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Africa Great Lakes Region Coffee Support Program (AGLC)

ESTIMATING FARMER COST OF PRODUCTION FOR FULLY-WASHED COFFEE IN RWANDA

By

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Food Security Policy *Research Papers*

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1. Introduction

The purpose of this research report is to provide a clear understanding of the methodology used by the Africa Great Lakes Region Coffee Support project (AGLC) to determine the cost of production (CoP) for coffee farmers in Rwanda. In documenting how the CoP data were collected and the estimates derived, users will be equipped to use the findings of this research confidently and appropriately as they incorporate them into planning and decision making in the coffee sector. It is intended for this report to also assist research purposes and program implementation elsewhere in the Africa Great Lakes region and beyond.

In the sections below, we first share the details of the methodology to estimate the costs (in absolute terms) per household of producing coffee in the 2015 season. Then we show how the more standardized metric, CoP per kilogram cherry produced, is calculated. We also discuss what this CoP estimate is and what it "is not," to avoid confusion about how this particular metric can be used. We address issues with transport costs and the data on CoP when differentiating between ordinary ("semi-washed") coffee and fully-washed coffee. Finally, we share some of the ways the AGLC project will analyze the CoP data in the future to generate other reports and policy briefs.

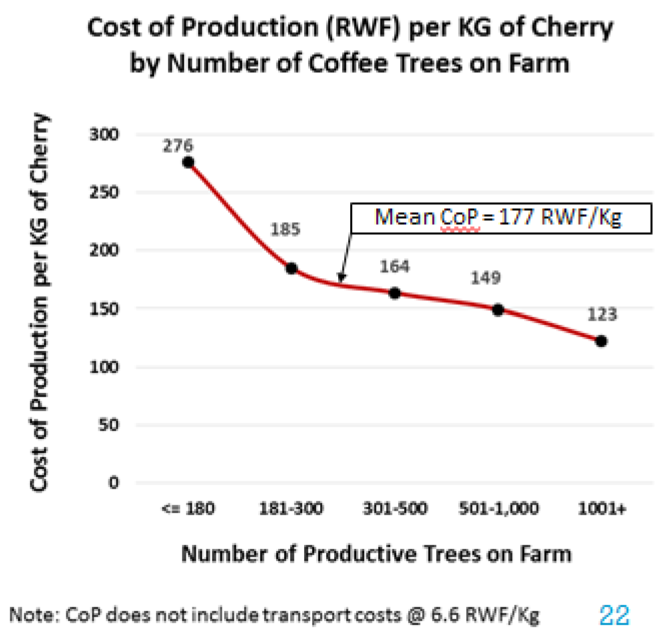

Figure 1: Cost of production (RWF) per KG of cherry by number of trees on farm.

The average CoP per KG cherry for the coffee farmer in the AGLC Baseline Survey sample is 177 RWF/kg ($US.10/lb.). Figure 1 above displays this estimate along with Cost of Production (CoP) per KG figures for coffee producing households grouped by the number of coffee trees in their plantations.

It is an important graph to begin our discussion for two reasons. It is an example of the kind of analysis and story-telling that is possible with CoP *data*, as opposed to theoretical approximations, anecdotes and rough guesses that we so often rely on in the absence of hard data. It also represents *recent* data coming from the AGLC farm-level baseline survey, conducted January – March 2016.

2. Sample Frame

The sampling frame used in the survey is as follows:

- 1024 farmers were interviewed in four of Rwanda's districts with large coffee production.
    - 256 in Gakenke (North)
    - 256 in Huye (South)
    - 256 in Rutsiro (West)
    - 256 in Kirehe (East)
        - 4 washing stations were selected in each of these districts
            - 64 farmers were randomly selected from the list of farmers delivering to each washing station.

Although the sample is not representative of the entire population of Rwanda's coffee farmers, it is large enough and diverse enough to give reliable indications of metrics like cost of production for farmers actively engaged in the production of cherry for fully-washed coffee.

The methodology used to calculate CoP has four major components:

- Household labor (by task)
- Wage labor (by task)
- Equipment (e.g., pruning shears, sprayers, masks)
- Purchased inputs (fertilizer, pesticide, mulch, etc.)

These components are "built up" from the variables included in the baseline survey. A breakdown of each major component into the variables that are the "bricks" follows.

