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Article

Cash Transfers and Management Advice for Agriculture: Evidence from Senegal

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Abstract

This study analyzes impacts of large, one-time cash transfers and farm management plans among farmers in Senegal. Farmers were randomized into groups receiving advisory visits; the visits and an individualized farm management plan; or the visits, the plan, and a cash transfer. After one year, crop production and livestock ownership were higher in the transfer group relative to the group that only received visits. Livestock gains persisted after two years. The evidence suggests the results were driven by increased investment, and, indeed, there is no robust evidence that the management plans alone affected agricultural outcomes.

JEL classification: O12, O13

Keywords: cash transfers, management training, agriculture, livestock

1. Introduction

Approximately 1.5 billion people in less developed countries live in smallholder households, and in sub-Saharan Africa and Asia such households produce as much as 80 percent of food (FAO 2012). Yet in many countries, a large gap exists between potential and realized agricultural productivity (e.g., Gollin, Morris, and Byerlee 2005; World Development Report 2007). Increasing production is thus a key component of improving smallholder livelihoods. This paper studies a project that alleviates two constraints, that keep smallholders from increasing production: capital and information.

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Increased access to credit and savings are common approaches to relieving capital constraints, but recent reviews of the literature suggest mixed impacts of microcredit programs and no impact of micro savings programs (Stewart et al. 2010; Banerjee, Karlan, and Zinman 2015). Information constraints are most often addressed with technical extension advice; however, rigorous evaluations of group-style extension programs find little evidence of impacts on anything but farmers' knowledge (Waddington and White 2014). Recent programs providing more individualized instruction to farmers demonstrate only modest impacts (e.g., Kondylis, Mueller, and Zhu 2017).[1] This paper examines a new approach to alleviating these constraints by evaluating the impacts of a two-year program that combined a large, one-time cash transfer and farm management advice for smallholder farmers in Senegal.

The program's goal was to improve the livelihoods of poor farmers through increased and more efficient investment in their farms. The program included a focus on both increased crop production and improved livestock care. The program, implemented in partnership with the Fédération des Organisations Non-Gouvernementales du Sénégal (FONGS), had three main components. First, all participating farmers received monthly advisory visits centered on farm management advice from an *animateur* (farmers from the area trained by FONGS). Second, as the rainy season began, farmers completed a farm management plan with their *animateur* to assist them in resource management and completing activities according to a schedule. Third, farmers received a large, one-time transfer of approximately US$200, timed near planting. Although the transfer was not conditioned on farmer behavior, farmers were told the funds were for investing in their farms and implementing the management plan. The cash transfer was only given in the first year, whereas advisory visits and the management plan were administered for two consecutive years. The program was intended to provide two years of intensive support, leaving farmers sustainably better off. To evaluate the additive impacts of the farm management plan and the cash transfer, the study was implemented as a cluster randomized control trial in which 600 households were randomly allocated at the *animateur* level to receive (1) only the advisory visits, (2) the advisory visits plus the farm management plan, or (3) the advisory visits and farm plan plus the cash transfer.

After one year of implementation, the study found large, positive impacts on agricultural outcomes among farmers in the cash transfer group. It documented a large increase of US$580 in the gross value of agricultural output (GVAO) relative to the group only receiving advisory visits. Endline results did not show continued impacts on crop production among the cash transfer group. Households in the cash transfer group also owned substantially more livestock after one year. The increase in livestock value was US$1,060 on average. This increase persisted in the second year when the effect size was US$700. Other results suggest that impacts were a result of increased investments in agriculture; the study found large increases in the use of chemical fertilizer and reported agricultural expenditures in the first year only, and an increase in agricultural equipment at endline.

GVAO was suggestively higher in the first year (but not robustly statistically significant) for households in the management-plan-only group, but there were no corresponding increases in other outcomes. If the management plan increased crop production in the first year, it did so through mechanisms that the study did not measure. Endline data suggest that the management plan was salient for households, but farmers report that implementation could have been improved, while highlighting their need for capital as well as services like the management plan.

Cash transfers without conditions are becoming increasingly widespread.[2] The transfer in this program can be characterized as a framed or labeled transfer, in which conditions were not enforced but in

1 New evidence does suggest that some types of mobile-based extension may be effective in increasing production (e.g., Cole and Fernando 2016). Other recent relevant work has sought to increase the impact of extension services by enhancing social learning in technology adoption (BenYishay and Mobarak 2018; Beaman et al. 2018). The program studied in this paper takes a different approach, focusing instead on directed, tailored farm management advice.

2 Examples of unconditional cash transfers and their impacts include Baird, McIntosh, and Özler (2011) and Haushofer and Shapiro (2016).

which recipients were encouraged to use the funds for a specific purpose, namely farm investments and implementation of their farm management plans. Benhassine et al. (2015) found that framing can be an effective and simple method for directing transfer funds in the context of education. The results of this study suggest that framing can also be effective in the agricultural sector.

Although a large literature exists on the impacts of cash transfers, few studies have examined programs that have the primary goal of affecting agriculture. However, a number of studies have examined the impact of cash transfers with different core goals on agricultural outcomes. These papers, including studies in Malawi, Mexico, and Zambia, find positive but modest impacts of transfers on agricultural investments or production (Todd, Winters, and Hertz 2010; Boone et al. 2013; Handa et al. 2015). These programs all involve small, regular transfers for continued income support, relative to the lump sum payment intended to increase investment and reduce the need for long-term support provided in this project. Work in Kenya has found that lump sum transfers are more likely to be invested than monthly transfers (Haushofer and Shapiro 2016), suggesting that households are liquidity constrained and that lump sum transfers are better suited to stimulating investment than smaller transfers spread over time.

Three studies examine large transfers for agriculture with differing results. Karlan et al. (2014) investigate the impacts of a large cash grant to farmers in Ghana and compare their impact with that of grants of weather insurance. They find modest effects of the cash grant on agricultural investment and output relative to the insurance grant. In contrast to the study by Karlan et al. (2014), Beaman et al. (2015) find that in Mali, cash grants have large impacts on farm investment and production. In Malawi, Ambler, de Brauw, and Godlonton (2018) find that large transfers of cash or inputs in one season have large impacts on production over two years. This heterogeneity across contexts highlights the importance of careful study of these programs in a variety of situations.

Beyond the context, the principal way in which this study is different from Karlan et al. (2014) and Beaman et al. (2015) are the support services that were combined with the cash transfer, which may have allowed farmers to use the grants more effectively. The additional services were developed from the viewpoint of the small farm as a business, intending to provide farmers with the tools needed to better manage their farms, thus boosting production. This idea departs from standard agricultural extension programs, which tend to provide only technical advice.[3] There is a parallel, though, to the large development literature on business training for small firms. Management practices have been found to matter for small firms (McKenzie and Woodruff 2015), but evaluations of programs teaching these practices typically do not find large impacts on firm profits (for a review, see McKenzie and Woodruff 2013).

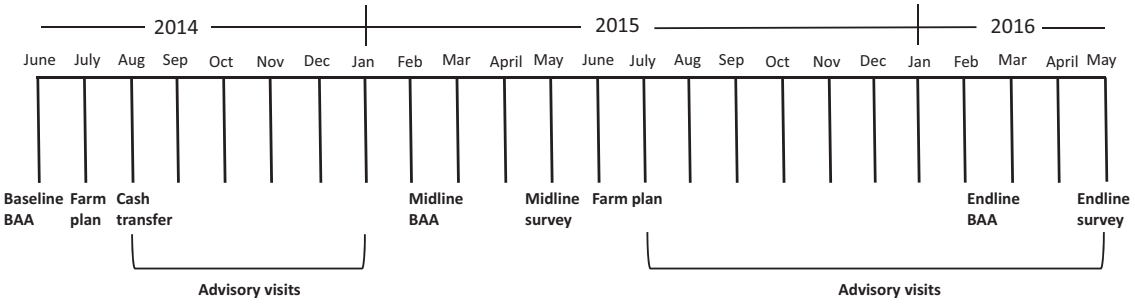
Viewing farms as small businesses also links this project to the literature on cash transfers given to firms. De Mel, McKenzie, and Woodruff (2008, 2012) found large short- and medium-term impacts of cash grants on firm profits and survival. Other projects have combined cash grants with business training. De Mel, McKenzie, and Woodruff (2014) found little impact of a business training program for women in Sri Lanka. When the program was combined with a cash grant, profits initially increased, but the increases were not sustained. Similarly, very poor, conflict-affected women in Uganda showed an increase in business income from a project that included cash transfers and business skills training (Blattman et al. 2016).[4]

The paper proceeds as follows. Section 2 describes the program and implementation in more detail, and section 3 describes the data and the empirical strategy. Section 4 presents the main results, section 5 examines the mechanisms, and section 6 provides a discussion. Section 7 concludes.

