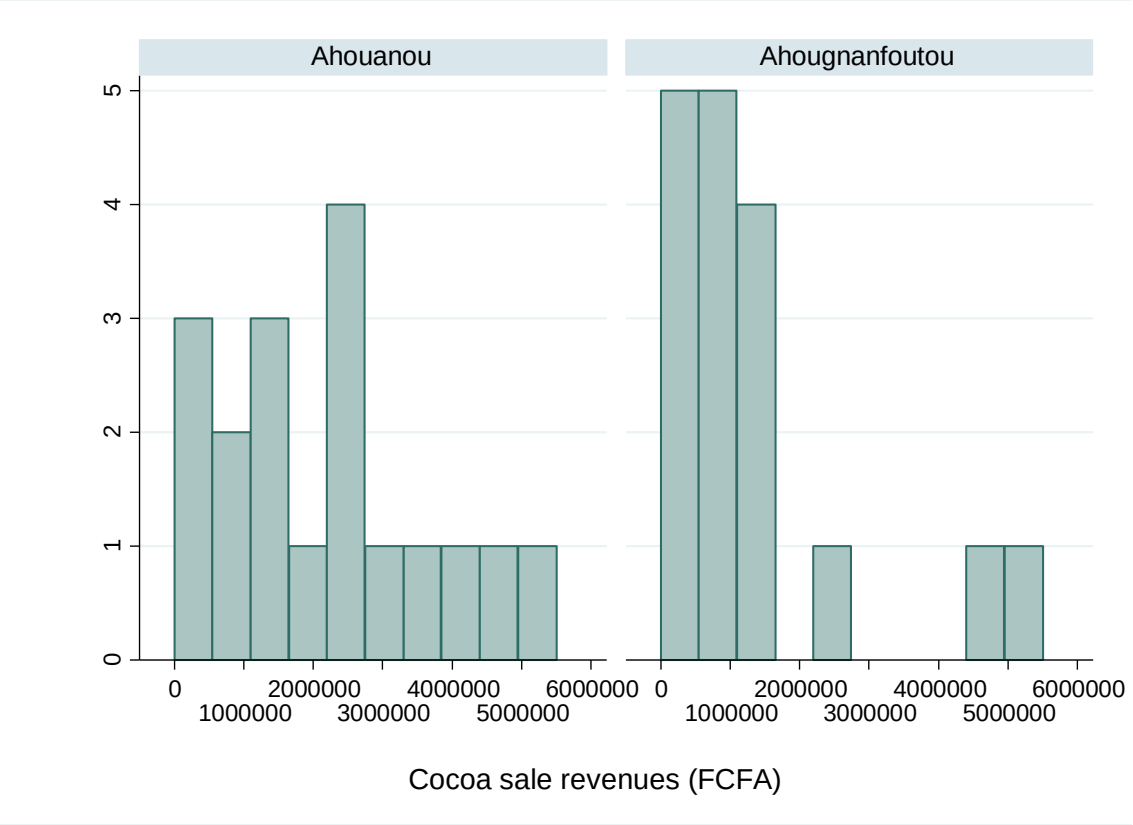


4.4 Cocoa revenues

Average total revenues from cocoa for the 2015-16 campaign amounted to 2,149,500 FCFA per plot in Ahouanou – or 3,520 USD per plot per agricultural year. In the smaller-sized Ahougnanfoutou, cocoa revenues totaled 1,372,800 FCFA, equivalent to 2,250 USD per plot per agricultural year. Figure 22 gives a graphic representation of their variability, by village.

The average plot-level revenues in the two villages amount to approximately 1,770,000 FCFA. Because each household had on average 3.19 plots and 12.3 members, **household-level cocoa revenues per agricultural campaign amount to approximately 460,000 FCFA, or 755 USD**.

Figure 22. Revenues from cocoa sales (FCFA) during 2015-16 harvest (small + big season), by village. Ahouanou: N=18; Ahougnanfoutou: N=17. Figures have been reported by farmers.



The survey has gathered preliminary evidence on some production patterns, respectively on the relation between production levels and use of fertilizers, prevalence of cocoa tree pathologies and adoption of soil management techniques (see Table 31-33 in Annex 2):

- Farmers who applied chemical fertilizers appear to have lower cocoa yields than farmers who did not use fertilizer (319 kg/ha vs. 424 kg/ha). Although many factors may undermine this conclusion (among others: the small sample size and omitted variable bias), this may raise concerns about data reliability.
- Similarly, some inconsistencies arise from cross-tabbing cocoa yields and the health status of the respective plot. For instance, plots with untreated pathologies during the last season show higher yields than plots which have not suffered from any disease. These results may be driven by the fact that farmers may not always have the technical knowledge to realize their field has suffered from any disease; the same caveats listed above (small sample size, correlation v. causation & omitted variables, etc.) may also apply.
- An analysis of the relationship between production and adoption of soil management techniques shows that, on average, farmers who report to have adopted at least one technique of soil management enjoy higher cocoa yields (472 kg/ha vs. 371 kg/ha for non-adopters).

4.5 Insights on data quality & recommendations

Data analysis gives positive indications in terms of data consistency:

- Production data across villages and across seasons are consistent with the expected relative levels. As a matter of fact, production is higher in the more populous Ahouanou, whilst it stands at lower levels in the small village of Ahougnanfoutou. Likewise, production in the main season is substantially higher than in the small season.

- All producers but 2 indicated a unit price equal to the official price for the 2015-16 campaign, i.e. 1,000 FCFA/kg.

- Data on cocoa yields appear to be realistic against national averages (500 kg/ha[5]) as well as localized averages (between 200-400 kg/ha[6]).

- As expected for a rent crop such as cocoa, the lion's share of the production is sold, negligible amounts are given as a gift and there are no instances of self-consumption.

Gross revenues appear to be lower than those highlighted by other studies in the area. A Mondelez study in the Tiassalé area, for instance, found annual cocoa revenues of more than 1.4 million FCFA per household (460,000 FCFA in our pilot). Because cocoa unit sale prices are in line with official prices, a degree of underreporting on production may therefore be at play. However, this gap is likely to be explained also by the fact that our sample is deliberately limited and that the production areas where the pilot was conducted are poorly professionalized (for instance, no evidence of certified cocoa production could be found and the only cooperative active in the territory did not seem to be operational).

> ***Recommendation:*** *in order to avoid any form of strategic bias resulting in underreporting on production or revenues, insist on the fact that the study is in no way linked to any development project or distribution of agricultural inputs. Enumerators should be instructed to explain this before interviewing; and field staff must insist on this during discussions with community leaders.*

Concerns about use of fertilizer may also arise. Although adoption is generally low at national scale (manure is at 35% and chemical fertilizers at 42%[7]), one may see indications of underreporting on both chemical and natural fertilizers. This may be due to different options: underreporting in the expectations of receiving donations; difficulties by enumerators in explaining technical terms linked to agricultural inputs and verifying information about their actual utilization.

Another type of data quality issue may arise as regards questions on pathologies of trees and soil management techniques. As stated elsewhere in the report, some enumerators were at times unable to clearly explain and/or address clarification questions asked by farmers. This may explain some of the inconsistencies described above, notably production patterns by plot health status, with pathology-untreated plots reportedly producing larger volumes of cocoa.

> ***Recommendation:*** *train enumerators on basic agricultural practices, including providing them with a glossary on technical terms and fiches explaining and visualizing cocoa tree pathologies. Survey supervisors must verify that field staff have fully absorbed these notions and provide ongoing oversight during data collection in the field.*

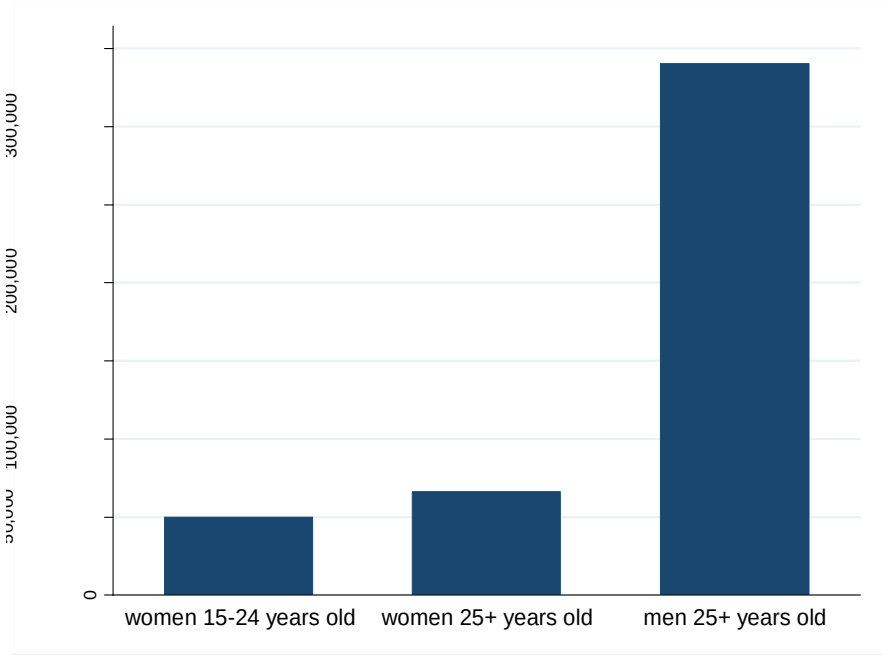
[5] Source: Bloomberg (2016): https://www.bloomberg.com/news/articles/2016-10-09/africa-s-biggest-cocoa-farm-takes-shape-in-central-ivory-coast.
[6] Mondelez study, cited above.
[7] Mondelez study, cited above.

5. Credit

This section explores the credits taken by individuals – across individuals and gender-age groups. The objective has been to list all credits taken as well as map out the reasons why these were taken. This allows, among others, to establish to what extent households use credits for agricultural purposes.

Overall, 26 individuals declared to have taken at least one credit in the 12 months preceding the survey. Of these, 14 were men and 12 were women.

Figure 23. Amount of credits taken, by gender-age group. N=26

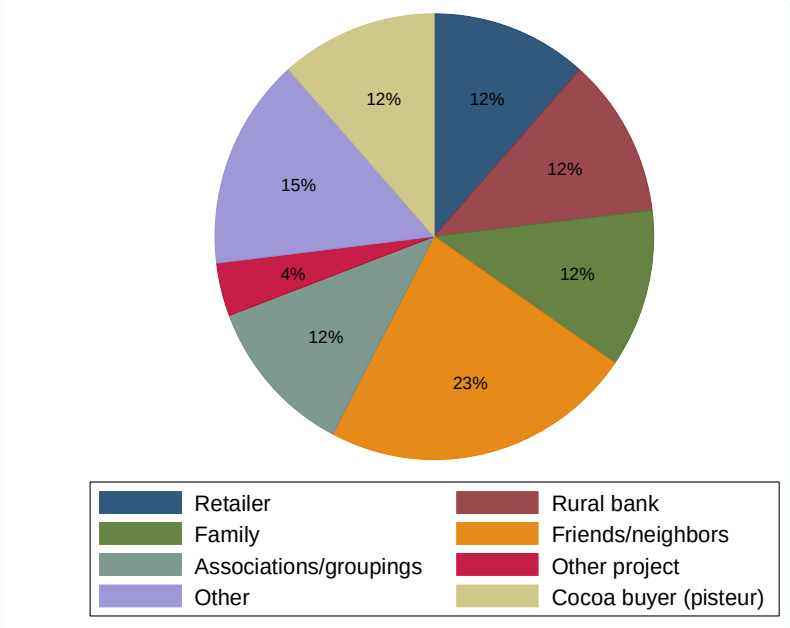


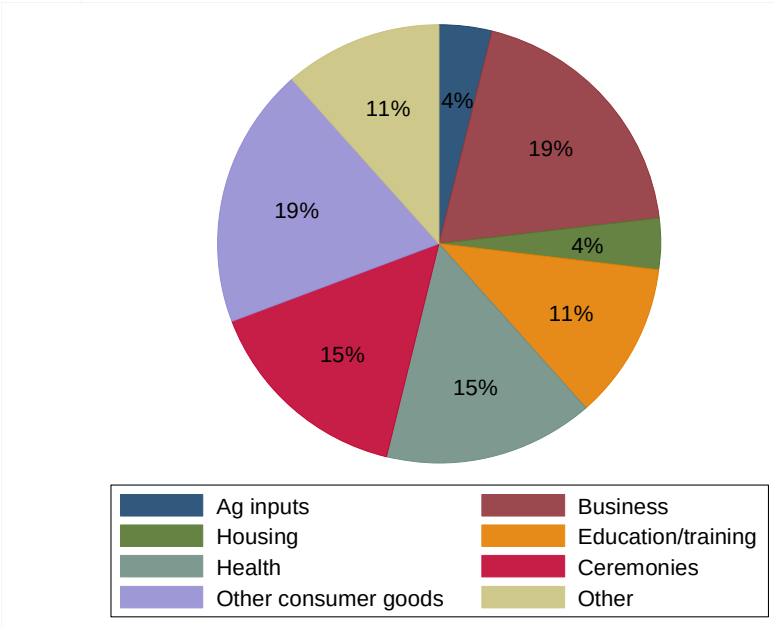
Men borrowed substantially more than women on average: 340,000 FCFA (560 USD) vs. 65,000 FCFA (110 USD). As shown in Figure 23, credits were taken by women aged 15-24 and by women and men older than 25. All other gender-age groups did not report any credit.