3. Valuation of Components

3.1 Value of household labor by task

A crucial but tricky part of any CoP calculation for coffee farmers is estimating the household labor hours invested in cultivation tasks and then valuing those hours. With the baseline survey the AGLC project compiled farmers' own estimates, not those of researchers, to calculate the time they spend on these tasks. Of course, farmer recall is not 100%. But that is where the large number (1,024) in the sample helps. Statistically, as the sample grows, we increase the chance of significance, because the mean more reliably estimates the population mean.

The labor categories included in the survey questions were seven cultivation tasks, plus harvest tasks (lumped together), and sorting tasks (lumped as one).

- Cultivation tasks
    1. Weeding
    2. Mulching
    3. Fertilizing
    4. Pesticide

5. Pruning
6. Stumping
7. Plant seedlings

- Harvest tasks
- Sorting tasks

For each cultivation task, farmers were asked "Last season, on how many days did members of your household weed your coffee fields?" and then, "On those days, how many hours per day (on average) were dedicated to weeding by members of your household?" This allowed researchers to calculate the number of "household labor days" spent on each task. These were totaled to create a single variable that is the total days the household spent on cultivation tasks.

The total household days invested in cultivation tasks were then added to the total days for harvesting and sorting.

To convert these labor days to values (in RWF), we multiplied by 700 RWF ($US .89) as that was the median wage per day paid by the sampled farmers to hire labor for all tasks (excluding sorting, which was significantly lower). The mean value of labor provided by the households in the baseline is RWF 35,868 ($US 45.40)[1].

3.2 Value of wage labor by task

Wages paid to workers who help on the farm, especially during harvest, are known to be a large part of the expense of any coffee farm. Researchers in Burundi, Rwanda and Colombia have determined that labor costs at harvest are typically the highest single cost in the coffee value chain (USAID Burundi, 2008; Aithal and Pinard, 2008; Lundy, 2015).
In the AGLC baseline survey farmers were asked about wages paid, and for how many days, to workers for the same seven cultivation tasks listed above for household labor. For example, they were asked, "Did you hire anyone to help you weed?", "In total, for how many days did you hire them?" and then, "How much did you pay them per day?" The answers allowed researchers to calculate the total value of wages paid to workers per household for cultivation tasks, for harvest tasks and sorting tasks, creating a 'total wages paid' variable. The mean value for total wages paid is RWF 44,313 ($US 56.09) for the 2015 season.

3.3 Value of Purchased Equipment

Equipment used on the farm is an important component of CoP. The method used by AGLC started by asking the farmers whether they own seven different types of equipment and also ask them to name any "other" equipment they own.

- Sprayer
- Mask
- Drying mat
- Drying table
- Barrel (for soaking)
- Bucket (for harvesting)
- Sacks
- Other

[1] Using $US 1 = 790 RWF.

"Other" equipment mentioned by farmers frequently were ropes, pruning shears, saws and hoes. So these were added to the equipment inventory. The most common tools owned by farmers in the sample were:

- Sacks
- Baskets
- Pruning shears
- Drying mats
- Ropes (for bending trees for harvest and pruning)

For each equipment item they said they owned, we also asked how much it cost them. For example, "How much did you spend for one sprayer?" To value each piece of equipment, we went back to a small sample of farmers and asked them to estimate how many seasons each of these pieces of equipment typically lasts. This helped us calculate an annual cost for each tool. By creating a total of the annual cost of each piece of equipment owned, an estimate of the value of the farmer's equipment for a single season was created, and the mean for all farmers in the sample was RWF 7,506 ($US 9.50). This amount includes only purchased equipment and excludes the value of any equipment the farmers received at no cost, which sometimes happens through local development projects.

3.4 Value of Purchased Consumable Inputs

The key consumable inputs for coffee are fertilizer and pesticide. In the AGLC baseline survey, we also asked whether they purchased mulch, manure, coffee plant seedlings or shade trees. For fertilizer and pesticide, we ask the farmers whether they used any last season, and then, if they said "yes," we asked them how much they actually purchased and how much was given to them by the government or others.

For this CoP calculation, we only include the inputs *paid for* by the farmers. We leave out inputs that are given to them (even though we know these have a high value) because we are interested in estimating the actual costs incurred (investments made) by farmers. In Rwanda, a certain amount of fertilizer and pesticides are distributed by CEPAR/NAEB to farmers every year for free. We had the farmers' report on those amounts, but they are not included as a cost to the farmer.