3 In Malawi (Ambler, de Brauw, and Godlonton 2018), the impact of transfers was studied when combined with services that included management plans, but also included individualized technical advice.

4 This program is also related to graduation models that combine asset transfers with training and other support (Banerjee et al. 2015).

Figure 1. Project Timeline



Source: Figure by authors.

Note: The gap in monthly advisory visits in early 2015 occurred first because of administration of the BAA (FONGS did not conduct advisory visits during months when the BAA was administered), and then because there was a gap between the BAA and the beginning of the next agricultural season. During the second season of implementation FONGS decided to extend visits over more months.

2. Experimental Design

The project was implemented by FONGS, an umbrella group of 31 autonomous farmer associations. Eight associations participated, all in the "peanut basin," a zone of central and western Senegal with a history of rain-fed groundnut production. Project implementation occurred in the 2014–2015 and 2015–2016 agricultural seasons. Figure 1 shows the timeline of events. From each association, 15 villages were chosen to participate, and 5 households in each village were selected, for a total of 600 households.[5] Each association selected households based on socioeconomic diversity and willingness to participate. Villages were assigned to an *animateur*, and each *animateur* was then randomly allocated into one of three treatment groups.

Group 1: Advisory Visits Only (Control)

Project participation began with the basic agricultural assessment (BAA), a tool developed by FONGS to collect information about a household's production and expenses. It was used to both track farmer progress and help farmers better understand their financial situation. The BAAs were administered by *animateurs*, individuals from the local area (though not usually from the same community as the farmers) who were trained by FONGS. *Animateurs* are similar to community health workers, but with a focus on agriculture. Table S1.1 in the supplementary online appendix (available with this article at *The World Bank Economic Review* website) shows some basic characteristics of the *animateurs* working on this project. They were mostly male, fewer than half had a high school education, and on average they had more than 13 years of experience.

After BAA implementation, households received monthly advisory visits from the *animateur*. *Animateurs* were trained to help with questions related to farm management, but did not receive training to provide technical agricultural advice. In some cases, *animateurs* assisted farmers by linking them with other services, such as technical support or credit access. The advisory visits continued for two agricultural seasons; two additional BAAs were administered following the harvest in both the first and second seasons. Because this group serves as the comparison group for analysis, the paper uses the shorthand "control" group throughout the text, though it is not a true control group, since members did receive some services.

5 Although the associations are geographically distinct, there are some cases of overlap. Because the associations operate autonomously, in two cases, two associations selected the same village for implementation. Therefore, two villages had 10 project households, but each group of five was served by a different association and *animateur*.

Group 2: Advisory Visits and Farm Management Plan (FMP)

Farmers in the FMP group received the same services as farmers in the control group, and they also received an extra visit from their *animateur* to develop a farm management plan at the beginning of the rainy season, using a tool specifically developed for this purpose. The plan focused on improving production by helping farmers better manage their resources. The *animateur* would guide household members to think through challenges faced in managing their farm, as well as the consequences of those challenges. They would then plan for when activities would occur and the amount and timing of expenditures, committing the household to improvement. Different from a business training exercise, this process guided households to think through their situation, anticipate issues, and proactively devise solutions. *Animateurs* used the monthly advisory visits to refer to the plan and monitor progress. Farm management plans were completed for two seasons.

The economic motivation for evaluating the FMP was that farmers face an information constraint that manifests as a lack of knowledge regarding how best to manage their farms. They may not effectively use their resources to maximize farm income. For example, they might continually plant all their land when they would be better off reducing the area planted and investing in inputs. They may also overcommit resources to planting, and neglect to properly care for their livestock, or they may use all their cash early in the season, without considering expenses for later weeding that could improve yields. The plan is intended to address this specific type of information constraint, with resulting impacts on the two main agricultural outcomes: crop production and livestock ownership.

Group 3: Advisory Visits, Farm Management Plan, and Cash Transfer (FMP + Cash)

Farmers in the FMP + Cash group received all the services described for the FMP group, as well as a one-time cash transfer of approximately US$200. The transfer was roughly equal to 15 percent of baseline GVAO. The cash transfer was distributed shortly after the management plan, and was timed near the beginning of the first season to help farmers implement the plan's main goals. Although the transfer was not conditioned on any specific farmer behavior, it was heavily framed for agricultural investment and implementation of the farm management plan.

The cash transfer was intended to address capital constraints faced by farmers. Though the management plan will be effective if farmers are misallocating their resources, the transfer treatment will be important if farmers also do not have access to the resources needed to make the most productive investments. Lack of capital is a common complaint made by smallholders served by FONGS in this region.

Randomization occurred at the *animateur* level to ensure that no *animateur* had to administer more than one treatment, and to ensure that the plan was not administered to farmers in the control group. *Animateurs* assigned to the control group were not invited to the trainings in which the management plan was discussed. Most *animateurs* worked in a single village, meaning that there was close to a village-level randomization. However, 11 *animateurs* managed 2 villages, resulting in 109 total *animateurs* at the start of the project. *Animateurs* were assigned to villages by the associations,[6] and randomization was then conducted by the research team using a computer. Randomization was therefore stratified by association and number of villages per *animateur* (either one or two). Three of the eight associations had *animateurs* working in more than one village, resulting in 11 distinct stratification cells.

6 There is only one case in which the initial assigned *animateur*-village-treatment was not respected. Two *animateurs* switched villages to allow an *animateur* more able to travel to work with a more distant village. They carried their assigned treatment with them to their new villages. Over the course of the project, households were assigned new *animateurs* when existing *animateurs* left the project. When this occurred, each household's initial treatment status was maintained. This happened in 16 villages; all but 3 changes happened after the midline BAA.

3. Data, Balance, and Empirical Strategy

This paper takes advantage of two main sources of data: FONGS-collected BAA data at baseline, and researcher-supervised household surveys at midline and endline. The BAA collects information on agricultural production, livestock, credit, and migration. In contrast to a traditional survey, the entire household is encouraged to participate, and the data collection is meant to be a learning experience for the family.

Because externally collected data are essential for a valid assessment of program impacts, the study uses the BAA only as baseline data.[7] The research team conducted a midline survey with 239 households and an endline survey with the full sample. The midline survey was conducted with only a subsample of participants due to concerns from FONGS regarding the overall time burden on respondents. The study chose to interview the full sample at endline rather than midline since the impacts of social programs are often largest immediately after implementation. The sample of respondents for the midline was randomly selected at the village level and stratified by association and treatment; 48 villages were included in the sample, which is two villages per association-treatment cell. All five households in each selected village were targeted.[8]

Attrition between data collection rounds was negligible: 239 of 240 households were interviewed during the midline survey, and 598 of 600 households during the endline survey. The missing households from the survey data in both years were due to household-level refusals.

Balance Tests

The study first shows that randomization was successful in creating comparable treatment groups. Table 1 displays the results of balance tests for the full sample.[9] Columns (1) through (3) show means of selected baseline variables by treatment group, and columns (4) through (7) show the p-values for tests of equality between the treatment groups. The table also shows p-values from F-tests of whether the baseline variables jointly predict treatment. This omnibus test considers the variables presented in table 1, but drops output per hectare, value of crops sold, and livestock value, since these variables are collinear with others. For consistency, the balance tests follow the same regression specification to be used in the main analysis and present randomization inference (RI) p-values.

The results should be interpreted with the caveat that the only source of baseline data is the FONGS-collected BAA. Overall, there are very few p-values less than 0.10, and the p-values from the omnibus tests are also above 0.10, indicating that statistically the three groups are well balanced. However, there is evidence that households in the FMP group are somewhat different; they are smaller, less likely to be female-headed, and the household heads are less likely to have any education. To allay any concerns about imbalance, the paper includes a robustness check showing that the main results are not sensitive to the inclusion of control variables (table S1.10 in the supplementary online appendix).

