
Rwanda Agronomy: Best Practices and Yield Analysis for Technoserve

December 2012



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I. Adoption of Best Agronomic Practices



Refresher: Intervention design

- Field experiment based on an agronomy training program (covering various best practices) run by TechnoServe (TNS) Coffee Initiative
- The sample is composed of the **1600 farmers** (from 27 villages in one sector, Nyarubaka) who **signed up for TNS's agronomy trainings**
- These households were **randomly assigned** to a treatment (50%) or comparison (50%) group after receiving a baseline survey. *Note:* subsequent analysis of the baseline data showed that the treatment and comparison groups were equivalent (in particular, the different levels of adoption were equally represented in both groups)
- Take-up and diffusion of the agronomy practices taught in the trainings was monitored closely through **yearly plot and tree inspections for all coffee farmers** in Nyarubaka (1,600 sample farmers and an additional 1,300 “non-sample” coffee farmers)

Adoption of Best Agronomic Practices

- The analysis we focus on here includes:
 - Adoption Rates of **8 agronomic practices, measured through plot inspections and household questions** (7 were measured at the tree-level and one at the household-level – described in slide 7), i.e. the proportion of adopters among the Treatment Group, Control Group and non-sample farmers, at the pre- and post-treatment stages
 - Summary statistics on households' reported **knowledge of coffee nutrition and Integrated Pest Management**, post-treatment

Best Practices - Data

- The Best Practices adoption results which follow were computed using three rounds of data (collected through plot and tree inspections performed by trained surveyors):
 - First round collected in April/May 2010 (for the sample) and July 2010 (non-sample)
 - Second round collected in June/July 2011 (“Sixth Monthly” survey)
 - Third round collected in January/February 2012 (“Eighth Monthly” survey)
- An additional round of plot and tree inspections was recently carried out in September and October 2012 (ninth monthly sample and non-sample surveys), but this data is currently in the process of being cleaned before it can be used for further analysis.
- Analysis of treatment effects includes sample households only



Analysis focuses on 8 adoption measures

PRACTICE	MEASUREMENT METHOD	DATE OF TRAINING MODULE(S)
Record Keeping	Household-level variable : <ul style="list-style-type: none"> ➤ We ask the farmers to show us their record books 	January 2010 – Introduction to Record Keeping October 2011 – Farm Profit and Loss
Weeding	Tree-level variable (tree inspections): <ul style="list-style-type: none"> ➤ Dripline should be completely weeded 	May 2010 – Weed Control
Mulching	Tree-level variable (tree inspections): <ul style="list-style-type: none"> ➤ Tree canopy should be at least partly mulched to prevent loss of nutrients 	June 2010 – Mulching October 2010 – Erosion Control
Pruning	2 tree-level variables (tree inspections): <ul style="list-style-type: none"> ➤ Removal of dead branches ➤ Removal of unwanted suckers 	July 2010 – Pruning and Rejuvenation July 2011 – Pruning and Rejuvenation (Review)
Nutrition	3 tree-level variables (tree inspections, focusing on leaves): <ul style="list-style-type: none"> ➤ Curling of leaves ➤ Yellowing of leaves ➤ Leaf rust 	March 2010 – Coffee Nutrition January 2011 – Nutrition (Review) April 2011 – Harvesting and Nutrition

What we expected to find for each practice:

- Based on the timing of the different training modules:
 - Adoption of **record-keeping and nutrition practices** was **expected to be significantly different** across the T and C groups in **all 3 rounds of data** (2010, 2011 and 2012), as the first modules on record-keeping and coffee nutrition were covered in 2010 (January and March 2010 respectively)
 - Since **weeding, mulching, and pruning** were only covered after April-May 2010 (dates of the first round of data collection), we expect effects on these practices to be shown by the **second and/or third round(s) of data only**
 - Because **pruning** is usually done after the end of the harvest (August/September), **adoption of pruning practices should only be detected by the third data round** (Jan/Feb 2012) -- the second was collected during the final harvest months of 2011 (June/July)

What the data shows (1)

- The next 3 slides include the adoption rates for each of the 8 practices analyzed:
 - The **practice with the highest difference in adoption** between the Control and Treatment groups was **record-keeping**, with a difference of about 70 percentage points
 - Measures of **nutrition** showed treatment effects **only in the first two rounds (2010 and 2011), but not 2012**. The timing of the 2012 round might be part of the explanation, as this survey was administered at the very start of the coffee season, and most fertilizers tend to be applied during the high of the coffee season (April-May), especially chemical fertilizers
 - Adoption of **weeding** was significantly higher in the **2011** data only, whereas **mulching** was significantly higher in **2010 and 2012** only