Informal channels were dominant among credit sources – friends and neighbors and family accounted for 35% of all instances; cocoa buyer and retailer credit, also informal channels, for another 24%, whilst rural banks (the most institutionalized form of credit) provided 12% of all credits.

Credits were more often taken to **purchase consumer goods and for non-agricultural business**. Facing health expenses and the costs of ceremonies were also common reasons for taking out credits.

Figure 24 shows the credit sources (left) and the main reason why credits were taken (right). N=26.





5.1 Insights on data quality & recommendations

Approximately 20% of individuals aged 16 or above have reported to have taken a credit – which may suggest a tendency towards underreporting. The field team feel this may be explained by two factors:

- It is important to ask credit-related questions to each household member *individually*. People, especially women and youth, may have a strategic bias in hiding or understating amounts of credits taken. In some cases, it was not possible to ask questions to all household members individually, mostly due to unavailability of members. At times, enumerators felt uncomfortable interrupting the flow of the survey to ask permission to survey household members privately, especially with the spouse.
- Respondent fatigue. This was the last sections of the survey, which in most cases lasted longer than 3 hours.

Recommendations:

- *Clearly instruct enumerators as to how request that some specific questions be asked individually. Enumerators should be ready to explain why this is needed, without frustrating the household head. Given the sensitivity of the subject matter, enumerators' wording must be very careful.*
- *In addition, rather than interrupting the flow of the survey, enumerator should be instructed to first finish off with one household member and then pass onto the next one.*
- *Another good practice is to mention the fact that some questions will be asked separately at the beginning of the questionnaire (for instance when the informed consent form is explained), so that any unpleasant surprise will be avoided later.*
- *Each surveyed member of the household should also be reminded that information will be treated confidentially and that they will not be disclosed to other household members.*
- *Shorten the survey and/or consider a different sequencing of modules.*

PART B

Measuring household labor: GPS trackers vs. self-reported tools

Introduction to Part B

One of the key objectives of the pilot has been to test different instruments for collecting labor-related data, with the aim of studying how time is allocated across productive and domestic tasks at the household level. Survey relying on self-reported answers may lack in precision as respondents do not always have a good sense of duration spent on activity, in addition to having difficulties to remember what they have done in the previous days. This data being crucial, it is worth to explore alternative measurement methods such as high-frequency data collection to overcome recall bias and technology that may be more reliable.

Endeavors for rigorously measuring labor are motivated by two crucial reasons:

- Labor is a fundamental input in estimating the productivity function of farmers; measuring labor allocated to each plot in a rigorous way therefore becomes critical in increasing the accuracy of the estimation of farmer's productivity (and its variations over-time).

- Knowing how labor is allocated across productive and domestic tasks allows to study how household decisions about time allocation, and especially of decisions about children's well-being, are taken and evolve as a result of external shocks – for instance, due to an increase in farming productivity at the household level, or following the provision of quality education services.

Three complementary instruments for labor data collection have therefore been designed and piloted[8]:

a. **Survey**: three modules of the multidisciplinary survey that IPA administered to households revolved around labor, including farming labor, domestic labor and other remunerated labor. This is essentially a *self-reported instrument based on respondent's best estimation, to assess workforce deployed in the fields and time allocated by household members to productive and domestic tasks*. The survey is conducted by an enumerator who record the respondent's answers.

b. **Activity logs**: activity logs are diaries where farmers and their children enter themselves their daily activities, including farming, domestic activities such as housework and cooking, and leisure time. These have been conceived to be as much user-friendly as possible (anticipating a certain degree of illiteracy rates in rural farming areas). Activity logs are another self-reported method to assess of time allocation, which complements survey data by providing information on recurring activities of interest *that respondents provide at frequent time intervals, rather than through one-off reporting as it is the case for the survey*. Typically, this instrument is used to mitigate recall bias (respondents not remembering exactly the amount of time spent on each activity if an enumerator asks them to recall for the last two weeks for instance) and provide a first source of triangulating labor-related information.

c. **GPS trackers:** GPS trackers that were used are clock-sized wearable devices that turn on automatically when set in motion; they log GPS datapoints of the paths taken by individuals wearing them. Tracker data can be matched against the GPS data of a set of locations of interest (notably the household's plots, the school, etc.) to reconstruct time spent in the fields, at school, etc. Trackers' purpose is therefore to *cross-check information provided in the activity logs as well as in the survey, in a way that does not leave room to the sorts of respondent bias that may arise in self-reported assessments.*

Two community agents (one in each village) were trained by IPA to assist the 39 individuals that were asked to fill activity logs and wear trackers. Their role consisted of ensuring regular feeding of information into the activity logs

[8] See Overview section of the present report and October 2016 Pilot Report for a broader presentation of the tools and of how they have been put in place.

and regular wearing of trackers, as well as help households with technical issues with the devices and with recharging batteries. The tracking/activity log period covered the period of 1-28 August 2016.

Part B focuses on the measurement of household labor through GPS trackers versus self-reported tools. **While sections 6 to 8 provide results on agricultural, domestic and non-domestic labor from the survey, section 9 compares labor data across the three measurement tools that IPA has piloted, i.e. survey, GPS trackers and activity logs.** It provides some suggestions as to the reliability of each measurement tool as well as on how these could be combined to achieve higher-quality data.

6. Agricultural labor

This section focuses on labor data for cocoa fields, as reported by cocoa farmers[9]. Having a precise estimate of agricultural labor is fundamental for two reasons: (i) the amount of agricultural labor is a key determinant in calculating household-level productivity; and (ii) it may constitute a substantial share of farmer's and their family members' time and it is therefore crucial in studying time allocation for household members of all gender-age groups.

In order to have a standardized way to compare labor across plots, we use the notion of person-days per hectare to measure labor. 1 person-day per hectare is the equivalent of an 8-hour work day of one person on a portion of land of 1 hectare[10]. All figures pertain to the last agricultural campaign (i.e. 2015-16); sample size consists of 36 cocoa fields.

Table 8 contains data on the different cocoa-growing activities: land preparation, planting, fertilizer application, manure application, pruning, herbicide application, harvesting, post-harvesting (comprising of removing seeds from pods, drying, fermenting), threshing and transportation.

In line with the empirical literature, **three types of agricultural labor** have been analyzed: household labor (i.e. carried out by any members of the household, as listed at the beginning of the survey), non-household paid labor and non-household unpaid labor (typically, acquaintances or relatives of the plot managers who help each other, out of mutual solidarity).

Land preparation and planting appear to be the most labor-demanding activities (9.8 and 7.4 person-days per hectare), followed by harvesting (3.4) and post-harvesting activities (2.4). All other tasks reportedly required less than 1 person-day of work during the 2014-15 campaign. Figures on fertilizer and manure application are low, as only few farmers reported having done these tasks.

Table 8. Average person-days of work, by form of labor – household, non-household unpaid, non-household paid – and by farming activity, for cocoa plots. N=36. All figures are in person-days per hectare.

	HH labor	Non-HH, unpaid labor	Non-HH, paid labor	Total
Land preparation	6.29	1.42	2.08	9.79
Planting	6.69	0.58	0.07	7.35
Fertilizer application	0.06	0.00	0.00	0.06
Manure application	0.17	0.00	0.00	0.17
Pruning	0.54	0.03	0.05	0.61
Herbicide application	0.22	0.01	0.16	0.38
Harvesting	2.46	0.47	0.49	3.42
Post-harvesting	0.71	1.25	0.44	2.40
Threshing	0.81	0.07	0.22	1.10
Transportation	0.38	0.11	0.17	0.66

[9] IPA's field team has collected labor data pertaining to *all* plots (and not only cocoa plots). However, for presentation purposes and in line with the Jacobs' Foundation prime interest, this section focuses only on cocoa. Statistics pertaining to all crops may be made available upon request.

[10] Farmers directly reported the number of men, women and children working on each of their plot in the 2015-16 campaign, then person-days/ha have been computed by IPA based on the respective plot size, as reported by farmers. In order to compute total work on a field, weights for men (equal to 1), women (0.7) and children (0.5) have been applied to the reported number of person-days worked, in line with common practice in agricultural labor economics.

The distribution of total labor data by farming task, as represented in Figures 9 and 10 of Annex 2, highlight some outliers; however, cross-village figures appear to be consistent. Further comments on the variability of these variables can be found in the "*Insights on data quality & recommendations*" section below,

Figures 25-29 focus on the contribution of household labor on total labor, for some selected activities, disaggregating by men, women and children to labor. Some key highlights can be summarized as follows:

- Child labor was reported only in the smaller village;
- In the smaller village, the farming activities to which children contributed more were harvest, post-harvest tasks and threshing, and to a lesser extent land preparation and pruning;
- Women's contribution to labor was also higher in the smaller village, although it never exceeded 25% of total household labor;
- Women were especially involved in post-harvesting activities and threshing;
- Men were by large the most important contributors to cocoa-growing activities.

Finally, Table 9 contains data on labor costs and wages, by activity. Dropping some outliers, wages (FCFA per person-day) range from 2,240FCFA (3.60USD) for planting to a maximum of 24,200FCFA (39USD) for transportation, which appears to be the most expensive task.

Labor costs indicate instead the costs incurred by farmer per hectare (ha). Average labor costs range from 1,216 F CFA (USD 1.96) for threshing to 46,820 F CFA (USD 75.5) for transportation. While transportation confirms to be the most expensive task, pruning, herbicide application and threshing appear to be the least pricey activities to outsource.

Table 9. Labor costs and wages, by farming activity, on cocoa plots. All amounts are based on the actual expenses for labor. Amounts are missing for fertilizer and manure applications. Labor costs figures are in FCFA/ha, labor wages are in (FCFA/person-day).

	Sample	Mean	Std. dev.
Panel A: Labor costs (FCFA/ha)			
Land preparation	11	9,987	9,857
Planting	2	4,000	4,243
Fertilizer application	0	-	-
Manure application	0	-	-
Pruning	2	4,417	1,532
Herbicide application	11	2,453	1,872
Harvesting	6	27,778	45,283
Post-harvesting	5	21,428	17,942
Threshing	1	1,833	-
Transportation	9	74,452	131,774
Panel B: Labor wages (FCFA/person-day)			
Land preparation	11	2,670	2,555
Planting	2	2,583	1,296
Fertilizer application	0	-	-
Manure application	0	-	-
Pruning	2	3,278	0
Herbicide application	11	2,453	0
Harvesting	6	9,104	8,974
Post-harvesting	5	13,860	5,940
Threshing	1	1,217	-
Transportation	9	24,022	21,832

*Figure 25. Contribution of household labor to total labor for **land preparation**, by village.*

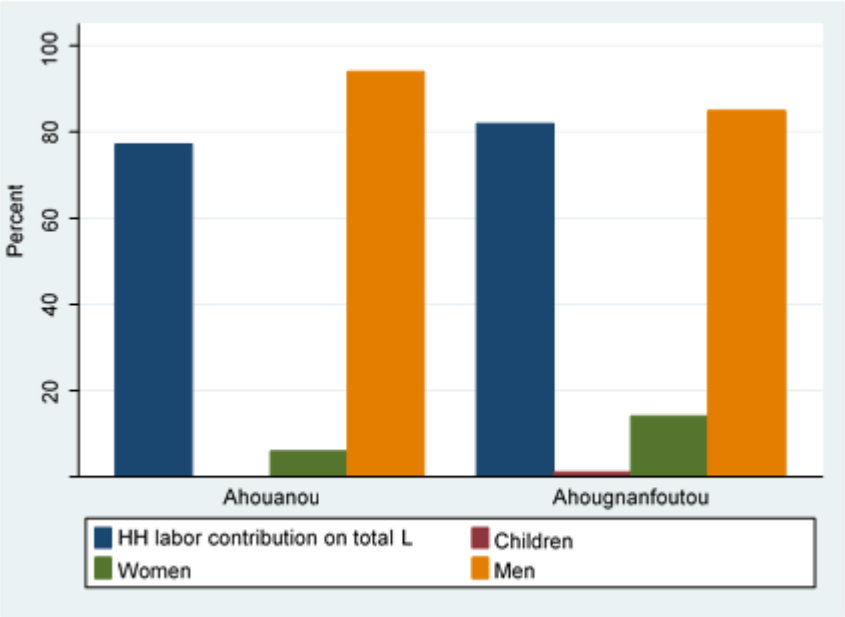


*Figure 26. Contribution of household labor to total labor for **pruning**, by village.*