Because the midline survey was only conducted with a subsample of participating households, the study also verifies that the households that participated in the midline survey were comparable to households that did not. Given the random selection of households by the research team, no large differences are expected. Table 2 presents the average of baseline characteristics according to whether the household was in the midline sample in columns (1) through (3). Column (4) presents the p-value for the test of

7 Project timing and the preferences of FONGS did not allow for a baseline survey to be conducted.

8 To incorporate organizational capacity-building into the data collection, FONGS *animateurs* served as enumerators for both the midline and endline surveys. At midline, one *animateur* from each association was selected, and at endline, two were selected. The *animateurs* were selected by FONGS, based principally on technical capacity. The survey was conducted by the *animateur* responsible for working with the respondent family in only 25 cases at midline, and none at endline. *Animateur*-enumerators were closely managed by an external team of supervisors, at a ratio of one supervisor to every two enumerators. Survey management and training were conducted by the research team.

9 Results of balance tests for the midline sample are largely comparable and shown in table S1.2 available in the supplementary online appendix.

Table 1. Baseline Balance by Treatment

	Control (1)	FMP (2)	FMP + Cash (3)	RI *p*-value for test that (1) = (2) (4)	RI *p*-value for test that (1) = (3) (5)	RI *p*-value for test that (2) = (3) (6)	RI *p*-value for test that (1) = (2) = (3) (7)
Main household composition characteristics							
Household head is female	0.15	0.08	0.14	0.160	0.836	0.230	0.246
Age of household head	52.97	51.95	54.35	0.413	0.592	0.156	0.328
Household head is polygamous	0.39	0.42	0.44	0.503	0.295	0.639	0.557
Household head has at least some education	0.32	0.26	0.41	0.442	0.302	0.052	0.106
Household size	17.01	15.39	17.23	0.141	0.747	0.050	0.107
Agricultural measures							
Total land area (ha)	9.80	8.94	7.58	0.630	0.241	0.518	0.561
Number of crops grown	3.34	3.10	3.20	0.126	0.248	0.761	0.292
Gross value of agricultural output	1,519.65	1,414.71	1,450.08	0.763	0.969	0.716	0.922
Gross value of agricultural output per hectare	212.05	170.71	256.28	0.662	0.486	0.203	0.309
Total value of crops sold	634.04	651.04	591.10	0.847	0.943	0.898	0.973
Tropical livestock units	4.16	3.17	3.38	0.194	0.210	0.986	0.406
Total value of livestock owned	2,649.86	2,159.47	2,002.79	0.492	0.319	0.689	0.617
Total agricultural equipment value	1,551.55	1,512.83	1,467.98	0.921	0.954	0.969	0.993
Total value of agricultural expenditures	603.47	559.79	588.62	0.707	0.738	0.467	0.771
Omnibus test across household-level variables				0.707	0.597	0.254	
***Animateur* characteristics (*animateur* level)**							
Animateur is female	0.11	0.09	0.22	0.601	0.106	0.067	0.517
Age of *animateur*	41.89	42.31	38.97	0.405	0.959	0.127	0.820
Animateur is Muslim	0.89	0.97	0.88	0.090	0.542	0.277	0.230
Animateur is polygamous	0.49	0.31	0.25	0.512	0.214	0.590	0.260
Total months working as *animateur*	174.06	174.09	134.28	0.424	0.907	0.223	0.757
Omnibus test across animateur-level variables				0.425	0.116	0.116	

Source: Authors' calculations using the FONGS 2014 Basic Agricultural Assessment and the project *animateur* survey.

Note: Sample varies slightly with missing values for age (598), education (599), and GVAO per hectare (599). Sample for *animateur* characteristics is 102 *animateurs*. All money amounts are in USD. Values in columns (1) through (3) are means. Values in columns (4) through (7) are from regressions of the baseline variable on treatment status including stratification cell fixed effects and standard errors clustered by *animateur* (with the exception of the *animateur*-level characteristics). Randomization inference *p*-values are based on 2,000 replications.

Table 2. Midline Survey Sample Balance

	Full sample (N = 600) (1)	HHs not in midline survey sample (2)	HHs in midline survey sample (3)	RI *p*-value for test that (2) = (3) (4)
Main household composition characteristics				
Household head is female	0.12	0.12	0.12	0.870
Age of household head	53.09	53.66	52.24	0.905
Household head is polygamous	0.42	0.41	0.43	0.539
Household head has at least some education	0.33	0.31	0.35	0.258
Household size	16.54	16.17	17.10	0.162
Agricultural measures				
Total land area (ha)	8.77	9.25	8.06	0.933
Number of crops grown	3.21	3.23	3.19	0.704
Gross value of agricultural output	1,461.48	1,419.20	1,524.90	0.367
Gross value of agricultural output per hectare	212.94	176.22	268.25	0.044
Total value of crops sold	625.39	579.71	693.91	0.218
Tropical livestock units	3.57	3.34	3.92	0.331
Total value of livestock owned	2,270.71	2,259.08	2,288.15	0.919
Total agricultural equipment value	1,510.79	1,448.24	1,604.61	0.184
Total value of agricultural expenditures	583.96	535.35	656.87	0.032
Omnibus test across household-level variables				0.735

Source: Authors' calculations using the FONGS 2014 Basic Agricultural Assessment.

Note: Sample varies slightly with missing values for age (598), education (599), and GVAO per hectare (599). All money amounts are in USD. Values in columns (1) through (3) are means. Values in column (4) are from regressions of the baseline variable on midline survey status including stratification cell (for association and treatment) fixed effects and standard errors clustered by village. Randomization inference *p*-values are based on 2,000 replications.

equality between the two samples. Overall, the samples are quite similar, with only two variables exhibiting *p*-values below 0.10. The *p*-value for the omnibus balance test across all variables is well above 0.10.

Table 2 can also be used to examine summary statistics. Almost all household heads are male, and only 33 percent have some schooling. More than 40 percent of the sample is polygamous, and the average household has 16.5 members. The study used a household definition encompassing extended families, living together in family compounds.[10] Households cultivate an average of 8.8 hectares on which they grow an average of three crops. GVAO is US$1,460, approximately 43 percent of which was sold. Livestock ownership is important, with average animal stocks valued at approximately US$2,270.[11]

To better understand the profile of project participants, the study compares their characteristics with data from a representative sample of agricultural households in Senegal's peanut basin. The Enquête de Suivi de la Pauvreté au Sénégal (ESPS) 2011 is used, which is the most recent national data available, and the study compares measures available in the baseline BAA and the ESPS survey (table S1.3 in the supplementary online appendix). Households in this study are demographically similar to the ESPS households, although household size in the project sample is much larger, likely due to definitional differences. Households are also similar on many agricultural measures, including crop diversity and production. Although this study's households report higher sales and livestock ownership, because household size is much larger, these measures are not that different on a per capita basis.[12]

10 The study opted to use this household definition as it is used by FONGS, and therefore it is the relevant measure for the project, given how FONGS implements its project activities.

11 Tropical livestock units standardize different animals with a single measure for total amount of livestock owned.

12 These agricultural measures also come from different seasons, making a direct comparison difficult due to differences in weather conditions.

Empirical Strategy

The study examines the impact of the project on various agricultural outcomes using the following ordinary least squares regression model, run separately at midline and endline:

$$Y_{iat} = \alpha + \beta_{FMP} T_{FMP\ a} + \beta_{FMP+Cash} T_{FMP+Cash\ a} + \delta Y_{i0} + \delta_{sc} + u_{ia}$$

where i indexes households, a the *animateurs*, t the time period (midline or endline), and sc the stratification cell. Y_{iat} is the outcome variable. $T_{FMP\ a}$ and $T_{FMP+Cash\ a}$ are indicator variables for the FMP group and the FMP + Cash group. β_{FMP} and $\beta_{FMP+CASH}$ represent the average difference between outcomes for farmers in that treatment group relative to the control. Regression tables also report a test for equality of β_{FMP} and $\beta_{FMP+CASH}$. The study presents the analysis of covariance (ANCOVA) specification for all outcomes for which the baseline value is available. Y_{i0} is the baseline value of the outcome in question. δ_{sc} are stratification cell fixed effects. Standard errors are clustered by *animateur*, the unit of randomization. Due to the relatively small sample size and clustered randomization, the regression tables present RI p-values in addition to the clustered standard errors, as a more conservative test of statistical significance. The randomization inference is performed using ritest in Stata (Heß 2017) with 2,000 repetitions for each regression. The calculation of the RI p-values exactly follows the randomization procedure.