The purchased input most commonly identified by farmers in 2015 is mulch (53%), followed by manure (14%). Interestingly, fertilizer and pesticide *purchases* by farmers are small – almost insignificant, presumably due to the "free" distributions from the government. The mean value of all purchased inputs reported by farmers was RWF 19,838 ($US 25).

3.5 Total CoP for costs through harvest and sorting

The sums of the means of the four categories above comes to RWF 107,527, ($US 136).

Table 1: Means (in RWF and $US) of each CoP Component and the Total

Mean value of household labor:	RWF 35,868	$US 45.40
Mean value of wage labor:	RWF 44,313	$US 56.09
Mean value of equipment used:	RWF 7,506	$US 9.50
Mean value of purchased inputs:	RWF 19,838	$US 25.00
2015 season Total:	**RWF 107,527**	**$US 136.00**

4. Costs per KG of cherry produced

Our interest is in the cost of production at the farm level and to be able to compare the CoP of different farmer groups, for example, those with many trees vs those with few trees, or female headed households vs male headed households. To do this we create a *household level* cost of production per KG of coffee cherry produced, then take the mean. We know the KGs produced by household, because in the survey we ask, "During the last harvest season (2015), what is your estimate of your total cherry harvest? (in KGs)" The mean of this variable is 1,025 KG. The resulting CoP per KG value for our sample of 1024 coffee growers in Rwanda is 177.32 RWF/KG, which is $US .22/KG, or $US .10/lb. This is the mean value reported in Figure 1 on page 1.[2]

It is also helpful to look at the median CoP/KG, as the median is less affected by the extremes of the distribution and thus better characterizes the "typical farmer." The median is a lower figure at RWF 122/KG, which is expected given that a small number of high-CoP farmers at the upper extreme skew the distribution and yield a mean that is higher than the median.

5. Understanding what this average CoP/KG is and is not

These CoP/KG estimates (mean 177/KG; median 122 CoP/KG) are not easily generalizable to all of Rwanda. They constitute accurate estimates of CoP for four of Rwanda's major coffee-growing districts (Gakenke, Huye, Kirehe and Rutsiro) and farmers growing coffee for the fully-washed channel in those districts. It is not necessarily a good estimate of those coffee farmers located too far from a CWS (about 20% in Rwanda) or those who simply choose to convert all of their coffee cherry to parchment on the farm and sell through traders and others in the semi-washed channel. In AGLC our focus is on the fully-washed channels as those are the farmers who comprise the target group for NAEB and the Ministry of Agriculture, as well as the major stakeholder groups in the coffee value chain. One of NAEB's strategic goals is to transition to 80% fully washed coffee within the next 4-5 years.

We also note that the 177 RWF/KG estimate is based on 2015 data. The value could be higher or lower for the year prior and for future years depending on climate variations affecting production as well as changes in the composite costs such as wage rates, equipment costs, etc.

[2] In some countries where this kind of data is not available, the CoP can be estimated at the aggregate level by dividing the total costs for all farmers by the total KG produced at the country level. This approach, however, will not yield the cost to the average farmer, as the estimate will be heavily weighted toward the larger producers with many trees, and typically lower costs. This simple "division of means" method typically underestimates the average CoP.

The 177 RWF/KG estimate is not intended to serve as an "ideal" CoP/KG in Rwanda. It is a carefully constructed measure of the mean cost that producer households incur to produce one KG of cherry for the fully-washed channel in four important coffee growing districts in Rwanda in 2015. In general, we know that yields per tree in East Africa, and Rwanda specifically, are very low by world standards. One experienced agronomist said $US .10/lb is "poverty coffee farming." Per KG and per LB costs in countries like Panama, Colombia and Hawaii will be much higher. In addition, further analysis will show whether many or few of the farmers in the AGLC sample were using best practices, what kind of prices they received the year prior and whether they were profitable last year. Any of these factors could be far from the ideal and can also heavily impact the CoP/KG for a given year.

While the 177 RWF/KG estimate is a useful single number, it is critical to remember that there are many and diverse *costs* of production – not just one. Each farmer's cost of production is different. The chart in the introduction section, and others like it, underscore this point. CoP is very different depending on the number of trees, access to processing facilities, availability of inputs, agro-ecology of the farm, access to financing, types of customers one is serving, and other factors that are explored more fully in other analyses sponsored by AGLC.