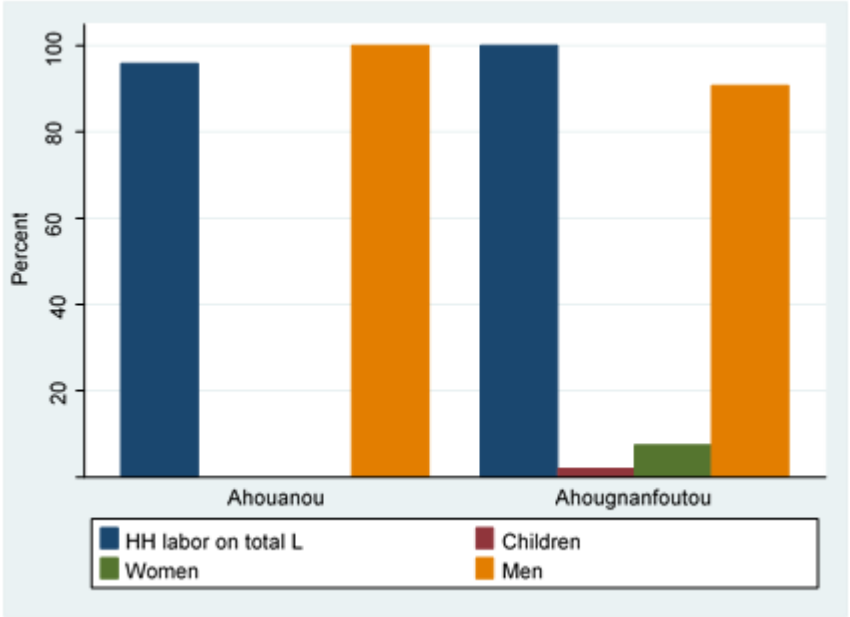


*Figure 27. Contribution of household labor to total labor for **harvest**, by village.*

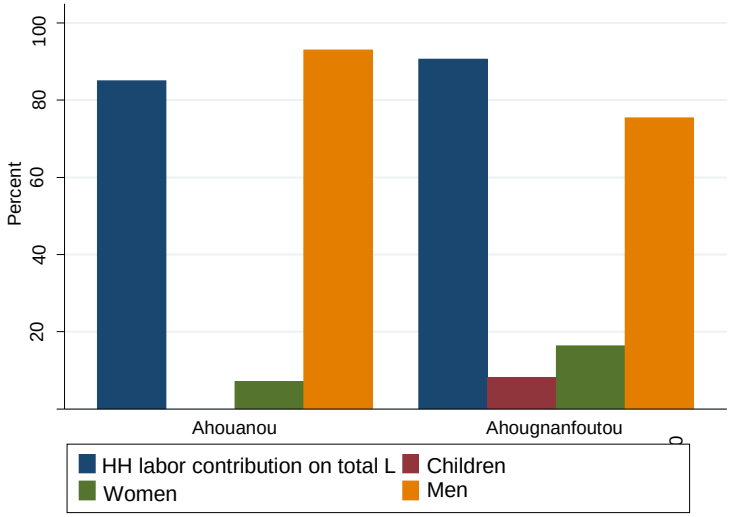


*Figure 28. Contribution of household labor to total labor for **post-harvesting** activities, by village.*

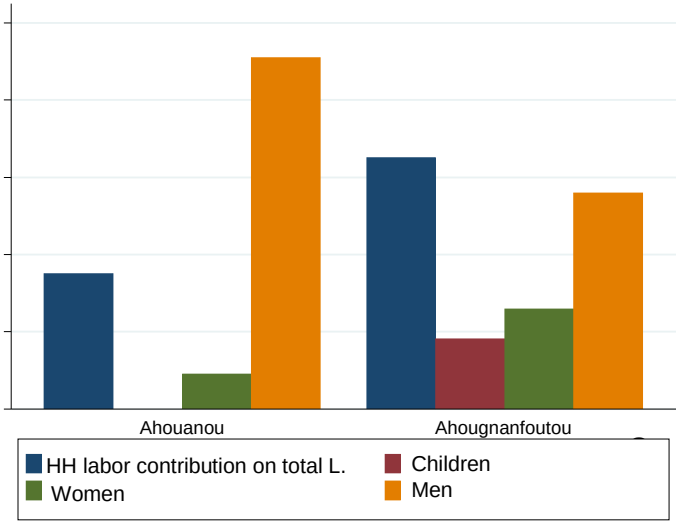
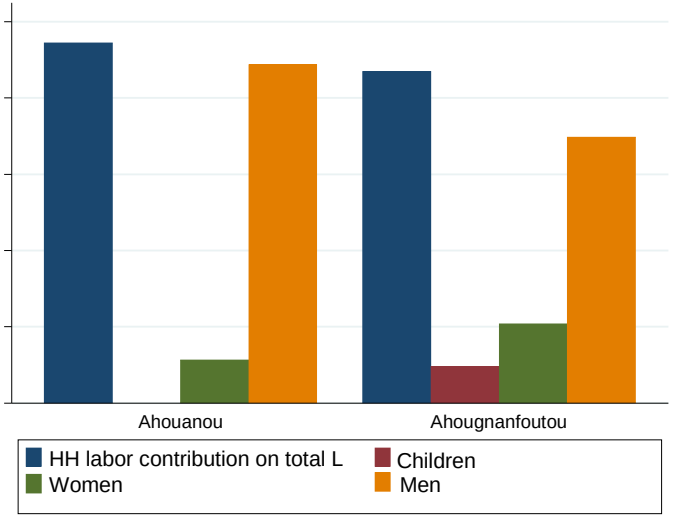


*Figure 29. Contribution of household labor to total labor for **threshing**, by village.*



6.1 Insights on data quality & recommendations

a. Total labor by farming activity

Some data consistency concerns may be raised, regarding the following points:

- There are some far-off outliers (at least two), which may be due to the way enumerators calculate person-days or to the way farmers have understood the question (e.g. is the right time reference mentioned in the question? Is the right plot mentioned?). However, this may also be simply due to the limited size of the sample.

- Some farmers reported no labor was carried out for some activities, such as land preparation, pruning and post-harvest activities, which we would expect to be conducted in any season, if the plot is in production.

- Some inconsistency in fertilizer use: out of the 7 farmers that in previous survey modules reported chemical fertilizer use, only 3 indicated an amount of labor that is greater than zero. The same is true for applying manure. Data analysis shows that respondents gave different responses to the same question; possibly because they were confused as to which plot the question referred to or due to respondent fatigue.

However, the distributions of total labor by activity appears to be consistent across the two villages. For instance, land preparation and planting consistently represent, in both villages, the tasks that have demanded more labor. The distributions for fertilizer and manure application, pruning and application of herbicides also appear to be similar (and less spread out) across villages. Similar remarks can be made about the distribution of harvest and post-harvest in the two villages.

Recommendations:

- *Insist on enumerator training, specifically on how to (i) calculate person-days for each plot and (ii) take the time to explain the question – indicating time and plot references and clearly explaining that information cover household and non-household labor (remunerated and not remunerated).*

- *Compare present results with larger-size studies to obtain further insights on data variability and outlier analysis.*

- *When no agricultural labor is reported but it is expected that there would be some, prompt enumerators to inquire on the underlying reasons. For instance, if the farmer declares no one worked on harvesting on a plot in production, this may raise suspects. Survey programming may take this into account by including a note when zero labor demand is reported.*

- *As recommended elsewhere, enumerator training needs including a module on agricultural practice. This will allow enumerators to better master the vocabulary, especially regarding the different types of fertilizer (and other agricultural inputs), and be instructed to systematically look out for and resolve data inconsistencies on their adoption.*

b. Contribution of household labor to total labor

In terms of data distributions, there appears to be consistency across villages and tasks. For instance, the share of household labor on total labor stands at comparable levels across the two villages, for all tasks (with the partial exception of post-harvesting activities – more on this below).

The main difference in the distribution of household contributions to total labor concerns children's contribution. As a matter of fact, there is no evidence of any child labor in Ahouanou, whilst there is some, albeit to a moderate extent, in Ahougnanfoutou. This may leave room for suspects of underreporting of child labor. IPA's team in the field felt this may be due to social desirability bias – communities had been already exposed to surveying on child labor in the past and appeared quite suspicious when questions around children's contribution to work in field were raised.

The largest variability across the two villages is found on post-harvesting activities, for which household contribution ranges from less than 40% in Ahouanou to more than 60% in Ahougnanfoutou. This and other inconsistencies (see below on labor costs and wages) may be explained by the fact that the phrasing "post-harvesting activities" may be interpreted differently across farmers: some may only include removing the pulp from the pods, others may understand it as including transport, for instance. In some cases, enumerators may have themselves overlooked what we meant by post-harvesting (i.e. removal of pulp, fermentation, drying).

Recommendations:

- *Treat the issue of child labor with extreme caution in host-communities. Hiding the goal of measuring children's participation to agricultural and domestic labor is of little use and will in fact raise frustrations once interviewing is underway. Yet, field research staff must emphasize that measuring child labor is not the main goal of the study, but a means of understanding how households take labor-related decision-making. In other words, it is important to highlight that the study is not about child labor, but rather on how to eradicate it.*

- *To further reinforce community trust and build confidence, it is also worth dwelling upon the voluntary nature of the participation to the research. Research field staff should inform community leaders and enumerators explain respondents about their full faculty to withdraw at any point or on any question that may be considered as bothering.*

- *Reconsider phrasing of "post-harvesting treatment" ("traitement post-récolte") into "removal of pulp, fermentation and drying". Less open-ended wording should minimize scope for different interpretations across different farmers.*

c. Labor costs and wages

Overall, labor costs and wages appear to be reasonable, with labor-intensive tasks such as land preparation, planting or pruning being relatively lower; and a more capital-intensive task such as transportation being more expensive. It is however difficult to find reliable data on farming labor costs that can be used as benchmarks. Another approach to construct a benchmark would be to disaggregate data by village and compare across them. Nevertheless, because of the limited sample of respondents to these questions, even this approach may yield results of limited interest.

7. Domestic labor

To gain an exhaustive picture of household members' time allocation, one cannot overlook at the domestic activities that they engage in. Domestic labor is here defined as the work carried out by household members in the interest of the household and without being systematically remunerated. Domestic tasks include, among others, cooking, domestic cattle, fetching water or wood and going to the market to buy food supplies.

As highlighted by the empirical literature on household economic decision-making (and on child labor), these activities are worth a substantial amount of an individual's time, especially for women but also children. In addition, when studying changes in time allocation patterns, there may be substitution effects between agricultural and domestic activities: for instance, when plot productivity and related revenues increase one may hypothesize that household labor demand diminish for working in the fields but be compensated by increased participation in domestic activities. In order to capture these potential substitution effects, it is therefore crucial to document and measure all forms of labor, agricultural and domestic (as well as non-domestic, to which the following section is dedicated).

Overall, 33% of all surveyed people or **48% of individuals in the age cohort 8-60 reported to have participated in at least one domestic task** in the 12 months preceding the survey.

Figure 31 sheds light on household participation to domestic activities, disaggregating data by gender-age groups; all data refers to the last 7 days before interviewing. Some highlights:

- The most recurring activities are farming (almost 25% of all individuals participated) and housework (23%).
- Except for cattle rearing, women (regardless of age) play a more salient role than men in all domestic activities, including farming on family plots[11].
- As far as domestic farming is concerned, women across all age equally appear to be more involved than men.
- Girls younger than 15 years old appear to engage more frequently in domestic activities than boys of the same age cohort.
- Girls under the age of 15 years old are more likely to be involved in housework, washing, fetching water and food, and child-care.
- Data confirms the existence of predominantly women-specific tasks: washing, water and wood supply, housework, cooking but also farming and harvesting/picking up trapped animals after hunting.
- Child care appears to be a rather gender neutral task (although intensity may vary).

[11] Here farming was presented as any work done on plots belonging to or being exploited by any household members.