In considering a range of outcome variables, the study also makes adjustments for multiple hypothesis testing. It controls for the false discovery rate (FDR) by calculating sharpened q-values (Benjamini, Krieger, and Yekutieli 2006; Anderson 2008), using the RI p-values. The FDR controls the proportion of false positives among rejected null hypotheses, and the q-value for each coefficient is the expected proportion of false positives obtained in that family if that coefficient is considered to be significant. Throughout the paper, the study adjusts within families of outcomes, but does not include aggregates, as these already combine information across outcomes.

In each table results from the midline and endline are presented in the top and bottom panels, respectively. The clustered standard error is below each coefficient estimate in parentheses, followed by the RI p-value and the sharpened q-value when applicable. At the bottom of each panel, the study also reports the minimum detectable treatment effect based on the baseline data, when the baseline data are available, incorporating the clustered design and the correlation between the baseline and outcome value. All money values are expressed in U.S. dollars.[13] All aggregate outcome variables are constructed as described in supplementary online appendix S2. To ensure consistent sample size across regressions, the study imputes missing values of outcome variables with median values. The numbers of values imputed are largely quite low and explained in detail in supplementary online appendix S3. Due to concern about outliers, the study also presents the main results with outcomes winsorized at the 99th percentile in tables S1.4, S1.6, and S1.7 available in the supplementary online appendix.

4. Impacts on Crop and Livestock Production

This paper first addresses the one- and two-year impacts of both the cash transfers and the farm management plans on a range of outcomes related to the project's core goal of increasing agricultural production, including both crop production and livestock measures. Table 3 shows the results for crop production in kilograms for the five main crops (columns 1 through 5). Column (6) presents a summary measure (the GVAO) that includes all crops grown by the household.

Coefficients at midline for the FMP group are mostly positive, but not statistically significant. The coefficient on the aggregate measure is significant at the 10 percent level using standard clustered standard errors, but not under the more conservative RI approach.

13 Exchange rates were determined by the rate on the first of the month in the month a data collection exercise began. The baseline exchange rate was 482 West African CFA francs (CFA) to US$1, the midline exchange rate was 586 CFA to US$1, and the endline exchange rate was 581 CFA to US$1.

Table 3. Treatment Impact on Crop Production

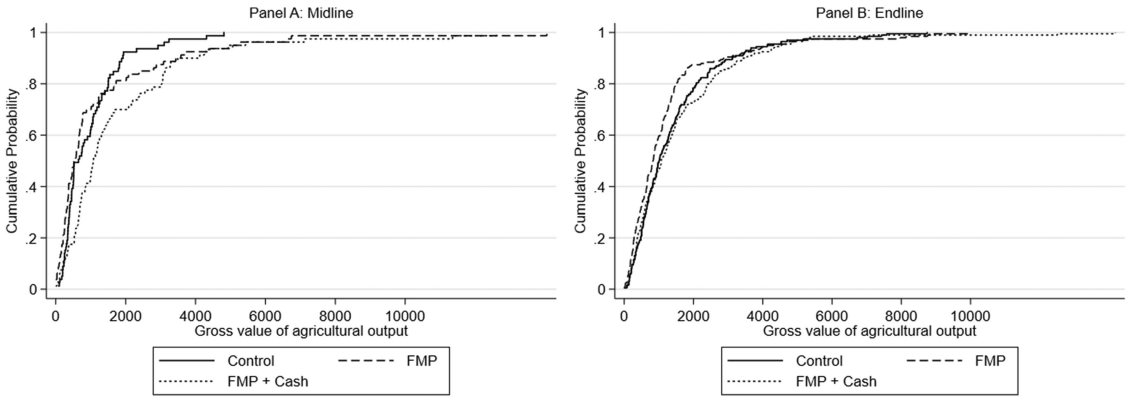
	Production in kg of . . .					Gross value of agricultural output
	Groundnuts (1)	Millet (2)	Sorghum (3)	Maize (4)	Manioc (5)	(6)
Midline survey						
Household received FMP	442.61	274.66	5.29	73.05	−40.71	512.15
Standard error	(255.98)	(174.75)	(19.67)	(72.79)	(34.35)	(257.35)
RI p-value	0.108	0.198	0.843	0.465	0.240	0.116
Sharpened q-value	0.665	0.665	0.665	0.665	0.665	
Household received FMP + Cash	252.61	340.38	15.30	186.72	−46.24	579.26
Standard error	(192.71)	(156.56)	(22.75)	(78.96)	(34.51)	(227.30)
RI p-value	0.384	0.097	0.551	0.027	0.154	0.060
Sharpened q-value	0.344	0.240	0.344	0.153	0.258	
Observations	239	239	239	239	239	239
R-squared	0.694	0.382	0.383	0.501	0.177	0.548
Control mean	923.95	990.33	46.75	78.97	42.41	973.33
Minimum detectable effect	439.15	398.59	58.12	108.69	133.32	403.60
Original *p*-value: FMP = FMP + Cash	0.469	0.725	0.677	0.022	0.677	0.789
RI *p*-value: FMP = FMP + Cash	0.531	0.752	0.714	0.239	0.889	0.834
Sharpened *q*-value: FMP = FMP + Cash	1.000	1.000	1.000	1.000	1.000	
Endline survey						
Household received FMP	−84.62	−25.28	−63.50	−4.22	−32.69	−90.15
Standard error	(379.79)	(95.19)	(28.15)	(30.26)	(31.35)	(168.22)
RI p-value	0.831	0.832	0.007	0.896	0.312	0.630
Sharpened q-value	1.000	1.000	0.034	1.000	1.000	
Household received FMP + Cash	−244.43	108.03	−39.57	38.59	−18.60	107.83
Standard error	(265.27)	(117.36)	(26.72)	(31.17)	(21.02)	(159.17)
RI p-value	0.492	0.408	0.115	0.228	0.592	0.557
Sharpened q-value	1.000	1.000	1.000	1.000	1.000	
Observations	598	598	598	598	598	598
R-squared	0.319	0.355	0.232	0.412	0.576	0.321
Control mean	1,876.84	1,222.53	100.48	110.91	35.93	1,447.53
Minimum detectable effect	639.37	228.23	41.43	112.10	100.08	345.51
Original *p*-value: FMP = FMP + Cash	0.587	0.240	0.106	0.128	0.604	0.196
RI *p*-value: FMP = FMP + Cash	0.641	0.287	0.346	0.171	0.726	0.229
Sharpened *q*-value: FMP = FMP + Cash	1.000	1.000	1.000	1.000	1.000	
Includes baseline value of outcome	YES	YES	YES	YES	YES	YES

Source: Authors' calculations using the project 2015 midline and 2016 endline surveys and the FONGS 2014 Basic Agricultural Assessment.
Note: Robust standard errors in parentheses are clustered by *animateur*. Randomization inference *p*-values are based on 2,000 repetitions. All regressions include the baseline value of outcome and stratification cell fixed effects. All money amounts are in USD. Sharpened *q*-values are based on the distribution of RI *p*-values in each row. Minimum detectable effects are calculated using baseline values and incorporate the correlation between the baseline value and the outcome variable.

The coefficients for the FMP + Cash group are positive across crops (with the exception of manioc) and statistically significant (under RI) for millet and maize, though the sharpened *q*-values are all above 0.10. In general, the minimum detectable effects reported in the table suggest the study is not well powered to detect crop-level increases in production. However, the cash transfer treatment has a large and statistically significant impact on the aggregate GVAO measure. The average GVAO of FMP + Cash households is about US$580 (59 percent) higher than the control mean at midline, suggesting a large return on the US$200 transfer.[14] Though the impact on GVAO for FMP households is not statistically significant when

14 Supplemental online appendix S3 describes a detailed cost-benefit analysis used to estimate program returns.

Figure 2. Gross Value of Agricultural Output: Cumulative Distribution Functions



Source: Authors' analysis using the project 2015 midline and 2016 endline surveys.

using RI, it is large in magnitude and exceeds the minimum detectable effect predicted using baseline data. In general, the study is unable to reject the hypothesis that the FMP and FMP + Cash coefficients are equal. As such, based on these regressions, the study is not able to definitively determine whether the crop production results at midline are driven by the management plan alone, or the plan in conjunction with the cash transfer.