What the data shows (2)

- Only **one of 2 pruning measures** showed **significantly higher adoption** by the treatment group in 2012 : removal of dead branches
- **When combining all 3 rounds of data for higher statistical power** (for all practices where the data is post-treatment), **all but 2 of the adoption variables** (curling of leaves and removal of unwanted suckers) **show significantly higher adoption by the treatment group** (slide 13)
- Adoption rates of the **non-sample** farmers were computed for all 3 rounds of data, but statistical significance of the difference between adoption of the non-sample farmers and that of the sample farmers is not included, because the estimates would be biased (non-sample farmers and sample farmers are not “statistically comparable” for lack of randomization into sample and non-sample groups, as opposed to the random selection of control and treatment farmers within the sample)

2010 adoption rates : sample (April/May) and non-sample (July)

	Record-Keeping	Weeding	Mulching	Dead Branches are Removed	Unwanted Suckers are removed	At least some leaves on the tree are curling	At least some yellow leaves on the tree	At least some leaf rust on the tree
Treatment Group	86.44%	57.40%	59.27%	38.42%	45.15%	1.69%	88.88%	84.05%
Control Group	3.16%	54.63%	54.94%	35.19%	41.88%	2.93%	90.63%	86.85%
Difference between T and C group statistically significant?	Yes	No	Yes	No	No	Yes	Yes	No
Non-sample Farmers	0.55%	65.43%	57.42%	16.55%	33.35%	7.38%	96.43%	95.61%

2011 adoption rates : sample (June) and non-sample (July)

	Record-Keeping	Weeding	Mulching	At least some leaves on the tree are curling	At least some yellow leaves on the tree	At least some leaf rust on the tree
Treatment Group	80.95%	50.07%	63.85%	6.57%	86.30%	77.50%
Control Group	8.76%	47.91%	61.41%	5.97%	87.61%	82.49%
Difference between T and C group statistically significant?	Yes	Yes	No	No	Yes	Yes
Non-sample Farmers	0.65%	50.19%	99.78%	0.89%	83.68%	84.96%

Note: pruning variables are excluded here because pruning is usually done in August / September (at the end of the coffee harvest season) so adoption could not have been captured by the June-July plot inspections

2012 adoption rates : sample (January) and non-sample (February)

	Record-Keeping	Weeding	Mulching	Dead Branches are Removed	Unwanted Suckers are removed	At least some leaves on the tree are curling	At least some yellow leaves on the tree	At least some leaf rust on the tree
Treatment Group	67.70%	58.67%	54.43%	22.96%	37.94%	5.50%	91.49%	80.34%
Control Group	7.50%	58.59%	51.65%	19.96%	36.33%	5.61%	91.97%	80.29%
Difference between T and C group statistically significant?	Yes	No	Yes	Yes	No	No	No	No
Difference between T and C group, all rounds combined (where relevant) significant?	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Non-sample Farmers	0.90%	63.03%	51.36%	18.26%	43.74%	2.93%	92.92%	87.52%

Awareness of agronomic practices vs. actual adoption

- The results show that **awareness** of coffee agronomy best practices is higher among treatment farmers (see next slide)
 - In particular, self-reported data (collected via household questions) suggests that **knowledge of integrated pest management methods** and awareness of **which fertilizers are particularly effective for coffee** are significantly higher among treatment farmers
 - This suggests that notions of what *can* be done to improve yields through best agronomic practices were definitely assimilated by at least some of the treated farmers, while the results outlined in previous slides suggest that treatment effects on *actual* application of the practices are somewhat weaker and less consistently detected across the different types of practices

Household self-reported knowledge of best agronomic practices on IPM and coffee nutrition

	Knows some insects are beneficial	Knows pesticides should not be used more than twice a year	Knows to keep trees well fed	Knows trees should be pruned	Knows to remove old and dry berries	Knows compost should be used on coffee trees	Knows NPK should be used	Knows Zinc and Boron should be used
Treatment Group	11.46%	3.70%	25.85%	33.67%	9.07%	97.49%	91.64%	4.24%
Control Group	1.24%	1.93%	17.31%	25.24%	2.62%	97.24%	86.96%	0.40%
Difference between T and C group statistically significant?	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Non-sample Farmers	0.41%	0.45%	20.44%	24.68%	0.98%	99.47%	82.56%	0.37%