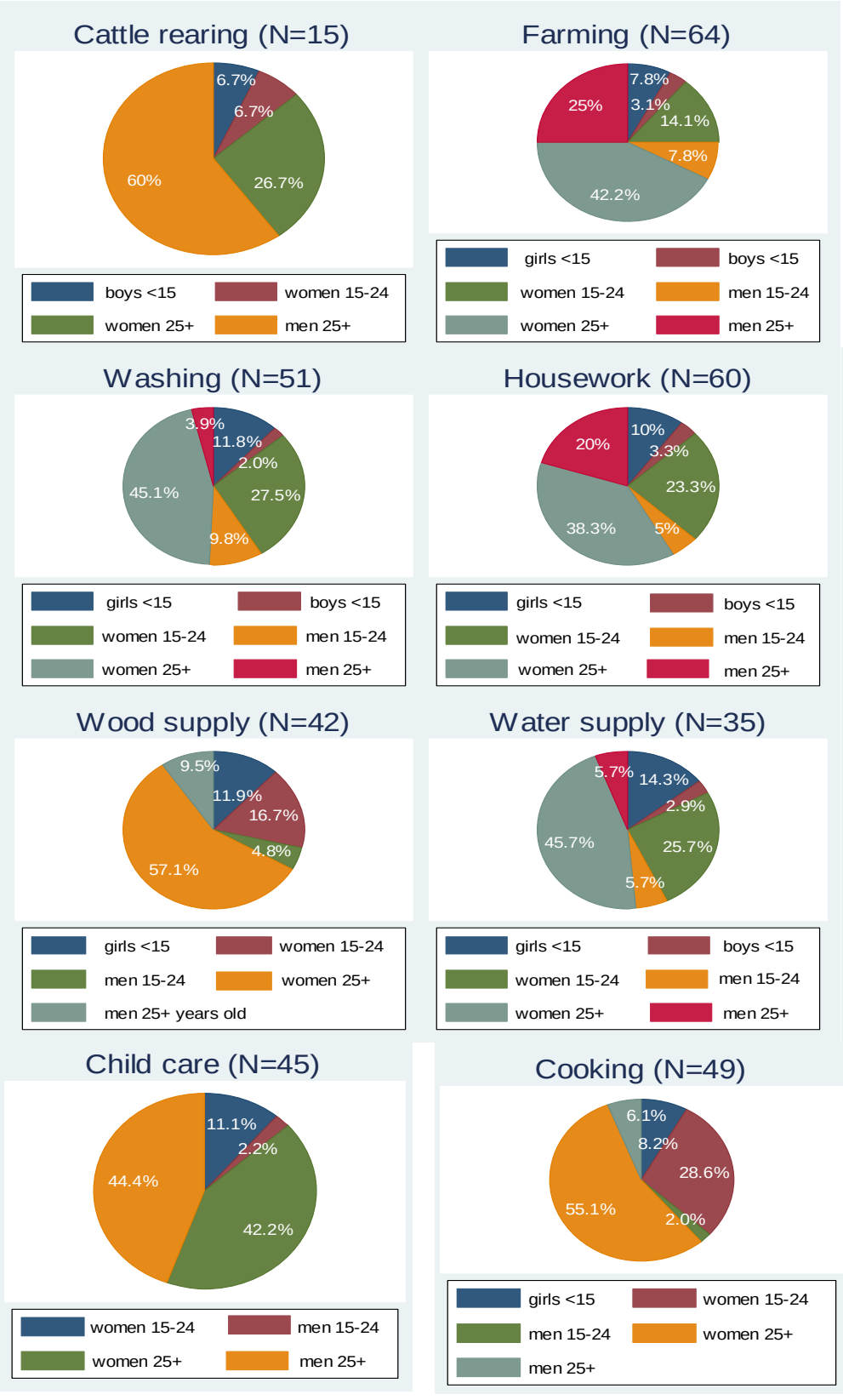


Figure 31. Distribution of household members across domestic activities, by gender-age group. Period: last 7 days preceding the survey.

Table 10 completes data contained in the previous charts by highlighting the *intensity* of participation in domestic labor. Details are given about the average time allocated to each domestic activity, in the week preceding the survey. Intensity is measured in terms of number of days in which the activity was conducted; and of total weekly hours.

Farming and cooking appear to be the most time-consuming activities for the surveyed individuals.

Table 10. Time spent on average by individuals for each domestic activity in the week preceding the survey. Sub-samples vary for each domestic activity.

Domestic activity	No. of days when activity was done, last 7 days before survey	Hours of work, last 7 days before survey
Cattle rearing	3.7	6.5
Farming	3.0	23.8
Hunting/picking up animals	1.9	2.4
Cooking	4.5	19.6
Washing	2.2	3.3
Household	3.6	1.5
Food supplies	1.3	1.7
Child care	1.4	1.6
Wood supplies	2.3	2.5
Water supplies	4.7	2.7

Previous tables and charts presented individual-level data. The next three figures turn instead to the household level, which allows to draw some indications as to domestic labor participation within a typical cocoa-growing household in our pilot villages.

Figure 32 provides an overview of how many members within a household members contribute to each domestic activity. Farming on family plots appears to be the activity that demands more household participation, in terms of people.

Table 11 gives a breakdown of participation to domestic labor by sex-age groups:

- Each household counts almost 4 members engaged in domestic activities;
- Among children below 15 years old, the average household has .33 girls and .14 boys engaged in domestic activities;
- The largest contribution within a typical household comes from women aged 25 or older (1.33 per household), followed by men aged 25+ (1.19).

Finally, Table 12 presents data on average household-wide time allocation to domestic labor, in the week preceding the survey:

- Cooking and farming on family plots remain the most time-consuming tasks;
- Doing housework and supplying water follow suit.

Figure 32. Household participation (no. of members) to domestic activities, by task.

Table 11. Household-level participation to domestic labor, by age-sex group (N=21). Figures refer to household members having engaged in domestic labor at least once in the last 12 months.

	Mean	Std. dev.
Household size	12.05	9.21
No. of HH members engaged in domestic work	3.95	2.09
Girls <15 years old	0.33	0.8
Boys <15 years old	0.14	0.36
Women 15-24 years old	0.67	1.06
Men 15-24 years old	0.29	0.64
Women 25+ years old	1.33	0.73
Men 25+ years old	1.19	0.68

Table 12. Average time spent by household for each domestic activity, in the week preceding the survey (N=21).

Domestic activity	No. of days spent in the last 7 days	Time (hours) spent in the last 7 days
Cattle rearing	2.67	2.5
Farming	8.71	51.0
Hunting/harvest	2.05	1.5
Cooking	10.48	35.4
Washing	5.33	6.9
Housework	10.33	3.4
Food supplies	2.48	1.7
Child care	3.05	1.4
Wood supplies	4.52	3.5
Water supplies	7.76	3.7

7.1 Insights on data quality & recommendations

Overall, data appears to be consistent and data variability moderate despite the small sample.

The main issue lies in potential underreporting of domestic activities. At the individual level, only 48% of all individuals aged 8-60 reported having done any domestic work in the last 12 months. Similarly, at the household level, the number of people participating in domestic tasks is less than 4, with an average household size of 12 people. Data analysis suggests that girls and boys aged below 25 have been frequently overlooked.

Explaining what constitutes domestic activities to respondent was relatively straightforward, with enumerators providing concrete examples of every-day tasks before commencing the interview. This underreporting may rather be explained by respondent fatigue. The domestic activity module indeed comes at some 3 hours into the survey and evidence of respondent fatigue was documented during the research. This may imply respondents deliberately skipping people having done domestic work in order to quickly get to the end of the interview.

Another potential measurement issue concerns women contribution to agricultural work. As a matter of fact, although women's contribution to agricultural work is relatively more limited than men's (see for instance Figures 25-29), here women appear as the main contributors (see Figure 37). This is however not necessarily an inconsistency in data. for a start, here the question asked whether any farming activity on a family plot was performed *in the last 12 months*, i.e. over a longer period. In addition, women may simply perform farming activities less frequently (i.e. as a one-off activity, not as regularly as men) and less intensively (i.e. working less hours).

An alternative (or perhaps complementary) explanation is that women's role comes out more strongly when labelling farming as a domestic task rather than as a main or remunerated occupation.

Recommendations:

- *Instruct enumerators to meticulously go through the list of all household members, in order to avoid leaving individuals out, especially children.*
- *Shorten the survey, or at least consider administering it at two points in time. For instance, the census and plot listing could be done first (these can be done rather neutrally at any point in time); and labor-related and credit sections may be sequenced right after the main season, when farmers can easily recall the workforce that was used.*

8. Non-domestic labor

The key difference between domestic and non-domestic labor lies in the that the latter is not carried out in the sole interest of the household and is usually, although not always, remunerated.

Non-domestic labor includes any non-domestic occupation which household members have engaged in. Examples can be farming, sale of agriculture produce, trade, services (food, hairdressing, housekeeping, etc.) and so on. It is usually remunerated, although not as a rule. Any form of remuneration – e.g. money or in-kind and any frequency of remuneration – daily, monthly, by task or piece – has been considered.

Mapping this form of labor is indispensable to complete the picture of the types of work done, in view of reconstructing household time allocation across all productive and domestic activities, and thus investigating their decision-making. The objective of this section was not only to gain an overview of the types of remunerated labor, but also to explore their seasonality and the revenue streams they generate.

Below are some preliminary findings, which are illustrated in Figures 33-35:

- Overall, 42% of all individuals aged 10-80 years old engaged in non-domestic labor.
- The largest contributors are men aged 25 or above (39%) and women of the same age range (35%).
- The proportion of women and men in the 15-24 age cohort participating to remunerated labor is similar (8% and 7% respectively).
- While girls below 15 were more involved in domestic activities than boys of the same age, boys (below 15) are more involved in remunerated work than girls.
- From a sector standpoint, most individuals are engaged in agriculture and livestock (68%), followed by agriculture/livestock/commerce (10%) and commerce (10%).
- There is evidence of child labor for farming activities: 8.5% of individuals engaging in remunerated work are boys below 15 years old, while the same figure for girls (>15 y.o.) is 4.3%.
    - In addition, there is evidence of child labor in non-agricultural activities, for which boys and girls below 15 years old respectively represent 12.5% of the workforce.
    - As highlighted elsewhere in the present report, some degree of underreporting of child labor may be playing out.

Figure 33. Distribution of non-domestic work, by gender-age groups (N=69).

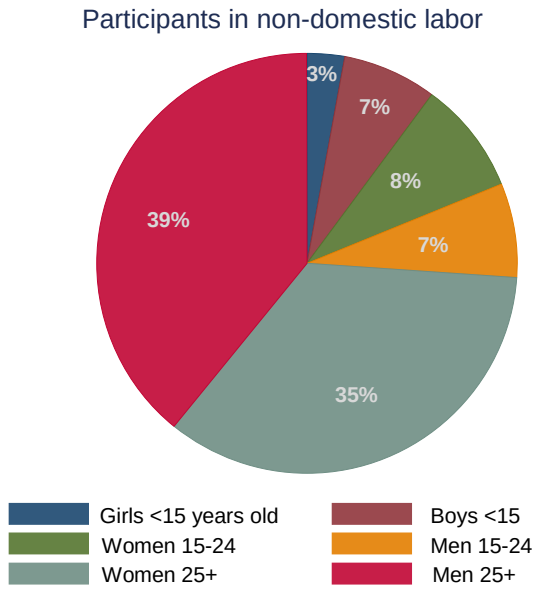


Figure 34. Mapping of sectors for non-domestic labor (N=69).

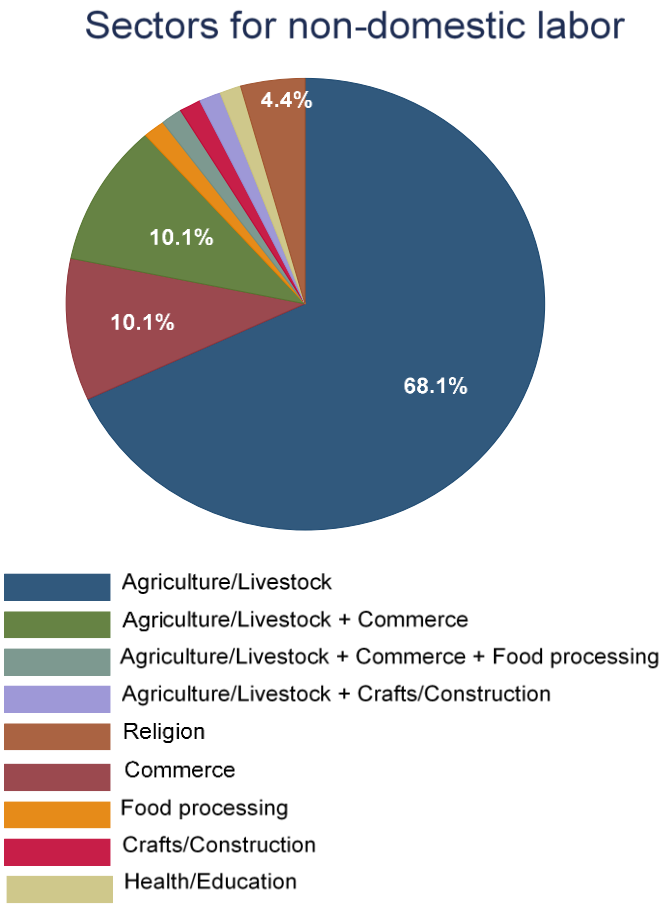
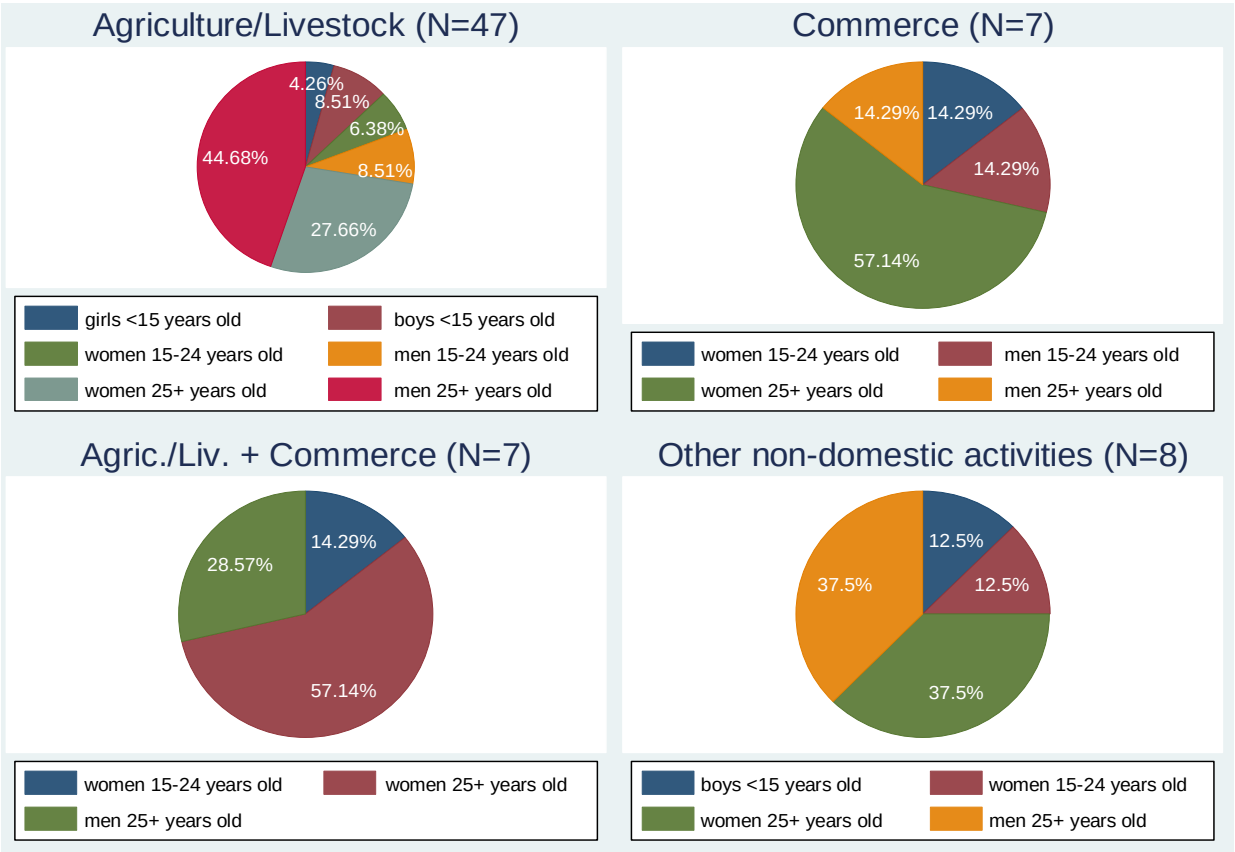