6. Transport Costs

Costs related to transporting cherry (or parchment) to the point of sale were measured as part of the baseline survey, but were not included in the CoP calculation of 177 RWF/KG. This is due primarily to the fact that transportation costs in much of the literature are treated as "marketing costs," which are not considered direct costs of production. In addition, in Rwanda there is a complication to calculating transport costs due to the phenomenon that some coffee is transported as cherry from the farm, and some coffee is transported after it is processed on the farm into parchment (for the "ordinary" or "semi-washed" market).

So there are two types of costs related to transportation, cherry and parchment, though the procedures for calculating the value of unpaid household time for both are similar. The transport costs for cherry include time required for the farmer or the farmer's household members to transport the cherry to a point of sale, normally a collection site or a washing station. The farmers in the survey were asked,

"During the previous harvest season, to whom did you sell most of your cherry?"
"What percentage of your cherry was sold to this buyer?"
"Did members of your household transport the cherry to this buyer?"
"How long does it take to walk to the point of sale to this buyer? (minutes on foot)," and
"How many times during the season do you deliver your cherry to this location? (number of trips)."

This set of questions generated responses that enabled the calculation of the number of hours per season a household member spends delivering cherry. Using the average daily wage rates from other questions in the baseline, we assume 5.5 hrs in a "work day" and compute the value of the partial days required for one delivery trip, then expand the estimate to the number of trips made to the cherry buyer in 2015. The mean of this variable is, however, not very large at RWF 988, ($US 1.25).

Using a similar procedure, household member time required to transport *parchment* during the whole season is calculated. The mean of that variable is only RWF 37. Combining the two values for household labor used to transport coffee we have RWF 1,025.

Transportation of cherry and parchment also involves paid transporters and other fees. The total of all fees paid for transport of both types of coffee has a mean value of RWF 3,960 ($US 5.00). The fact that this cost is markedly higher than the RWF 1,025 cost for the farmer's own household labor used to transport coffee is an indication that farmers are likely paying transporters more often than they are transporting cherry themselves.

To summarize the transportation costs, the value of household labor spent on transportation plus the cash spent on fees comes to an average of RWF 4,986 ($US 6.31), but the majority of these costs is cash paid to transporters at RWF 3,960 ($US 5.00). To compare transport with the CoP per KG calculation, we must divide the total transport costs by the number of KG produced. This value is RWF 7.4 per KG.

7. Ordinary vs. Fully Washed Coffee

As mentioned above, the farmer can choose to sell coffee cherry or to "vertically integrate" one level by processing cherry to parchment on the farm (see Figure 2 below).