In contrast to the midline results, the endline results for crop production suggest the project did not affect crop production in the second year (table 3, bottom panel). The coefficients have large standard errors and are small compared with the midline results and the size of the effect that the data are powered to detect. One explanation is that the production results were driven by the cash transfer, and that these impacts do not carry over into year 2 when transfers were not made. This interpretation is supported by examining impacts across the distribution. Figure 2A plots the cumulative distribution function (CDF) of the GVAO measure by treatment group in year 1, with the FMP + Cash distribution clearly shifted to the right. The distribution for the FMP group is shifted to the right of the control group only at the top of the distribution. Two-way Kolmogorov-Smirnov test statistics, which test whether the empirical distributions come from the same underlying distribution, indicate that the FMP + Cash group does not come from the same distribution as the control group and the FMP group (p-values < 0.001), while the study cannot reject the hypothesis that the FMP group and the control group come from the same distribution (p-value $= 0.265$). In year 2, the CDFs of GVAO for the two treatment groups (fig. 2B) are not statistically to the right of the control distribution.[15] In sum, FMP + Cash households experienced a large increase in crop production after one season, but that change was not sustained over two years, while the evidence for FMP households is not robust to examining the distribution.[16]

The study next examines the impacts of the program on livestock ownership (table 4). Recall from table 2 the importance of livestock holdings for farmers in this sample; the total value of livestock owned exceeded GVAO at baseline. Columns (1) through (6) present results for the six main types of animals owned by households. Columns (7) and (8) present two aggregate measures: the number of tropical livestock units and the total livestock value. Tropical livestock units provide a convenient way of standardizing different animals with a single measure expressing the total amount of livestock owned. An exchange

15 The FMP distribution is in fact, to the left of the control and FMP + Cash distributions.

16 The study also examines changes in land productivity (table S1.5 available in the supplemental online appendix). Results are generally imprecise, but the aggregate GVAO per hectare is statistically significantly larger at midline among FMP + Cash households.

Table 4. Treatment Impact on Livestock Ownership

	Number of . . .						Tropical livestock units	Total livestock value
	Cows (1)	Sheep (2)	Goats (3)	Poultry (4)	Donkeys (5)	Horses (6)	(7)	(8)
Midline survey								
Household received FMP	0.39	0.03	0.00	1.99	−0.02	−0.01	0.47	254.66
Standard error	(0.87)	(1.24)	(0.83)	(2.34)	(0.29)	(0.25)	(0.82)	(507.10)
RI p-value	0.720	0.983	0.999	0.447	0.945	0.989	0.654	0.648
Sharpened q-value	1.000	1.000	1.000	1.000	1.000	1.000		
Household received FMP + Cash	1.95	2.38	1.45	4.43	−0.31	0.77	2.32	1,062.70
Standard error	(0.74)	(1.05)	(0.79)	(1.88)	(0.25)	(0.28)	(0.68)	(411.99)
RI p-value	0.069	0.106	0.115	0.094	0.342	0.021	0.018	0.065
Sharpened q-value	0.141	0.141	0.141	0.141	0.161	0.141		
Observations	239	239	239	239	239	239	239	239
R-squared	0.471	0.496	0.413	0.147	0.226	0.167	0.513	0.454
Control mean	2.90	6.52	4.38	11.14	1.62	1.39	5.19	2,290.43
Minimum detectable effect	2.11	2.24	1.43	2.87			1.74	986.93
Original *p*-value: FMP = FMP + Cash	0.092	0.021	0.046	0.334	0.259	0.007	0.017	0.082
RI *p*-value: FMP = FMP + Cash	0.161	0.100	0.127	0.365	0.387	0.023	0.078	0.158
Sharpened *q*-value: FMP = FMP + Cash	0.251	0.251	0.251	0.318	0.318	0.161		
Endline survey								
Household received FMP	0.34	0.05	0.75	−0.44	0.09	−0.13	0.41	−73.65
Standard error	(0.66)	(0.72)	(0.48)	(1.16)	(0.18)	(0.14)	(0.61)	(414.83)
RI p-value	0.682	0.957	0.218	0.701	0.620	0.443	0.570	0.859
Sharpened q-value	1.000	1.000	1.000	1.000	1.000	1.000		
Household received FMP + Cash	1.25	1.23	1.67	1.24	−0.04	0.24	1.53	702.94
Standard error	(0.76)	(0.91)	(0.51)	(1.18)	(0.17)	(0.15)	(0.65)	(460.56)
RI p-value	0.139	0.243	0.004	0.321	0.842	0.114	0.034	0.124
Sharpened q-value	0.302	0.386	0.022	0.386	0.574	0.302		
Observations	597	597	597	597	597	597	597	597
R-squared	0.322	0.246	0.397	0.052	0.109	0.164	0.360	0.280
Control mean	2.88	5.24	3.92	9.04	1.20	1.43	4.79	2,388.05
Minimum detectable effect	1.14	10.42	0.87	3.51			0.99	983.13
Original *p*-value: FMP = FMP + Cash	0.262	0.215	0.129	0.144	0.425	0.014	0.116	0.047
RI *p*-value: FMP = FMP + Cash	0.470	0.275	0.248	0.171	0.501	0.017	0.244	0.096
Sharpened *q*-value: FMP = FMP + Cash	0.700	0.523	0.523	0.523	0.700	0.110		
Includes baseline value of outcome	YES	YES	YES	YES	NO	NO	YES	YES

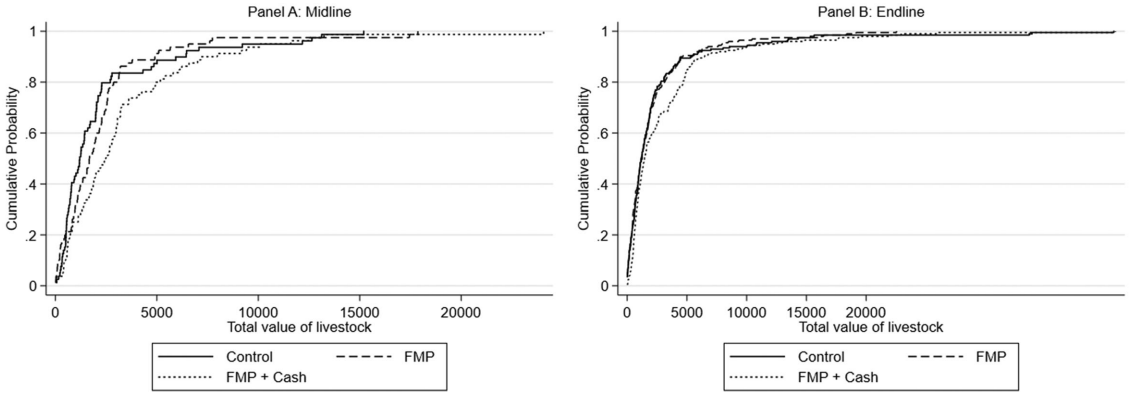
Source: Authors' calculations using the project 2015 midline and 2016 endline surveys and the FONGS 2014 Basic Agricultural Assessment.
Note: One extreme outlier is dropped from the endline sample. Robust standard errors in parentheses are clustered by *animateur*. Randomization inference *p*-values are based on 2,000 repetitions. All regressions include the baseline value of outcome where noted and stratification cell fixed effects. All money amounts are in USD. Sharpened *q*-values are based on the distribution of RI *p*-values in each row. Minimum detectable effects are calculated using baseline values and incorporate the correlation between the baseline value and the outcome variable.

ratio is applied to each animal, so that animals of different average size can be described using a common unit.[17]

The midline results provide convincing evidence that the FMP + Cash group experienced large increases in livestock holdings after one year. Although the study is not well powered to detect impacts on

17 Note that in the endline results the study has dropped one extreme outlier that is clearly due to enumerator error. This is the only case where outliers seem to affect the results. In all other cases the main results are similar to the results that are winsorized at the 99th percentile (presented in tables S1.4, S1.6, and S1.7 in the supplemental online appendix).