Adoption estimates for farmers with higher attendance

- Results of the analysis of the **attendance data** on the first 15 (out of 16) trainings held by TechnoServe in Nyarubaka over 2010-2011 include:
 - The average treated household attended **69% of the trainings** (i.e. either the household head or their spouse was present)
 - **76% of treated farmers** attended **more than 50%** of the trainings
 - The estimates of the impact of the treatment are about **30% higher** (for all adoption measures) for the group of **farmers who attended at least 50%** of the trainings

II. Yield Analysis



Yields in Kg/Tree for each harvest season, 2009-2012

	Control Group	Treatment Group	Is the difference between Control and Treatment yields statistically significant?
2009 (March - July) – Baseline	1.18	1.26	NO
2010 (April 1 st – June 30 th)	1.27	1.79	YES
2011 (March 1 st - June 30 th)	1.40	1.33	NO
2012 (March 1 st - June 30 th)	1.29	1.28	NO

Note: 2009 and 2010 harvest data was collected using self-reports of farmers recalling a period of at least 4 months at a time, whereas the 2011 and 2012 data was collected using yield - recording calendars filled in by the farmers on a monthly basis (while assisted and monitored by our survey staff).

Estimation of treatment effects on yields

- As shown by the previous slide, the **average effect of the trainings on yields** was **positive and statistically significant only for the 2010 season**. The difference in yields between Treatment and Control groups is very close to zero for the other two post-treatment seasons (2011 and 2012).
- Further analysis revealed that the treatment seems to have had a positive impact on 2011 and 2012 in-season harvest yields for a specific subset of the treatment group : the farmers whose cherry production was in the lower end of the distribution at the pre-treatment stage (lower baseline yields). However the coefficient estimates were not statistically significant (only significant at the 15-20% level).

III. Further results forthcoming



Further results will include... (1)

1) Social networks and technology diffusion analysis:

- Reminder: through this study, we would like to understand **which information channels are most effective at transmitting agricultural knowledge** -- information flows not only from trainers to farmers, but also between farmers and their friends, relatives, neighbors
- The preliminary results we have computed on technology diffusion within social networks of the treated farmers are not clean enough to be shared at this stage, but will be the focus of our 2012 analysis (slides 22-23)

Further results will include... (2)

A. Coffee friends:

- In our surveys we asked all farmers in the sample and non-sample groups to list the friends they talk about their coffee practices with, which allowed us to produce **social network maps of coffee farmers in Nyarubaka**
- We are in the process of using these maps to study the diffusion of adoption across the friends of treated farmers, and friends of friends.

B. Geographical diffusion of the agronomic practices from treated plots to plots of neighbors:

- We will be looking for higher adoption among farmers whose houses or plots are close to plots of “adopters”.
- This will be achieved using the GPS coordinates which we collected for all houses and plots during each of our visits.

Further results will include... (3)

C. Village treatment concentration analysis :

- Villages in our sample were randomly assigned to different intensity levels: in some villages $\frac{1}{4}$ of registered households received treatment (i.e. $\frac{3}{4}$ comparison), others $\frac{1}{2}$, and others $\frac{3}{4}$.
- Preliminary analysis seems to suggest that treatment effects on adoption and yields tend to be significantly stronger in villages with highest treatment concentration (75% treatment)
- Upcoming analysis will examine whether proximity to other trainees makes farmers encourage each other to attend the trainings (making use of our attendance data), and/or a higher concentration of treated farmers induces a higher concentration of plots where highly visible practices are adopted (such as weeding and mulching), leading to imitation by other farmers.

Further results will include... (4)

2) Analysis of Ninth Monthly data

- This is our final round of data collection, collected in September/October 2012
- The data, once cleaned, should contribute to further analysis in two ways:
 - It provides us with **another round of data on adoption** of agronomic practices, and perhaps show more significance for treatment effects on the agronomic practices which tend to be applied in the end-of-harvest/post-harvest period
 - We are hoping that it will help shed light on the **main shortcomings of the agronomy training program** -- it includes two qualitative modules where the farmers gave feedback on the trainings: in one module, they were asked how much they learned from the program, and in the other, they were asked to list the different barriers to adoption that they faced for each type of practice.