Figure 2: Two Channels for Cherry to Parchment Processing in Rwanda

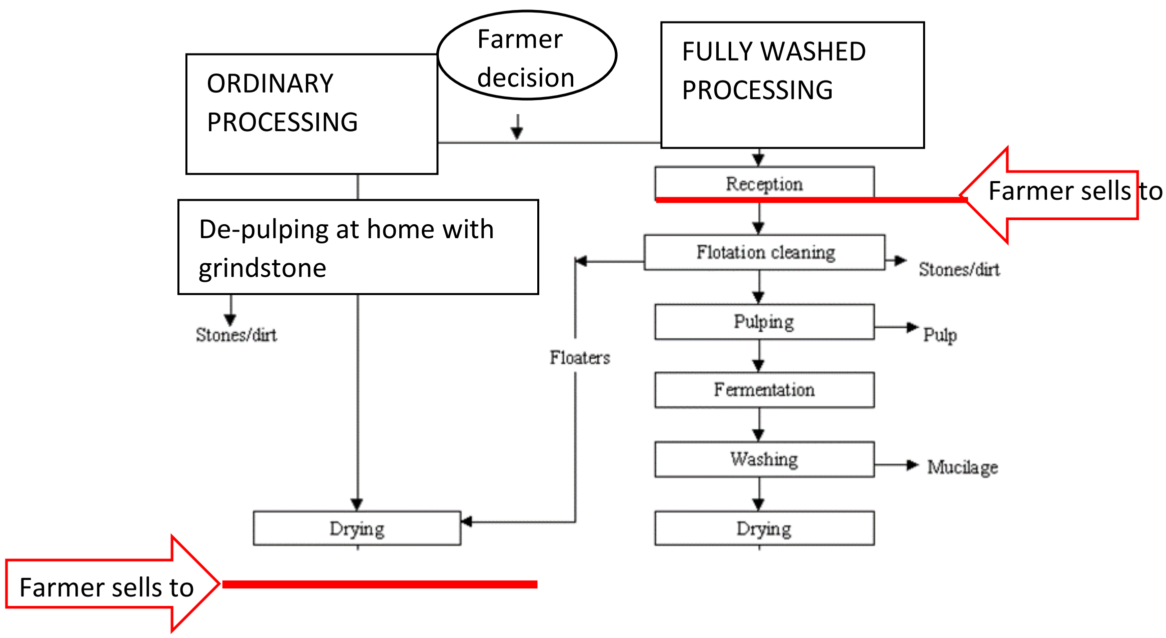

Figure 2: Shows how the farmer vertically integrates one level when he/she sells to the ordinary market channel instead of the FW channel. Quality is an issue. Source: Winston, E. (2005) Arabica Coffee Manual for Myanmar. FAO.

There are pros and cons to each choice for the farmer. If a washing station is near-by, it often makes sense for the farmer to deliver cherry there, and spare themselves the work of processing cherry into parchment, and drying it, at home. Rwanda's National Export Administration Board (NAEB) is promoting the fully-washed channel to farmers as their best option, as it generally results in higher quality coffee and thus higher market prices. However, farmers often opt to process cherry to parchment because of other factors, one being the fact that parchment is a stable product that can be stored for weeks or months before it is sold. Cherry, on the other hand, must be delivered to the washing station within 8 hours of the time it is picked. Another advantage to parchment production is that it can eliminate the trek (sometimes a long one) to and from the washing station. Being away from the household during that time has implications for child care and other responsibilities, especially for women. Also, when farmers have fly-crop coffee, the washing stations are usually closed so processing parchment on the farm is the only option.

Figure 1 gives a visual overview of the difference between fully washed and "home made" parchment, or ordinary. In many cases, a single household produces and sells both cherry (the right side of the diagram) and parchment (the left side of the diagram). The added cost of processing parchment at home is computed based on a small survey of parchment producers among our sampled households. This survey provided us with the average time required to process cherry to parchment and this was in turn applied on a per KG basis to the parchment produced. So this value for the labor (which is some household labor and some paid labor) used to convert cherry to parchment, can be added to the CoP for cherry through harvest and sort. We derive "CoP for *parchment* before transportation," and it is RWF 9,864, ($US 12.64). Now we can calculate the CoP per KG parchment, and the mean is RWF 211 ($US .27).

8. Further analyses of COP

The purpose of this report is to give interested parties a clear understanding of the methodology used by the AGLC project to calculate CoP/KG. With this level of detail users can better understand and interpret the data in Rwanda and possibly draw insights as they may apply to programs in other countries. In appendix 1 "other costs" are noted which were not included in this analysis, but which may be important for CoP calculations in other contexts and other countries.

The AGLC team has already conducted follow-on analyses of CoP/KG and will be preparing reports and briefs with these insights in the near future. Interesting results have already been obtained looking at CoP as it relates to numbers of trees (as shown in the chart on page 1), and to household and farm characteristics. The CoP data have also been used to develop household-level gross margins and to model farmer investments in coffee.

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Appendix 1: Other Costs

While all of the major cost categories for Rwanda's coffee farmers are included in this composite measure, it is important to note that some items are not included in this calculation of cost of production which may be important to include in other countries and other contexts. Many important investments for coffee are long term, one-time investments. So, for example, some farmers in some countries have costs in the following areas that the AGLC survey would not have captured:

- Costs of water (as 'cost to the environmental system' if water is not an actual expense.)
- 'Environmental services' from the land.
- Land value.
- Costs of getting a certification (e.g. Fair Trade). This is often born by the washing station.
- Value of free compost. (AGLC collected data on manure and mulch, but not compost - for example from cherry pulp composted at the washing station.)
- Membership fees for joining a cooperative or maintaining membership.
- Building, stocking, maintaining a nursery.
- Installation of irrigation systems.
- Installation of erosion prevention (AGLC asked whether this was done, but did not estimate costs).
- Installation of infrastructure and purchase of animals for manure production.
- Expense for animal feed and labor for animal care for organic farms that utilize on-farm manure.
- Purchase and labor for planting of intercropped crops, including shade trees (AGLC asked whether this was done, but did not estimate costs).
- Getting soil analyses from a lab.

While Rwanda's coffee farmers can have expenses in one or more of the above categories today, we note that they are very few.