Figure 3. Total Livestock Value: Cumulative Distribution Functions



Source: Authors' analysis using the project 2015 midline and 2016 endline surveys.

specific types of animals, the coefficients on most individual categories are positive (and statistically significant by RI) for cows, poultry, and horses. The aggregate measures show large increases: The FMP + Cash treatment led to a 44 percent increase in tropical livestock units and a 46 percent increase in total livestock value. In contrast to the crop production results, there is no evidence of an increase in livestock holdings among FMP households. Coefficients for the aggregate measures are positive, but not statistically significant. The study can reject the possibility that the FMP and FMP + Cash coefficients are the same for tropical livestock units, but not for total livestock value.

The increase in aggregate livestock holdings is evident across the distribution, as shown in fig. 3A. The FMP + Cash distribution is significantly different both from the control group (p-value = 0.001) and the FMP group (p-value = 0.013). FMP + Cash households made large investments in livestock that included both livestock used as a separate enterprise for sale or by-products (such as cows) and livestock that are tools in agricultural production (such as horses).

There is evidence of a sustained increase in livestock holdings for FMP + Cash households in year 2. Coefficients on all variables except for donkeys are positive, and are statistically significant by RI for goats and tropical livestock units. Tropical livestock units increase by 32 percent. Again, there is no strong evidence of increased livestock ownership in the FMP group. However, though the FMP + Cash coefficients are consistently larger than the FMP coefficients, at endline it is not possible to reject the hypothesis that the FMP and the FMP + Cash coefficients are equal. That said, the CDF for total livestock value (fig. 3B) clearly shows the distribution of the FMP + Cash group lying to the right of the other two groups, and the possibility can be rejected that the FMP + Cash distribution is equal to the control (p-value = 0.009) and the FMP (p-value = 0.0061) distributions.

5. Mechanisms

The treatment given to farmers in the FMP + Cash group appears to have had a large, positive impact on production-related outcomes, increasing crop production in the first year and livestock holdings in both years. These robust impacts compare with inconclusive evidence of impacts of the management plan only; coefficients for year 1 crop production are positive, but not statistically significant. The large short-run impacts of the FMP + Cash treatment are in contrast to the modest impacts found in Ghana (Karlan et al. 2014) but similar to those measured in Mali (Beaman et al. 2015) and Malawi (Ambler, de Brauw, and Godlonton 2018). The complementary aspects of the program (the advisory visits and the management plan) may be one reason for the effective use of the cash transfers. It was not

Table 5. Treatment Effect on Investment and Input Use

					Input use			
	Agriculture equipment value (1)	Non-agricultural assets value (2)	Total assets value (3)	Agriculture expenditure (4)	Used chemical fertilizer (5)	Kg of chemical fertilizer used (6)	Used non-chemical fertilizer (7)	Used pesticides (8)
Midline survey								
Household received FMP	9.60	153.88	165.95	28.18	−0.07	−53.77	0.04	−0.12
Standard error	(34.11)	(179.35)	(209.03)	(43.93)	(0.07)	(58.28)	(0.07)	(0.07)
RI p-value	0.882	0.539	0.560	0.661	0.562	0.593	0.673	0.194
Sharpened q-value					1.000	1.000	1.000	1.000
Household received FMP + Cash	103.47	266.64	397.12	117.94	0.18	123.27	−0.02	−0.09
Standard error	(55.84)	(199.11)	(223.14)	(43.00)	(0.08)	(72.61)	(0.08)	(0.07)
RI p-value	0.107	0.261	0.137	0.052	0.083	0.147	0.827	0.350
Sharpened q-value					0.415	0.415	0.705	0.415
Observations	239	239	239	239	239	239	239	239
R-squared	0.218	0.090	0.083	0.365	0.218	0.190	0.158	0.268
Control mean	274.4	934.0	1,208.3	294.3	0.44	165.90	0.67	0.87
Minimum detectable effect	447.93			208.90				
Original *p*-value: FMP = FMP + Cash	0.099	0.608	0.362	0.096	0.006	0.009	0.468	0.707
RI *p*-value: FMP = FMP + Cash	0.142	0.639	0.407	0.133	0.017	0.039	0.489	0.714
Sharpened *q*-value: FMP = FMP + Cash					0.071	0.071	0.484	0.556
Endline survey								
Household received FMP	3.26	46.29	39.83	−25.99	−0.04	−48.66	0.00	−0.03
Standard error	(32.59)	(192.81)	(223.55)	(35.37)	(0.06)	(33.33)	(0.06)	(0.04)
RI p-value	0.951	0.804	0.855	0.679	0.518	0.239	0.987	0.562
Sharpened q-value					1.000	1.000	1.000	1.000
Household received FMP + Cash	95.32	−4.12	87.98	48.32	0.07	17.72	0.05	0.01
Standard error	(47.38)	(166.06)	(190.19)	(59.70)	(0.06)	(37.53)	(0.05)	(0.05)
RI p-value	0.042	0.981	0.689	0.454	0.249	0.627	0.394	0.890
Sharpened q-value					1.000	1.000	1.000	1.000
Observations	598	598	598	598	598	598	598	598
R-squared	0.253	0.087	0.068	0.278	0.139	0.199	0.099	0.135
Control mean	454.8	1,127.1	1,581.9	371.5	0.50	190.09	0.75	0.86
Minimum detectable effect	220.01			124.08				
Original *p*-value: FMP = FMP + Cash	0.043	0.753	0.802	0.165	0.035	0.066	0.297	0.415
RI *p*-value: FMP = FMP + Cash	0.040	0.777	0.815	0.199	0.066	0.065	0.349	0.483
Sharpened *q*-value: FMP = FMP + Cash					0.151	0.151	0.303	0.318
Includes baseline value of outcome	YES	NO	NO	YES	NO	NO	NO	NO

Source: Authors' calculations using the project 2015 midline and 2016 endline surveys and the FONGS 2014 Basic Agricultural Assessment.
Note: Robust standard errors in parentheses are clustered by *animateur*. Randomization inference *p*-values are based on 2,000 repetitions. All regressions include the baseline value of outcome where noted and stratification cell fixed effects. All money amounts are in USD. Sharpened *q*-values are based on the distribution of RI *p*-values in each row. Minimum detectable effects are calculated using baseline values and incorporate the correlation between the baseline value and the outcome variable.

possible in this study's setting to study the cash transfer without the supporting activities; however, the study can use complementary data from the surveys to examine the mechanisms driving the increases in crop production and livestock ownership.

To do so, the study first examines the impact of the program on the value of assets owned, disaggregated by agricultural and nonagricultural use (table 5, columns 1 and 2) and the total (column 3). The

coefficient estimates for the first year are all positive (in both treatment groups) but not statistically significant by RI. However, the p-value on the coefficient for agricultural equipment for the FMP + Cash group is 0.107. The increase in agricultural equipment is sustained in year 2 (RI p-value = 0.042). When examining impacts on expenditures specifically related to agriculture (column 4 of table 5), it is found that FMP + Cash farmers have statistically significantly higher agricultural expenditures in the first year, mirroring the equipment results. The US$118 increase in expenditures is a 40 percent increase over the control group and represents approximately half the provided transfer. The increase does not carry through to the second year at detectable levels. These results suggest the cash transfer was used to make investments in inputs and equipment in year 1, contributing to the increase in agricultural production. Farmers did not make further investments in equipment in the second year, but preserved the investments already made.

Increased agricultural investment is limited to the FMP + Cash group; the coefficient on agricultural equipment for the FMP group is only 9 percent of the FMP + Cash coefficient in year 1 and 3 percent in year 2 (RI p-values for equality are 0.142 and 0.040). The management plan alone also did not affect agricultural expenditures, though it is not possible to reject the equality of coefficients across the two groups (RI p-values equal to 0.133 in year 1 and 0.199 in year 2).