Figure 35. Participation of individuals in non-domestic labor, by gender-age group. Sub-sample varies with type of activity.



Household-level data (Table 13 and 14) provides additional insights into how household members' time is allocated to income-generating activities:

- Each household has on average 3.3 individuals engaging in non-domestic labor.
- Of these, 2.2 are employed in agriculture, .3 in commerce and .3 in agriculture + livestock + commerce.
- The average household has .10 girls employed in remunerated labor and .24 boys.
- In terms of intensive margin (i.e. how much people work, Table 18), person-days per year have been estimated based on the number of weekly hours that each individual reported to have worked during the week preceding the survey.
    - In the average household, boys below 15 years old worked the equivalent of almost 30 man-days in a year, whilst girls worked for the equivalent of less than 5 man-days.

Table 13. Household-level no. of individuals participating in non-domestic labor, by gender-age groups (Panel A) and by activity (Panel B) (N=21).

	Mean	Std. dev.
Household size	12.05	9.21
Number of workers (non-domestic labor)	3.29	2.03
Panel A. Number of workers by gender-age group		
Girls <15 years old	0.1	0.44
Boys <15 years old	0.24	0.77
Women 15-64 years old	1.38	1.02
Men 15-64 years old	1.33	0.66
Women 65+ years old	0.05	0.22
Men 65+ years old	0.19	0.4
Women 15-24 years old	0.29	0.56
Men 15-24 years old	0.24	0.44
Women 25+ years old	1.14	1.01
Men 25+ years old	1.29	0.64
Panel B. Number of workers by activity		
Agriculture/Livestock	2.24	2.07
Commerce	0.33	0.48
Agriculture/Livestock + Commerce	0.33	0.73
Food processing	0.05	0.22
Agriculture/Livestock + Food processing + Commerce	0.05	0.22
Crafts/Construction	0.05	0.22
Agriculture/Livestock + Crafts/Construction	0.05	0.22
Health/Education	0.05	0.22
Religion	0.14	0.65

Table 14. Average amount of work of household members, by age-gender groups (Panel A) and by sector of activity (Panel B) (N=21). Person-days per year have been estimated based on the number of weekly hours that each individual reported to have worked during the week preceding the survey.

	Mean	Std. dev.
Panel A. No. of person-days of remunerated work by gender-age category		
Girls <15 years old	4.76	21.82
Boys <15 years old	29.14	118.1
Women 15-64 years old	187.69	163.76
Men 15-64 years old	217.69	161.92
Women 65+ years old	7.39	33.85
Men 65+ years old	14.13	41.14
Women 15-24 years old	22.21	51.83
Men 15-24 years old	31.86	69.91
Women 25+ years old	172.86	160.92
Men 25+ years old	199.96	156.81
Panel B. No. of person-days of remunerated work by activity		
Agriculture/Livestock	325.21	337.8
Commerce	41.5	80.87
Agriculture/Livestock + Commerce	52.86	141.56
Food processing	6.86	31.42
Agriculture/Livestock + Food processing + Commerce	7.14	32.73
Crafts/Construction	15.43	70.7
Agriculture/Livestock + Crafts/Construction	0.02	0.11
Health/Education	1.07	4.91
Religion	10.71	49.1

Finally, IPA collected data on labor revenues among surveyed households – key insights are detailed in Table 15:

- The average annual revenue per household is FCFA 501,600 (USD 805);
- Children (boys and girls) below 15 do not appear to perceive any remuneration for their non-domestic work.
- Men (15-64 years old) are the largest contributors to household income, with FCFA 413,326 (USD 664). The gap with women revenues is substantial, the latter amounting to FCFA 51,095 (USD 82).
- Agriculture & livestock is by far the largest source of revenues (FCFA 435,707 or USD 700).
- As displayed in Table 15 (standard deviation column), the distribution of annual revenues is spread out for agricultural activities.
- There are some households that declare less than FCFA 100,000 (USD 160) per year, or less than USD 0.5 per day. 4 out of the 21 surveyed households fall in this category.

Table 15. Household revenues from non-domestic work, by gender-age group (Panel A) and by activity (Panel B). N=21.

	Mean	Std. dev.
Annual revenue from non-domestic work (FCFA)	501,659	451,204
Panel A. Annual revenue from non-domestic work (FCFA) by gender-age group		
Girls <15 years old	-	-
Boys <15 years old	-	-
Women 15-64 years old	51,095	96,827
Men 15-64 years old	413,326	462,148
Women 65+ years old	-	-
Men 65+ years old	37,238	117,661
Women 15-24 years old	571	2,619
Men 15-24 years old	27,857	104,842
Women 25+ years old	50,524	96,975
Men 25+ years old	422,707	429,871
Panel B. Annual revenue from non-domestic work (FCFA) by activity		
Agriculture/Livestock	435,707	452,893
Commerce	32,952	85,527
Agriculture/Livestock + Commerce	21,714	69,078
Food processing	8,571	39,279
Agriculture/Livestock + Food processing + Commerce	714	3,273
Crafts/Construction	-	-
Agriculture/Livestock + Crafts/Construction	571	2,619
Health/Education	-	-
Religion	1,429	6,547

8.1 Insights on data quality & recommendations

Data and field observation suggest that there may be less underreporting in non-domestic work than there is in domestic work. This is because it is perhaps easier to report on occupations that are relatively stable than it is for domestic task.

In addition, the relative participation and contribution of men and women appear to be in line with general trends in farming rural areas.

However, some concerns can be raised:

- Data variability appears to be substantial, as shown in Table 14. On aggregate across gender-age groups, person-days of non-domestic work may for instance range from 0 to over 300. Once again, this may be simply due to limited sample size, but hypotheses of error measurement cannot be excluded a priori. Respondent fatigue may have kicked in at this stage of the interview (generally, more than 2-2.5 hours). Respondent bias – for instance underreporting out of expectations of benefits – may also be likely, despite efforts by the field team in making clear that study be unlinked to any sorts of support or community project.

- The fact that children (boys and girls below 15) do not report to perceive any remuneration may be due to social desirability bias (will to mask child labor). An alternative explanation is that remuneration may be unstable or not even perceived as remuneration. As a matter of fact, children are often simply expected to aid with specific tasks.

- There may be evidence of underreporting of revenues. Based on our figures on cocoa revenues, each household gained approximately 460,000 FCFA in a year – from cocoa only. The correspondent figure for non-domestic work is roughly 500,000 FCFA (Table 15). This means that non-cocoa revenues amount to only 40,000 FCFA per household, which may raise some doubts about reporting of non-cocoa revues.

    - This underreporting may come in 2 ways: reporting less remunerated activities than those the household engages in; or declaring revenues that are below the actual amounts gained, for each sector of activity reported.

Recommendations:

- *Insist on the study not being linked to any form of assistance or support, in order to minimize any strategic bias.*

- *As explained in more details in the previous recommendation section, it may be recommended to shorten survey time or administer the questionnaire at different times – in order to reduce risks of losing quality information due to respondent's fatigue.*

- *When programming the survey, insert a logic check prompting enumerators to verify inconsistencies when cocoa-revenues are higher or close to overall revenues (which include farming/cocoa).*

9. Comparison between different data sources for measuring labor & time allocation

Sections 6 to 8 have provided labor-related data from self-reported surveys, conducted by an enumerator. We now turn to comparing how measurement of labor compares (or differs) across survey data, activity log information and GPS tracking data.

Before turning to any comparative analysis of results, it is however worthwhile mentioning that **Annex 1** provides data on **utilization rates of GPS trackers and activity logs** among participating households. Assessing actual use of these non-conventional measurement tools is a crucial step in evaluating their chances for a successful scale-up.

The pilot aimed to analyze matching between the three measurement tools, at different levels of precisions:

1) Matching in localization: do activity logs and tracker data both signal an individual on a family plot?

2) Matching in time spent on farming activities: comparing time spent on farming activities as per different measurement tools;

3) Matching in time spent on farming activities: comparing time spent on domestic activities as per different measurement tools.

This section is structured around the 3 points above.

9.1 Localization matching

The first element of interest to IPA has been to measure the overlap between activity logs information and tracker data, as far as farming activities are concerned[12].

OVERALL APPROACH

Matching between activity logs and tracker data occurs when for any given time of the day (i.e. morning, afternoon or evening[13]):

- The activity log indicates the individual as having undertaken any farmer-related activities and tracker data confirms his/her presence in one of the family plots[14] (for at least 20 minutes[15]); or

- Activity log indicates no farming activity and tracker data shows no presence (or presence for less than 20 minutes) on any family plots.

[12] A similar exercise for domestic tasks would be trickier: most domestic activities are in practice carried out outside the house (e.g. cattle rearing, fetching water, going to the market, etc.). it is therefore difficult to associate "being at home" and "did domestic task" the way we did for farming activities.

[13] Based on discussions with farmer households, a commonly accepted repartition of the day is as follows: morning from 6am to 12 noon; afternoon from 12 noon until 4pm; evening from 4pm onwards (for our purposes, evening time has been capped at 11:59pm).

[14] In order to establish an individual's presence on a plot, we used a radius of 250 meters, centered on the plot's GPS coordinates that were collected. The radius was chosen based on the average size of plots, as well as based on visual mapping of fields and tracker data, which helped identified density points and the perimeter around them.

[15] This threshold was introduced to avoid flukes, e.g. individual passing by the family plot without in fact doing any farming work.

Results for all the 39 individuals are presented in Table 16. The table shows the percentage of matching, as defined above, for each day, during the morning, afternoon and evening. For instance, on Monday 1 morning, activity logs and tracker data overlapped for 64% of individuals.

The table also shows an average matching rate by day (column C), which averages the percentages of matching of morning, afternoon and evening, on any day. Column D aggregates results weekly, in order to highlight trends in matching over-time. The bottom line of the table finally contains the average matching rate by part of the day (i.e. morning, afternoon, evening) and the overall average rate of matching. Matching rates that are closer to 100% are displayed in more intense green tones, whilst cells containing lower matching rates are shaded in yellow.

Table 16. Matching between activity logs and tracker data for farming activities (N=39).

