Cash, Inputs, and Information:
Direct Effects and Complementarities in Malawi

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Abstract

We examine a program designed to alleviate credit, input market, and information constraints among smallholder famers through cash and input transfers and a cross-randomized program offering intensive agricultural extension. Farmers receiving transfers increased their agricultural investments, leading to gains in production and consumption, with no important differences between modalities. We document strong complementarities between the two sets of interventions. Investment, production, and consumption are highest across years for farmers that received both transfers and extension. Transfers alone have little to no impact, and intensive extension alone has negative impacts. Credit and information constraints are limiting, and must be addressed together.

Keywords: Agriculture, Extension, Cash transfer, Inputs, Malawi

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1. Introduction

The gap between potential and actual agricultural yields is large, suggesting that programs designed to enhance agricultural productivity have real potential to reduce poverty (World Bank 2007). Factors limiting agricultural production and productivity are myriad and include lack of knowledge about production technologies and farm management techniques, resource constraints, and incomplete input markets. Many of these factors have been studied in isolation to understand their independent impact on household productivity (Bridle et al. 2018; Magruder 2018). However, households may face more than one limitation, motivating the importance of understanding both the independent and joint impacts of alleviating multiple constraints.

This study examines a cross-cutting randomized controlled trial with a transfer arm that offers either cash or in-kind transfers and an agricultural training arm that tests an intensive agricultural extension model against a more standard model. The potential for complementarities between transfers and agricultural training is clear. However, limited rigorous empirical evidence exists directly testing their relative and joint importance for increasing productivity. The transfer element of the intervention studied provides capital, the in-kind transfers address failures in input markets while controlling purchases, and the training program addresses knowledge constraints. The research design allows the identification of the separate impacts of transfers and training and their complementarities over time. We study impacts of these interventions on a series of farm investment behaviors, and then analyze whether any changes in investment affected crop production, and, ultimately, household wellbeing as measured by consumption expenditure.

Farmers were randomly allocated to a control group that received no transfers, a cash group that received a series of three strategically timed framed cash transfers, and an input group that received transfers of equivalent value, of which approximately 50 percent were given in kind (seed,

hoes, inoculant, storage sacks).[1] Transfers were provided only in the first year of the project, with the goal of achieving large production improvements so farmers could afford to make similar investments in the second year. In the cross-cutting agricultural training component, farmers were assigned to receive either group extension services or intensive extension services, provided by the National Smallholder Farmers Association of Malawi (NASFAM), who also administered the transfers. Group extension services primarily rely on a lead farmer extension model. The intensive extension model provided additional support to farmers, with extension officers expected to conduct at least three one-on-one visits with each farmer, during which they provided both technical support and farm management advice. Farmers were randomly allocated to one mode of extension support in the first year, and re-randomized to one mode of extension support in the second year.

First, we examine whether the modality of the transfer matters in this context. We find that both cash and in-kind transfers led to increases in investments in farming. Farmers receiving either type of transfer invested more in agriculture-specific assets and inputs, predominantly the use of *ganyu* (day labor). These investments are complemented by increased adoption of labor-intensive agriculture practices. Increased investments in farming are observed both during the year of implementation and in two subsequent years. These investments translate into production gains. Gains in the total value of production are sizable, exceeding the value of the transfer, in the first year for those in the cash group, and gains to overall crop production for those in the inputs and cash groups in the second year. In the third year, we continue to find positive impacts attributable to both transfer types, but the effects are less precisely estimated. In general, there are limited

[1] Framed transfers have been shown to be effective at achieving their intended outcomes, even without conditions. See Benhassine et al. (2015) in the context of education in Morocco and Ambler, de Brauw, and Godlonton (forthcoming) in the context of agriculture in Senegal.

differences between the cash and input package transfers, suggesting that incomplete markets for inputs are not binding in this context. At the same time, the results indicate that the paternalistic aspect of the input transfers are also not key to improving production. Conversely, we do not observe that cash is more effective; there is no large benefit in this context to the flexibility offered by cash.

These findings contribute to the literature on transfer modality that to date has focused primarily on the impacts on food consumption and dietary diversity (e.g. Gilligan et al. 2014; Hidrobo et al. 2014; Aker 2017). We extend this research on transfer modality out of the food aid context, to a setting where lump-sum cash transfers are heavily framed for agricultural investment. In this context, our results suggest that cash can be just as effective as in-kind transfers when given with the intended purpose of investment stated.[2]

Next we examine the independent and joint impacts of the two intervention components, collapsing cash and input transfers into one treatment arm. We find that intensive extension services when provided alone resulted in farmers decreasing their on-farm investments leading to decreased production during the year of implementation. These short-term negative impacts are sustained; in the two subsequent seasons farmers continue to invest less in inputs, and produce less, resulting in lower consumption. Conversely, we do not document a consistently significant pattern of results from receiving transfers alone. There is some evidence of small increases in inputs, but they do not translate into increased production or consumption in any year.