The increase in total agricultural expenditures can be disaggregated further to examine whether and how the use of specific inputs changed. Columns (5) through (8) of table 5 show the findings for use of chemical fertilizer, amounts of chemical fertilizer used, use of nonchemical fertilizer, and use of pesticides. At midline, there is an 18 percentage point increase in the probability that FMP + Cash farmers used chemical fertilizer, a 45 percent increase relative to the control group (sharpened q-value is 0.415). Use of chemical fertilizer among FMP + Cash farmers is statistically significantly different from that of the FMP farmers. There is no increase in the use of nonchemical fertilizer or pesticides or any impacts among the FMP group. In sum, the data suggest that the cash transfer has an impact on the extensive margin of fertilizer use. Use of chemical fertilizer is much lower in the control group (44 percent) relative to nonchemical fertilizer (67 percent) and pesticides (87 percent). This difference in the control group provides one explanation for why the FMP + Cash farmers chose to invest in chemical fertilizer instead of other inputs.[18]

In year 2, chemical fertilizer use in the FMP + Cash group is not statistically significantly different from use in the control group. It is, however, statistically higher than fertilizer use in the FMP group under RI (sharpened q-value for the difference is 0.151). Fertilizer use increased in the second year by 6 percentage points in the control group, perhaps limiting the scope for continued differential impacts. There is no other evidence of increased input use in year 2 by either the FMP group or the FMP + Cash group.

Taken together, the results provide strong evidence that in the first year farmers used the cash transfer to invest in agriculture, resulting in increased production and larger livestock holdings. In the midline survey, farmers were specifically asked what they spent the cash transfer on. Although the most common category overall is household expenses, fertilizer purchase is also frequently reported, as are seed purchases and investment in agricultural equipment. Self-reports regarding transfer use are consistent with the investment of at least part of the transfer in their farms, complementing the regression results. While table 3 provides some suggestive evidence of an increase in crop production associated with the management plan only, there is no evidence of a mechanism through which that increase may have operated, suggesting that these farmers may have employed strategies independent of increased investment. That could be consistent with the motivation behind the plan implementation, in that the planning activities would assist households in more effectively managing their existing resources. Unfortunately, that behavior is likely to vary widely by household and is therefore difficult to empirically identify.

18 Table S1.8 (available in the supplemental online appendix) explores fertilizer use by crop and shows the increase in fertilizer use can be attributed to increased use on groundnuts and millet among the FMP + Cash group.

Results from the second year show that although increases in crop production were not sustained, FMP + Cash households continued to benefit from larger livestock holdings and other productive assets.[19] The farm management plan alone did not have a detectable impact on agricultural outcomes over time. The minimum detectable effects presented in the tables reinforce the observation that the relatively small sample with which this study was conducted means that the study is powered to detect large program impacts, but generally not small or moderate impacts. However, given the intensity and expense of the program, large impacts were expected. Relating these results to the motivation behind the treatments, the study concludes that farmers do face capital constraints, and transfers are an effective method of relieving them. However, the lack of impacts in the FMP group could mean that farmers are already planning effectively, that they are not planning effectively but the plan was not well designed to help them, or that improvements could only be achieved with the simultaneous alleviation of both constraints.

To investigate impacts on household welfare more broadly, the study collected information on consumption and expenditure (table S1.9 available in the supplemental online appendix). At midline, the study estimates positive coefficients on all three measures among FMP + Cash households (statistically significant by RI for nonfood expenditures only: sharpened q-value = 0.174). At endline, there is a statistically significant increase in food expenditures only in this same group. These coefficients are generally imprecisely estimated, with no consistent pattern, limiting any conclusions to be drawn from this analysis.

6. Discussion

The results show that the combination of farm management planning and cash transfers had a robust impact on crop production after the first year and persistent impacts on livestock stocks and agricultural equipment. Although the impacts on crop production were not sustained, households had significantly larger productive savings stocks that generate income and serve as buffers against negative shocks. There are a number of explanations for the lack of persistence in crop production. First, the second year was a good year in the study region. Average rainfall in the 12 months preceding the endline survey was 609 millimeters in the region, compared with 360 millimeters in the year preceding the midline. Production was also higher at endline: GVAO in the control group was US$1,417 at endline, compared with US$973 at midline. It is possible that impacts on crop production may be evident only in more difficult years.[20]

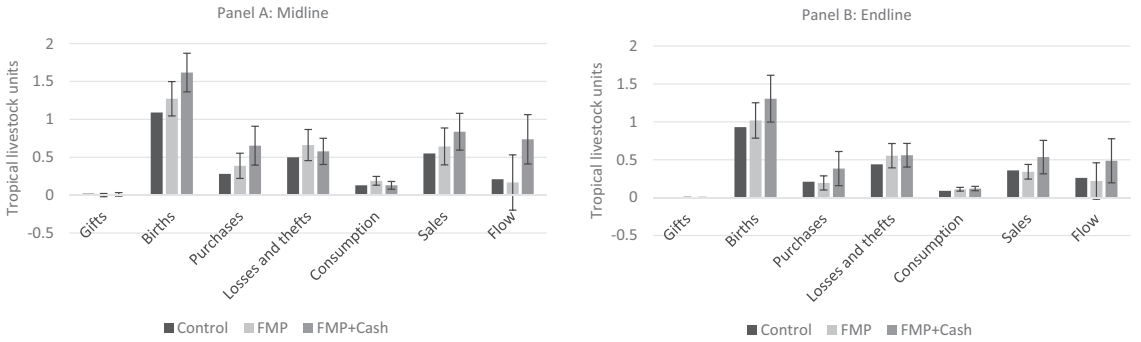
An additional possibility is that livestock are the preferred investment among many sample households. The study further investigates the livestock result by examining flows of livestock. For tropical livestock units and total livestock value at midline and endline, the study analyzes livestock gifts, births, purchases, losses and thefts, home consumption, sales, and aggregate flows. Note that these flows differ from the impacts on stocks presented in table 4. The averages for each category by treatment group are presented in figs. 4 (tropical livestock units) and 5 (total livestock value). Although not all results are statistically different, these figures suggest that the FMP + Cash treatment led to a large increase in the flow of livestock at midline, driven by increased births and purchases and reduced losses.

At endline, there is continued evidence of positive flows in the FMP + Cash group relative to the other groups, driven almost entirely by births. Births are, by far, the most important component of livestock

19 One possible explanation for the fact that the study finds sustained impacts for livestock but not for crop production is that livestock is easier to measure, allowing for more precision in the estimates. However, a review of the minimum detectable effects in tables 3 and 4 suggests that this is not the issue here. The minimum detectable effect for GVAO is 41 percent of the control mean at midline and 24 percent at endline. The corresponding numbers for tropical livestock unites and total livestock value are 33 percent and 43 percent at midline and 20 percent and 41 percent at endline.

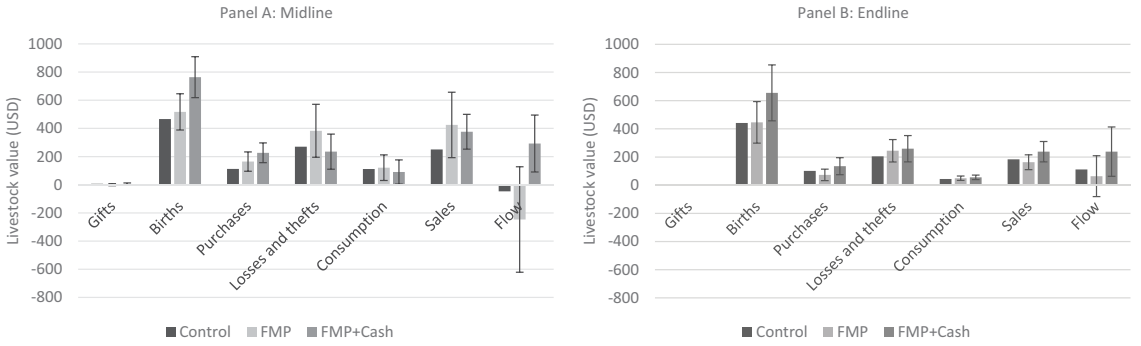
20 See Rosenzweig and Udry (2016) for a description of how returns to investment in agriculture and other sectors can vary with aggregate shocks.

Figure 4. Tropical Livestock Units: Flow Measures



Source: Authors' analysis using the project 2015 midline and 2016 endline surveys.