	A.	B.			C.	D.
	Day	**Morning**	**Afternoon**	**Evening**	**Average by day**	**Average by week**
Week 1	Monday, 1	64%	64%	69%	66%	79%
	Tuesday, 2	69%	69%	82%	74%	
	Wednesday, 3	64%	72%	85%	74%	
	Thursday, 4	77%	74%	79%	77%	
	Friday, 5	79%	85%	95%	86%	
	Saturday, 6	82%	77%	87%	82%	
	Sunday, 7	92%	95%	97%	95%	
Week 2	Monday, 8	64%	72%	82%	73%	83%
	Tuesday, 9	74%	69%	82%	75%	
	Wednesday, 10	77%	79%	87%	81%	
	Thursday, 11	64%	79%	72%	72%	
	Friday, 12	95%	92%	92%	93%	
	Saturday, 13	92%	90%	90%	91%	
	Sunday, 14	95%	97%	95%	96%	
Week 3	Monday, 15	82%	90%	90%	87%	85%
	Tuesday, 16	85%	85%	90%	86%	
	Wednesday, 17	74%	72%	85%	77%	
	Thursday, 18	95%	87%	85%	89%	
	Friday, 19	85%	77%	90%	84%	
	Saturday, 20	90%	85%	87%	87%	
	Sunday, 21	87%	90%	87%	88%	
Week 4	Monday, 22	64%	67%	74%	68%	85%
	Tuesday, 23	85%	87%	97%	90%	
	Wednesday, 24	87%	72%	85%	81%	
	Thursday, 25	77%	90%	97%	88%	
	Friday, 26	97%	92%	97%	96%	
	Saturday, 27	72%	72%	87%	77%	
	Sunday, 28	97%	95%	95%	96%	
Average by time of the day		**81%**	**81%**	**87%**	**83%**	

Table 17 reproduces the same exercise, this time breaking data down by gender-age groups.

Table 17. Matching rates between activity logs and tracker data, by gender-age groups. Children are aged <=15. Men and women are aged 16+.

	Matching rate	Sample
Total males	**80.1%**	**18**
Men	79.5%	10
Boys	80.7%	8
Total females	**85.8%**	**21**
Women	86.0%	10
Girls	85.6%	11
Total	**82.9%**	**39**

Before proceeding to present some preliminary results, one caveat is in order. It was not always possible to collect GPS data for all families' plots, due to their distance from the village or trying access conditions. Spatial analysis was therefore conducted to retrieve GPS coordinates for these plots. The tracked paths taken by individuals belonging to these households were mapped using GIS (Geographic Information System) software; then lands susceptible of being farmed (based on satellite images) for which there was a density of tracker data (meaning that the individual made recurring journeys to/from these portions of land) were identified; and lastly, land areas which were visited at times compatible with farming were recorded (for instance, lands where presence was systematically detected late at night were discarded).

This exercise allowed to retrieve 4 plots belonging to 4 different households; eventually, we have missing GPS data for 7 plots (out of a total of 33). However, because spatial analysis did not highlight any farming areas that was regularly visited by the concerned individuals during the monitoring period, this may reduce concerns related to the lack of GPS data for these plots.

DISCUSSION OF RESULTS

Table 16-17 offer some interesting preliminary evidence on overlapping as regards farming activities:

- **The aggregate average matching rate at 83% appears to be a promising result.** Not only it confirms that individuals have worn trackers quite regularly, but also suggests that i) logs and tracker data independently collect information that is reasonably accurate; and ii) combining activity logs and tracker data can be an effective approach to triangulate information on farming activities to increase accuracy.

- The **rate of overlapping slightly increased over-time** from day 1 to day 28. Week 1 registered a matching rate of 79%, which gradually grew until reaching 85% during week 4.

- There is **higher overlap in the evening than in the morning and afternoon**. Because morning and afternoon are typically the time of the day that is dedicated to farming, this may raise some concerns in terms of accuracy in measuring agricultural labor. This may be due to an inherent bias in self-reported assessment of farming labor (i.e. the farmer indicates he/she undertook agricultural work when in fact he did not) or by GPS measurement errors (for instance due an individual not falling within the perimeter around the GPS datapoint identifying the plot, or due to lacking GPS data for certain plots). Another source of mismatch may be that the farmer did indulge in agricultural work (as indicated in the activity log) but did so on a plot other than one of his family's (which the tracker data would not capture). Finally, another explication is that since activity logs are generally filled in during the evening, people better recall what they have done closer to that time, and less so for the morning and afternoon.

The fact that overlapping between activity logs and tracker data appears to be higher during weekends, when farmers do not work as much in their fields, may corroborate this hypothesis about farming activities being more difficult to measure.

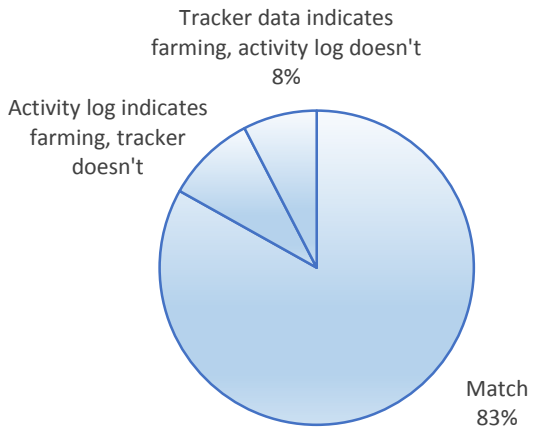


Figure 37. Sources of mismatch.

▪ As represented in Figure 37, among mismatch cases, 8% are due to tracker data indicating farming activities but activity log not indicating farming activities; whilst 9% are instances where activity log indicates a farming activity but tracker data does not. The similar share of "error" of the two tools may suggest that there may be a certain **"neutralilty" towards the two measurement tools**: farmers did not appear to "lie" (or overreport) on activities more through one measurement tool than through another.

▪ **Matching rates are higher for women than for men**, respectively at 86% and 80%.

▪ Within genders, differences in matching rates between age groups are very limited.

9.2 Farming time across measurement tools

The previous section focused on whether information on having done farming work or not, as per activity logs and tracker data, converged. This section now turns to *time* spent farming and on how its measurement compares across activity logs, tracker data and survey. It looks at monthly days worked first, then at weekly hours.

It is important to underline that, while tracker data and activity logs cover the same period (1-28 August 2016), survey data refers August 2015. Although the calendar of agricultural tasks may be assumed to be relatively stable for the same month across two consecutive years, some recall bias is likely to affect responses. The main comparison of interest should therefore be that between tracker data and activity logs, with survey data as a control check.

DAYS WORKED

Table 18 compares the number of days in which farming activities were taken up as per trackers, activity logs and survey data[16]. It is worth highlighting that here we do not measure effective work time (which is done below, see "Weekly hours"), but we rather aim at establishing whether farmer has performed any farming activity, regardless of its duration. Therefore, days worked across measurement tools are defined as follows:

- Activity logs: individual has been reporting any farming activities in the morning, or afternoon, or evening during one month (August 2016);

- Tracker data: detects presence on family plots; if individual is found to be on any plot for at least 20 minutes, then during that day he has taken up farming tasks (tracking period: August 2016);

- Survey data: individual reported the number of days worked for the previous year (August 2015).

[16] The period of reference is August 2016 for trackers and activity logs (1st-28th); and August 2015 for survey data (the survey asked respondents what was the number of days worked during the *last* campaign). Due to the seasonality of the agricultural (and cocoa particularly) calendar, one may expect that deviations from one year to the following remain within reasonable ranges. However, this is a caveat that is worth mentioning. Memory bias may also kick in.

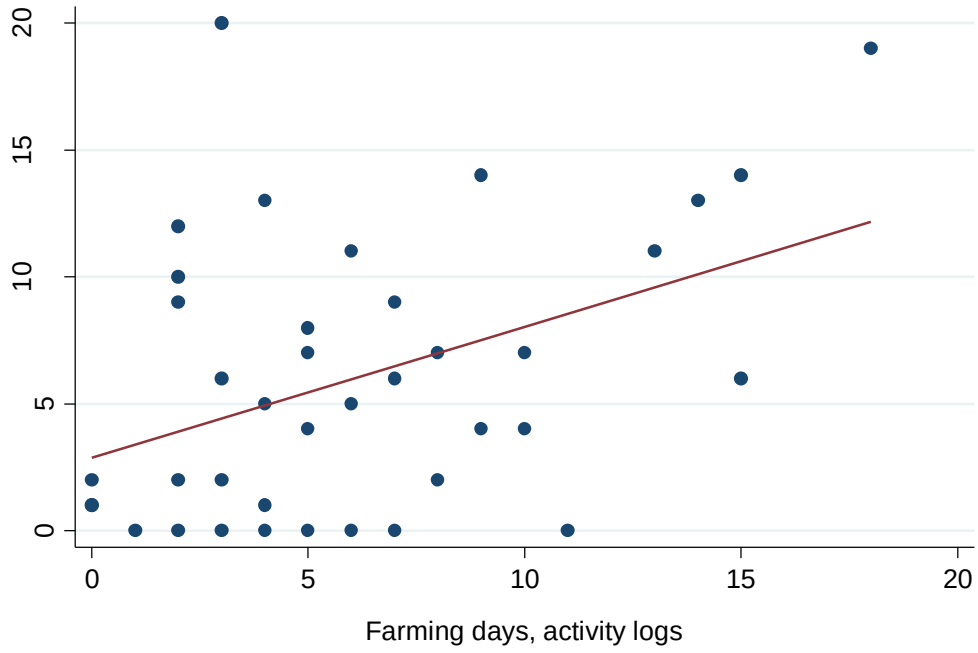
Table 18. No. of days in which farming activity was taken up, by gender-age groups and across our different measurement tools. Period: August 2016 for trackers and activity logs, August 2015 for survey data. N=39.

	Average no. of farming days		
	Trackers	**Activity logs**	**Survey data**
Adult (>=16)	**6.1**	**7.9**	**14.0**
Men	8.5	9.3	15.4
Women	3.6	6.4	12.5
Children (>= 15)	**6.0**	**4.3**	**3.1**
Boys	8.0	4.6	5.5
Girls	4.5	4.0	1.3
Total average	**6.0**	**6.1**	**8.6**

On average, the number of farming days as per trackers and activity logs is very similar: 6.0 days and 6.1, respectively.

However, when looking at individual-level data, the correlation between tracker and activity logs data seems to be less strong. Figure 38 plots the number of farming days as per tracker data against the no. of farming days as per activity logs. There appears to be a weaker, although still positive, linear relationship between days measured through the two measurement tools. The coefficient of correlation stands at 0.2. This result should however not be taken at face value for two reasons: (i) the relationship, as displayed by the scatter plot, does not seem linear at low values; and (ii) sample size remains limited.

Figure 38. Correlation between no. of farming days worked as per tracker data (y axis) and as per activity logs (x axis). Period: August 2016, N=39.



If farming days as measured through tracker data and activity logs are on average very similar, survey data appears to overreport efforts put into farming, which amount to 8.6 days (as opposed to 6.0-6.1 days measured by trackers and activity logs).

A breakdown of data by gender-age groups suggests that:

- Most children (80%) do not report any farming work during the survey, whilst reporting some farming activity in activity logs;

- However, those who do report working in the field tend to overstate the number of days in survey data, as compared to activity logs and tracker data;

- In some cases, farming tracker time for children appear to be much higher vis-à-vis what declared in the survey and in activity logs. Their work load therefore appears to be more substantial when measured by trackers than when self-reported. This appears to apply to girls and boys alike.

- The opposite trend applies to adults: the number of farming days reported in the survey and in the activity logs is higher than the number of farming days recorded through the trackers. Again, this holds true for men and women.

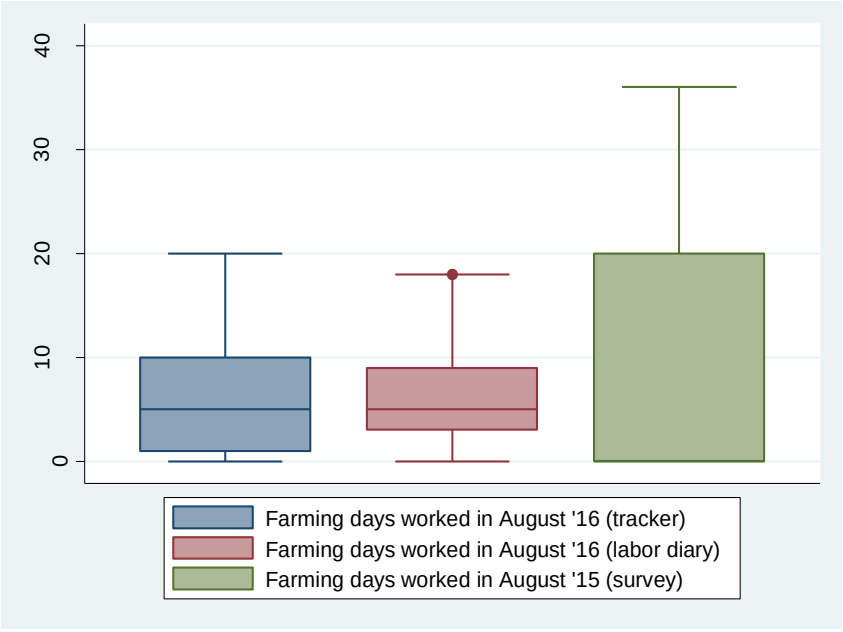
- Male children appear to be more involved than female children in farming activities, consistently across measurement tools – and more pronouncedly when using survey data.

- The difference in no. of days worked by adult and children is low as per tracker (6.1 v. 6.0 days respectively), but this gap substantially increases when using survey data (14.0 v. 3.1 respectively).

- The share of individuals reporting no farming labor during survey is substantially higher for children than for adults (40% for adults v. 80% of children).

In order to shed further light on the reliability of the three instruments, Figure 39 presents the variability of farming days across them. Survey data is more spread out than tracker data and activity logs. The latter is the measurement tool that appears to ensure the lowest variability among the three instruments. However, it is worth restating that higher variability for survey data may be related to recall bias, as the reference period is August of the previous year.

Figure 39. Distribution of farming days, across measurement tools. Period: August 2016, N=39 (for each measurement tool).



WEEKLY HOURS

Thus far, the report has focused on the number of days an individual has worked on farming, without yet considering the intensity of this work, for instance the number of hours worked in the fields. The attention now turns to this issue, by looking at weekly farming time, as measured by tracker data.

One way to triangulate tracker data is to use survey data. An important caveat is in order though: survey data on weekly farming hours refers to the last 7 days before the day of survey administration (i.e. the 3rd week of July 2016) – an element that must be kept in mind when comparing across data, because workloads in July are typically heavier than in August[17]. Another caveat is that, although enumerators were instructed to ask questions about labor done to each household member, sometimes not everyone was available for interviewing. Therefore, in a few cases, we had the household head or his spouse responding on behalf of other members, which may lead to bias (and it is difficult to predict in which direction).

Table 19. Weekly hours as measured by trackers and survey. Period: August 2016 for trackers; 3rd week of July 2016 for survey data. N=39 for both tools.

	Weekly farming hours	
	As per trackers	**As per survey**
Adult (>=16)	**5.7**	**12.7**
Men	8.1	9.1
Women	3.3	16.3
Children (<=15)	**5.3**	**5.1**
Boys	7.0	6.4
Girls	3.6	4.2
Total average	**5.5**	**9.0**

Table 19 reports weekly farming time as per tracker data, disaggregated by gender-age group. During the 4-week window of observation, adult men have worked in their field over 8 hours per week, while adult women have worked 3 hours and 20 minutes. Among children (below 16 years old), boys have worked 5 hours and a half and girls over 3 hours and a half.

For men, this figure would mean less than a full day of work (i.e. 8 hours) per week, which may be an understatement of farming work. However, there are reasons to hypothesize that the extent of this understatement be limited, because:

- Generally, August is not a high-intensity work for cocoa (most of the small harvesting is already done), especially among farmers who do not systematically use fertilizers and pesticides[18].
- During July 2016, which is supposedly a more labor-intensive month, survey data documents 9.1 hours, i.e. only 1 hour more than tracker data for August.

In any case, underreporting based on tracker data can be attributable to five main reasons, which deserve attention:

1) Farmers have not systematically worn the devices when working in the fields;
2) The precision of plot-level GPS data is insufficient;
3) GPS data at plot-level was not always collected accurately by enumerators;
4) The technique to define a radius around plot-level GPS data is not systematically effective;
5) The gap is explained by missing data for a certain number of family plots.

[17] There may be for instance more intense harvesting in July than there is in August – see source above.
[18] See for instance Rainforest Alliance and NYU Stern School of Business Sustainable Cocoa Investment Challenge (2013), Sustainable Cocoa Investment Challenge: A Case Study (Appendix 16).

The biggest deviation between tracker and survey data comes from women's participation: 16.3 hours (survey) v. 3.3 hours (trackers). This is in contradiction with survey data on the relative contribution of men vs. women during harvesting (July is a harvesting time), which shows that men are usually more involved.

Despite the absolute values of tracker hours, which may be to an extent understating actual work loads, some of the underlying patterns appear to be confirmed. For instance, the relative participation of men and women is in line with data on the number of days worked (Table 18). Similarly, the relative involvement of adults and children as per tracker is aligned with what Table 19 pointed out.

Figure 40 offers a visual representation of the distribution of farming hours as measured via trackers, by gender-age groups. Boys and adult men show the highest variability (possibly because of their higher involvement in farming), while for girls and women figures are less spread out.

Figure 41 shows instead the distribution of weekly hours across the 4 weeks of monitoring. The distribution is wider during week 1 and week 4, and relatively more concentrated during week 2 and 3. Further analysis and individual-level comparison with survey and activity log data may yield additional insights on this trend.

Figure 40. Average weekly farming time as measured by trackers, by gender-age group. Period: 1st-28th August 2016, N=39.

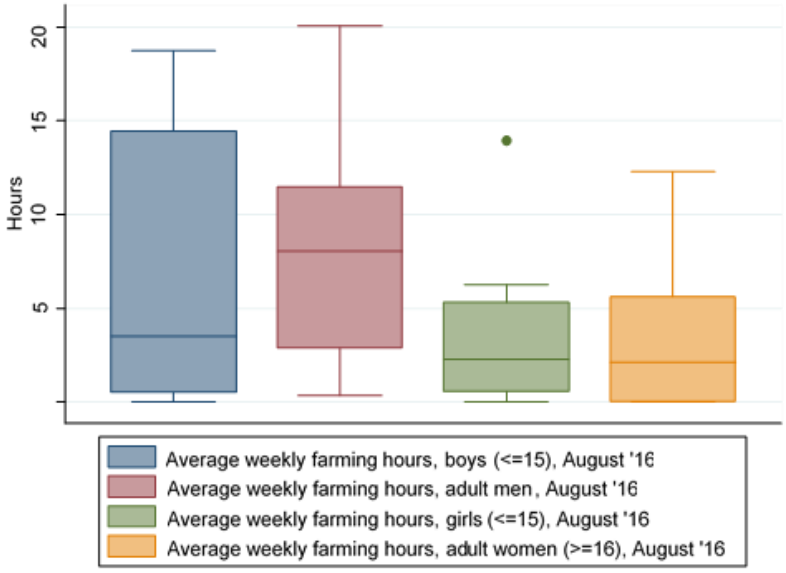
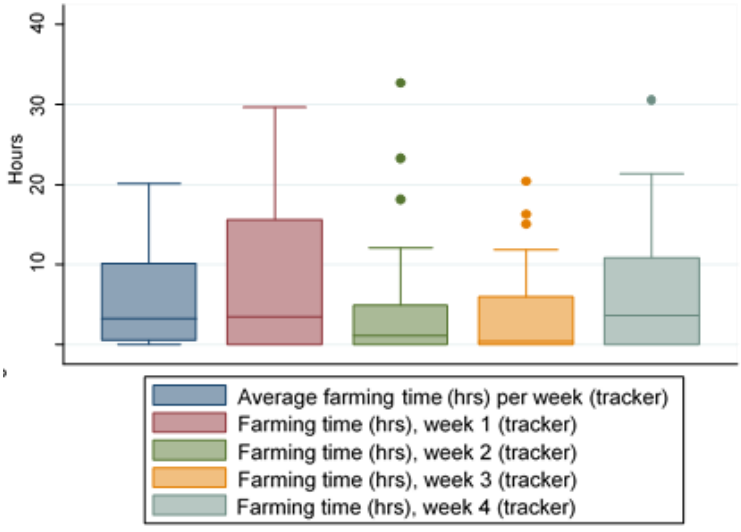


Figure 41. Distribution of weekly farming hours, by week, as measured by trackers. Period: 1st-28th August 2016, N=39.



9.3 Time allocated to domestic tasks across measurement tools

Survey and activity logs have also been tested as tools for measuring time allocated to domestic activities, i.e. daily or weekly tasks, such as looking after domestic cattle, cooking or doing housework, that are carried out by household members in the interest of the household itself (typically without any remuneration). We do not use trackers to measure domestic activities because it would be difficult to associate being at home on one hand and conducting domestic activities on the other. As a matter of fact, most of domestic activities, such as cattle rearing, fetching water or wood, going to the market buy food supplies, are not necessarily performed at home or within its perimeter.

Before presenting preliminary findings, it is worth mentioning some caveats. Survey enumerators were instructed to ask each household member individually about time spent on each domestic task. However, in some cases not all household members were available for interviewing, so it occurred that questions were asked to a different member (e.g. the mother or the head of household) responding on behalf of other household members. This may to an extent bias results (difficult to establish in which direction). In addition, survey data and activity logs refer to two different time periods: surveys asked respondents about the time spent "in the last 7 days", i.e. during the week preceding the survey. Activity log data instead refers to the whole of August, presenting an average of the 4-week monitoring period. The fact that these domestic activities are typically recurring tasks may however limit concerns over this lack of overlapping in time.

Figure 40 compares, for each domestic task, the average number of days worked, as measured by survey and activity logs. For instance, respondents spent on average 0.18 days per week looking after domestic animals (cattle) according to survey data; and 0.58 days as per activity logs. **Results appear to be broadly consistent** – the main deviation being on cooking**. People seem to report more days via activity logs for most tasks, except for housework and going to the market** (for the latter the deviation being almost negligible). This is true for cattle (0.6 days v. 0.2 days), cooking (2.7 v. 1.6 days) and fetching water (1.4 v. 0.9), while figures for collecting wood are the same.

While Figure 42 provides a punctual estimate (mean) for days when each domestic task was taken up, Figure 43 gives a visual representation of the *distribution* of days, for the two measurement methods (survey and activity logs). Each dot along the axis represents an observation, so that the distribution from minimum to maximum values is plotted. Some interesting patterns emerge:

- More people reported having performed domestic tasks in activity logs than during the survey. This can be seen by looking at the number of dots in the chart, which is higher for activity log data, for each task.
- Survey data appears to have more variability than activity log data. This can be seen, for instance, in correspondence of "fetching wood" or "going to market" where observations are more concentrated for activity logs.

Figure 44 breaks down the number of days worked by gender-age groups:

- Men and children (boys and girls) report more days via activity logs than via survey.
- Adult women are the exception to the above trend, reporting slightly more days in the survey.
- The biggest gap between survey and activity logs data occurs for girls – especially so for cooking, housework and fetching water.

Such preliminary evidence therefore suggests that intensive margins (i.e. the no. of days of doing the task) and extensive margins (no. of people performing the task) both appear to be higher in activity logs than in survey data.

Figure 42. Average number of days in which domestic activities was undertaken, by type of task. For survey data, figures refer to the last week preceding the survey; activity logs data refer instead to an average of the 4-week monitoring period (August 2016). N=39. Missing data: No information for hunt and child care was collected in activity logs. No information on repairing construction was asked during the survey.

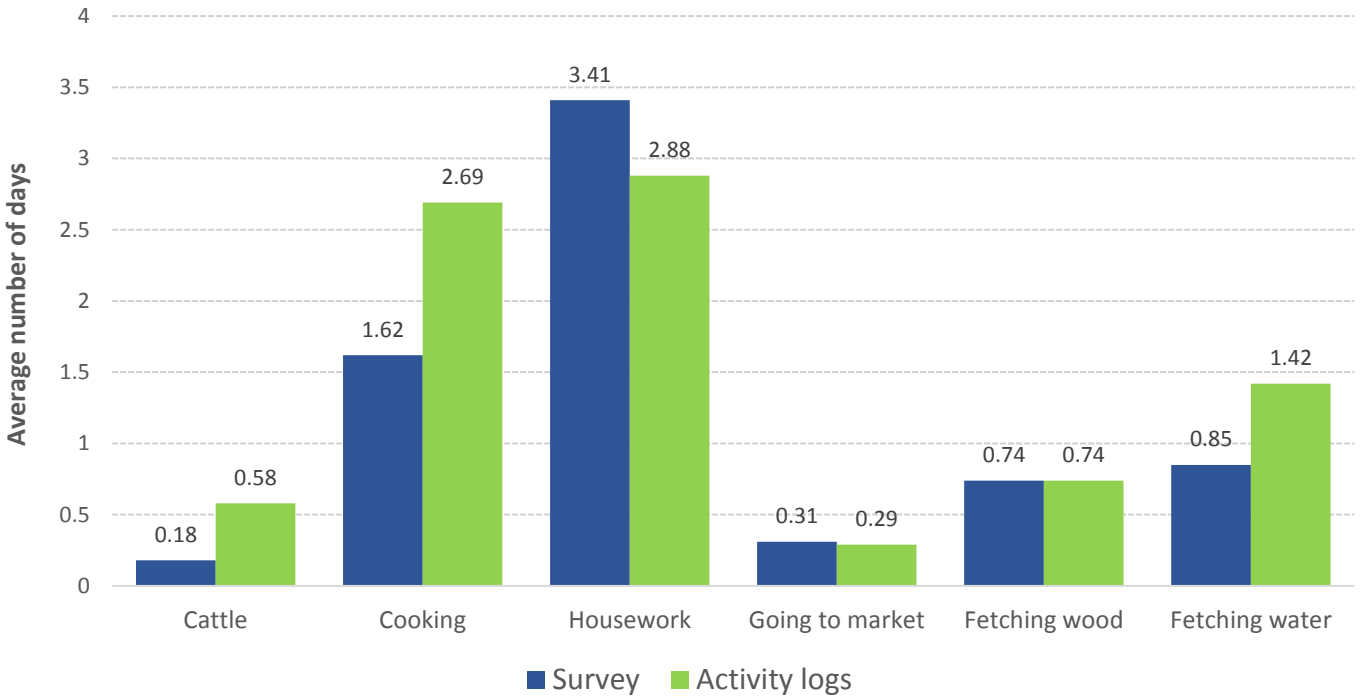


Figure 43. Distribution of number of days worked by type of domestic activity and measurement method (N=39). Missing data on "hunt", "washing" and "child care" due to the fact that these tasks were not initially included in the activity log template ("washing" was integrated with "housework"). No question on time spent on repairing/construction was asked during survey.