Figure 5. Total Livestock Value: Flow Measures



Source: Authors' analysis using the project 2015 midline and 2016 endline surveys.

flows. As such households in the FMP + Cash group may see their investments continue to grow over time. Households may also invest in livestock as a form of savings or insurance and not for income generation; the data do not make it possible to distinguish between these explanations. However, regardless of the reason, the positive flows over two years suggest that livestock are a sustainable investment for households. For those households that prefer to invest in livestock, the benefit of an unconditional cash transfer is that it gives them flexibility when making investment decisions.

The results are less promising for households in the FMP group. There is some evidence of a similarly sized increase in crop production in the first year for the FMP households, but there is no evidence that the management plan had any impact on the other measures. The possible increase in crop production would have to be driven by mechanisms unrelated to the investment channels that are examined here. Given the implementation of the plan in both years, the lack of increased crop production in year 2 is not encouraging evidence for the efficacy of the plan alone.

To better understand the effectiveness of the plan, the study uses data collected during the endline survey regarding household experiences with the project: 96 percent of households reported receiving advisory visits in the second year, and the average number of visits reported is eight, close to the target of nine visits. As expected, the measures do not vary by group, as all households received monthly visits. FMP and FMP + Cash households were much more likely to report that they completed the management plan and discussed it during their visits. They were also somewhat more likely to report discussing the

participation of household members in agricultural decision making and to report participating in planning activities with the *animateur*. FMP and FMP + Cash households also had visits that were approximately 10 percent longer than the control group.

These findings suggest that the management plan was implemented as designed and that it was salient for households. However, the more interesting question is whether the plan had important effects on farmer behavior. Although the individualized nature of each plan makes creating appropriate indicators difficult, the study uses a set of endline survey questions that measure whether the household engaged in a series of planning activities outside of the presence of their *animateur*. These activities were chosen to mirror topics included in the management plan and include reducing or eliminating the causes and consequences of agricultural problems, anticipating yields, and discussing how to improve production, planning the timing of specific activities, finding solutions in advance to periods of tension in the household budget, finding solutions in advance to periods of tension in household labor supply, and discussing the use of agricultural inputs.

The results are presented in table 6. Column (1) presents results for the total number of planning activities (out of 6) in which the household reported participation. The coefficients are suggestive of increased planning among both treatment groups, and are of similar magnitude, but are not statistically significant. Large, but not statistically significant impacts are observed across most activities. The endline survey also directly asked farmers if they completed the farm plan (column 8). The FMP group was 55 percentage points more likely than the control group to report completing the plan. However, FMP + Cash households were still 20 percentage points more likely to do so than the FMP group. The cash transfer appears to have made the plan more salient and possibly more effective, at least from the perspective of the farmers themselves.

Qualitative evidence suggests that the plan implementation could have been improved. For example, when asked why farmers did not refer to the plan, the most frequent response (68 percent) was that they were unable to read it. Although the plan may have been salient, ease of use is essential in a population with low literacy. Otherwise, qualitative reports mirror the quantitative analysis. When asked whether the program led to positive household changes, FMP + Cash households were 19 percentage points more likely to say yes, while there was no difference between FMP and control households (table 6, column 9). Indeed, when asked what changes could make the monthly visits more useful, most households (68 percent) reported that either input provision or other financial support would be useful. Feedback from *animateurs* also reflects the fact that farmers request access to capital. These reports are consistent with the main results, suggesting that farm management plans may be most successful when combined with access to capital.

The substantial impacts of this program over two years suggest that it is a good candidate for scaled implementation. However, it is important to understand whether the benefits are large enough to outweigh the costs of providing both transfers and management advice. The study conducted a detailed cost-benefit analysis exercise described in supplemental online appendix S4. The best assumptions lead to an estimated rate of return of 74 percent, and a simulation exercise that varies these assumptions leads to an average estimated rate of return of 81 percent.

These estimates suggest that a scaled implementation of this program could be successful, especially as implementation costs could be reduced without materially changing benefits to participants. However, a better understanding of some program elements is key for designing the most cost-effective program. This includes study of the impact of the advisory visits and an improved farm management plan. Most important, better understanding of the importance of the advisory visits and management plans in conjunction with the cash transfers is needed. Ambler, de Brauw, and Godlonton (2018) address a related question in a partner study in Malawi, finding that extension services combining technical and management advice and cash transfers do appear to be complementary.

Table 6. Treatment Impact on Management Indicators

		In the last 12 months, did you or anyone in your household make plans regarding . . . when your *animateur* was not present?							
	Total number of planning topics discussed without *animateur*	. . . the causes and consequences of agricultural problems . . .	. . . how to improve production before/at planting . . .	. . . when hh would perform specific agricultural activities . . .	. . . periods of tension in the hh budget . . .	. . . periods of tension in hh labor supply . . .	. . . fertilizer and/or pesticides . . .	Completed management plan	Report that program has resulted in positive hh changes
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Endline survey									
Household received FMP	0.24	0.08	0.07	0.02	0.10	0.00	−0.03	0.55	0.00
Standard error	(0.25)	(0.06)	(0.05)	(0.05)	(0.06)	(0.04)	(0.06)	(0.06)	(0.06)
RI p-value	0.370	0.210	0.223	0.688	0.092	0.969	0.628	0.000	0.946
Sharpened q-value	1.000	1.000	1.000	1.000	1.000	1.000	1.000		
Household received FMP + Cash	0.31	0.08	0.11	0.07	0.03	0.01	0.02	0.75	0.19
Standard error	(0.28)	(0.06)	(0.05)	(0.06)	(0.06)	(0.04)	(0.06)	(0.05)	(0.06)
RI p-value	0.260	0.202	0.057	0.222	0.653	0.894	0.802	0.000	0.003
Sharpened q-value	0.664	0.664	0.664	0.664	0.832	0.832	0.832		
Observations	597	597	597	597	597	597	597	598	598
R-squared	0.200	0.147	0.197	0.275	0.117	0.121	0.117	0.480	0.127
Control mean	1.5	0.3	0.2	0.3	0.3	0.2	0.3	0.1	0.6
Original *p*-value: FMP = FMP + Cash	0.77	0.97	0.44	0.32	0.17	0.90	0.37	0.00	0.00
RI *p*-value: FMP = FMP + Cash	0.815	0.973	0.519	0.412	0.238	0.940	0.480	0.051	0.002
Sharpened *q*-value: FMP = FMP + Cash	1.000	1.000	1.000	1.000	1.000	1.000	1.000		
Includes baseline value of outcome	NO	NO	NO	NO	NO	NO	NO	NO	NO

Source: Authors' calculations using the project 2015 midline and 2016 endline surveys.

Note: Robust standard errors in parentheses are clustered by *animateur*. Randomization inference *p*-values are based on 2,000 repetitions. All regressions include stratification cell fixed effects. All money amounts are in USD. Sharpened *q*-values are based on the distribution of RI *p*-values in each row.

7. Conclusion

This paper examines the impacts of a program aimed at increasing agricultural production among smallholder farmers in Senegal. The evaluation was designed to differentiate the impacts of a farm management plan designed to help farmers more effectively manage their resources and the plan plus a large cash transfer intended to relieve capital constraints from a group that received only monthly advisory visits. The treatment that included the farm plan plus the cash transfer led to large increases in crop production, livestock ownership, and expenditures on agriculture after the first year. While there is no increase in crop production after two years, investments in livestock and agricultural equipment are maintained. The management plans alone may have increased crop production in year 1, but did not lead to increased investments or savings.

These results show that large, one-time transfers aimed at agriculture can have substantial impacts on farmers, in contrast with Karlan et al. (2014) but consistent with Beaman et al. (2015) and Ambler, de Brauw, and Godlonton (2018). This difference may be due to the support and guidance that accompanied the transfers. This study is one of the first to suggest that large cash transfers can be effective tools for small farms, particularly because the simplicity of implementation makes scaling more feasible relative to microfinance, insurance programs, and even programs that offer frequent, smaller transfers.

This paper also contributes to the literature on financial training for small businesses by moving that research to the agricultural sector. As with other types of businesses, there is little evidence that the management plan can be effective when not combined with the transfer. Though the explicit comparison of the cash transfer to other methods of alleviating capital constraints is beyond the scope of this paper, the results do indicate that research addressing the combination of these other methods with management training would be a useful addition to the literature.

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