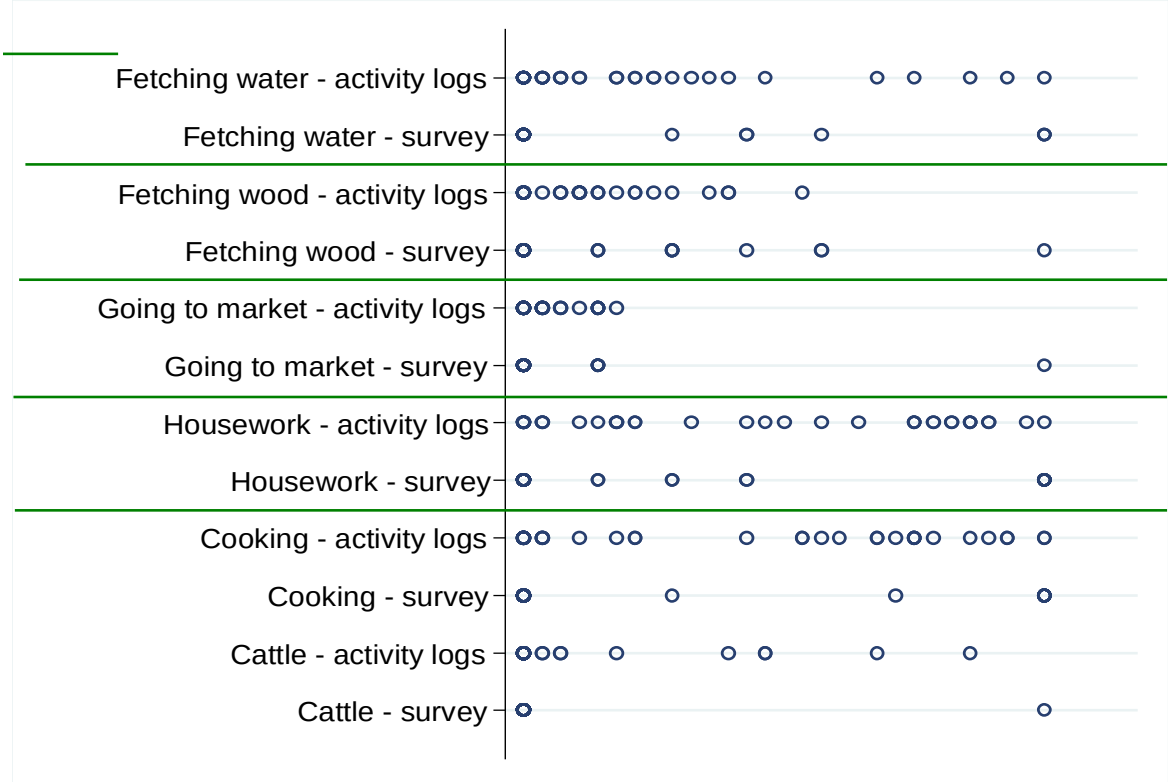
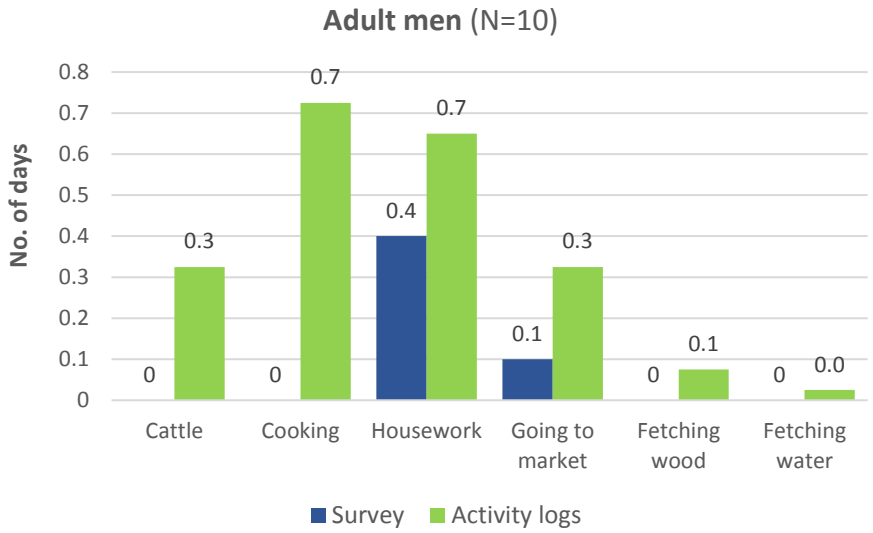
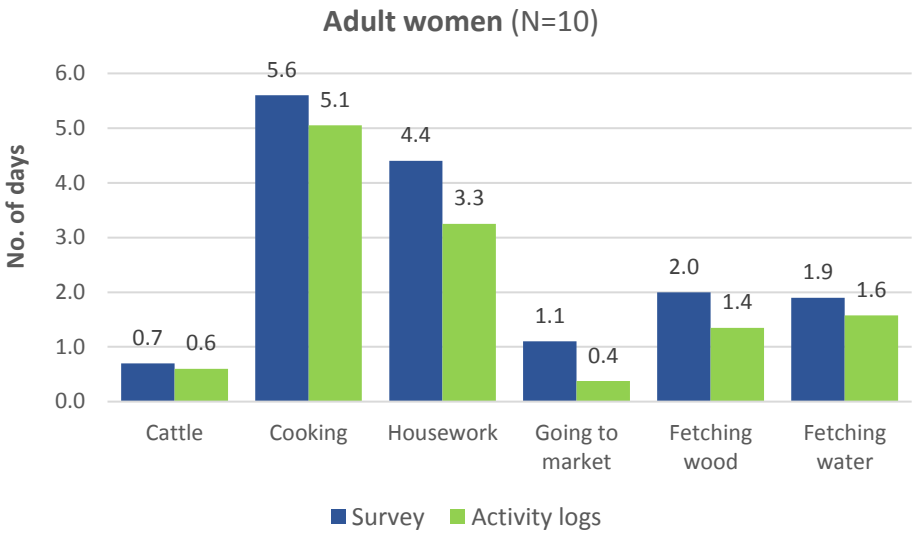
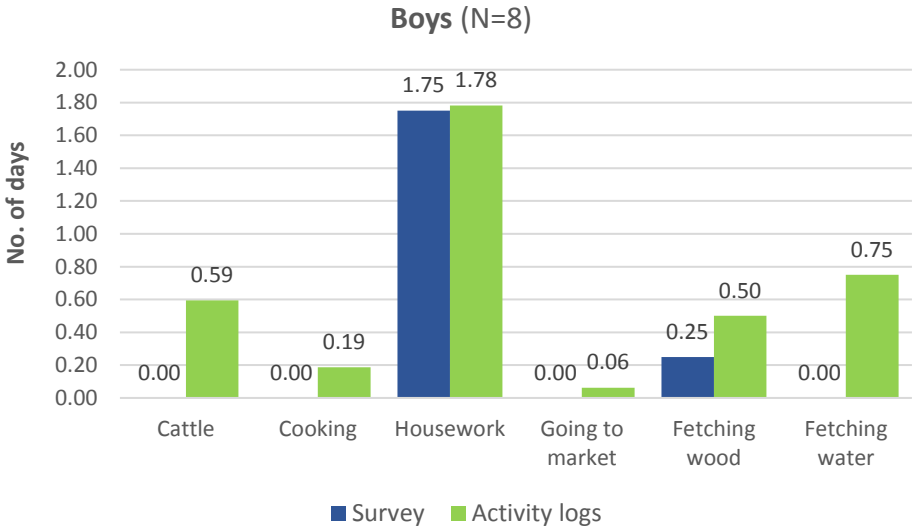
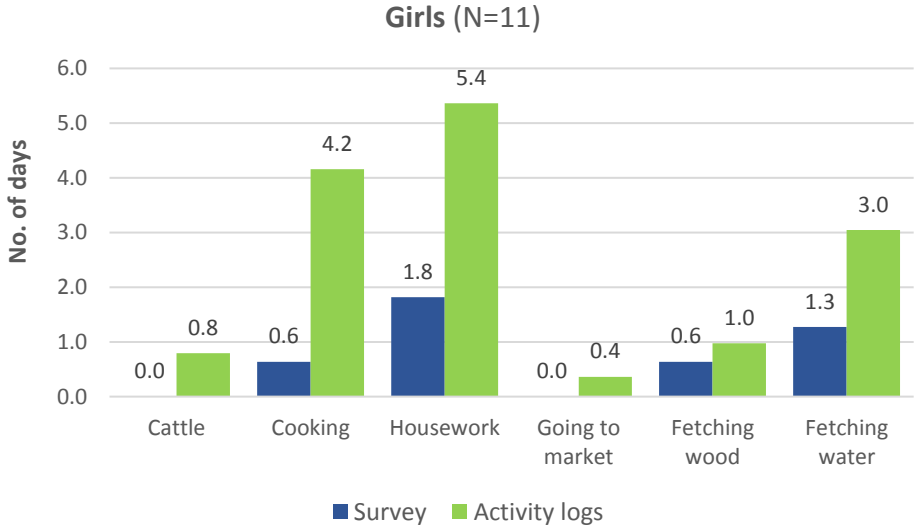


Figure 44. Average number of days of domestic activities, by gender-age groups. Adult are defined as aged 16+, children <=15. Sample size in brackets.









9.4 Preliminary conclusions on measurement issues

This section aimed at showing how labor-related data compared across different measurement tools, notably activity logs, tracker data and survey information. Although the sample size is deliberately limited and some caveats – described in more details in each sub-section – apply, some valuable considerations can be drawn:

Localization matching: do activity logs and tracker data converge in detecting presence or absence in the field?

- Localization matching rate between tracker data and activity logs has proved to be high (83% of cases). This is encouraging evidence for replicating the experience: it shows individuals' take-up of trackers and activity logs was substantial and accurate – albeit of course room for improvement exists. Data also validates the distribution protocols followed.
- The rate of overlapping, despite a decrease in utilization of trackers, slightly increased over-time.
- Overlap is higher in the evening than in the morning and afternoon. This may be a result of agricultural labor – typically done in the morning and in the afternoon – being more difficult to be measured. The latter in turn may owes to several reasons, including: farmers not always wearing the tracker, lack of some plot-level data, irregular shape of some plots which makes GPS matching complicated.
- The fact that overlap during weekends is generally higher may corroborate the hypothesis above.
- Matching rates are higher for women than for men: respectively at 86% and 80%, while differences within gender but across different age ranges are limited.
- There appears to be some "neutrality" as regards the source of mismatch: the number of cases when individuals indicate farming labor in activity logs but tracker data does not confirm are equivalent to the number of cases in which tracker data shows farming and activity logs do not.

Farming time across measurement tools

- On aggregate, the number of farming days as per tracker and activity logs is similar, and 30% lower than what reported during the survey.
- A closer look at the relationship between tracker and activity log data however shows that, while on aggregate results are very similar, the correlation between individual-level data is not as strong (although positive).
- A considerable share of children does not report any farming labor during the survey, but they do so through activity logs.
- Children's work load appears more substantial when measured via trackers than when measured via self-reported tools (survey and activity logs). This holds for girls and boys alike.
- Male children appear to be more involved than female children in farming activities, consistently across measurement tools – and more pronouncedly when using survey data.
- The difference in no. of days worked by adult and children is low as per tracker (6.1 v. 6.0 days respectively), but this gap substantially increases when using survey data (14.0 v. 3.1 respectively).
- Variability appears to be more limited when farming days are measured by activity logs and trackers than it is the case for survey.
- In terms of hours effectively worked, tracker data appears to understate workloads when compared against survey data, except for children who work longer hours as per trackers than as per survey.

Domestic labor across measurement tools

- Results are broadly consistent across survey and activity logs, but…
- Men and children (boys and girls) report more days via activity logs than via survey – but adult women are the exception to this trend, reporting slightly more days in the survey.
- In addition, more people reported having performed domestic tasks through activity logs than it is the case during the survey.
- Survey data are characterized by higher variability than activity log data.