We do however document large, positive effects of receiving both the extension services and the transfers in the first year, indicating that there are significant complementarities between

[2] Households may, in fact, prefer in-kind to cash transfers. In Ethiopia, households overwhelmingly report a preference for in-kind (food) transfers, and this preference is related to the accessibility of markets, among other factors (Hirvonen and Hoddinott 2020).

the two types of interventions. In the first year, those farmers that receive transfers and extension invest significantly more in agriculture than both the control group and the combined separate impacts of the intensive extension and the transfers, and household consumption expenditure is significantly higher. In subsequent seasons, we find continued evidence of strong complementarities between receiving the transfers and intensive extension in the first year. The pattern of results is consistent with the first-year results, in that production improvements appear to be driven by increased investment in agriculture-specific inputs, leading to increased consumption. Despite the fact that transfers were given out only in the first year, both investment and consumption remain higher two and three years later. Because extension support was re-randomized in year 2, we can examine whether continued receipt of those services in year 2 affect this persistence. The strong complementarities between the interventions on outcomes in the second year are almost entirely concentrated among those who also received extension support in year 2. This result demonstrates the importance of continued support for sustained production gains.

Our results suggest that both capital and information constraints are binding for the farmers in our sample, and further that relaxing both is much more effective than relaxing one or the other in isolation. These results speak to the importance of simultaneously addressing these constraints to production in developing countries. Most of the existing literature is focused on nonfarm enterprises, providing both capital and training (McKenzie and Woodruff 2013). In general, the studies find short-term positive impacts (that are often small) and tend to quickly dissipate (de Mel, McKenzie, and Woodruff 2014, Blattman et al. 2016, and Brudevold-Newman et al. 2017). This study brings these questions to the farm setting where these constraints may operate differently. These findings also complement a set of papers which study large transfers specifically

intended for agricultural investment with mixed results.[3] Ambler, de Brauw, and Godlonton (forthcoming) and Beaman et al. (2015) both find large, positive impacts of transfers on agricultural production after one year, whereas Karlan et al. (2014) find modest effects of cash relative to insurance. Although Ambler, de Brauw, and Godlonton (forthcoming) find that production results are not sustained in the year following transfer disbursement,[4] Beaman et al. (2015) document sustained impacts. This paper finds large, sustained effects of transfers on crop production, and shows that a sizable transfer split across the agricultural season generates positive production impacts similar to those found in studies with large lump sum transfers.

These results contribute to the economics literature on the design of agricultural extension services to improve learning and technology adoption. Two reviews—one by Birkhaeuser, Everson, and Feder (1991) and one by Evenson (2001)—document that at that time, most existing studies found significant positive impacts, but with highly variable returns. More recently, a review by Fabregas, Kremer and Schilbach (2019) similarly find profitable returns, on average, to digital agricultural extension. Our paper focuses on whether an intensive model of extension by trained agents is more effective than a lead farmer model. Whereas previous studies have typically focused on the adoption of specific technologies (e.g. Kondylis, Mueller, and Zhu 2017, BenYishay and Mobarak 2019, and Bobic et al. 2017), the intensive program studied here focuses on holistic advice, including management advice.[5] Instead of adoption, we focus on production outcomes, and also consider other measures of household wellbeing such as consumption. Our results

[3] Most papers that studying the relationship between transfers and agricultural production examine the impact of small, regular transfers, principally intended for social protection, on agriculture as a secondary outcome. These studies usually document small, positive effects (e.g. FAO, 2015).
[4] In Ambler, de Brauw, and Godlonton (forthcoming) we also examine cash transfers and management advice to farmers in Senegal, but there the treatments were additive rather than cross-randomized.
[5] There are exceptions. For example, Cole and Fernando (2020) find impacts on demand for (general, but crop specific) information but no significant impact on yields; while Van Campenhout, Spielman and Lecoutere (2020) find that the effectiveness of general extension depends upon the gender match of the extensionist and recipient.

demonstrate that intensive extension offered without capital support may actually be harmful to farmers in this context, but that it can be very effective when combined with cash or input transfers.

The paper proceeds as follows. Section 2 describes the implications of key constraints that motivate the interventions studied. Section 3 presents the institutional setting and the experimental design. Section 4 describes the data, discusses the measurement of key outcomes, and outlines the empirical analysis. We present the transfer modality results in Section 6, and our complementarity analysis in Section 6. Section 7 provide further discussion, while Section 8 concludes.

2. Addressing agricultural constraints: Pathways for impact

The goal of this project was to study how the relaxation of certain constraints to the improvement of agricultural productivity affect farmers' behavior and livelihoods. In this section we detail the three main constraints we study: credit market inefficiencies, incomplete input markets, and information gaps. We additionally explain how they may interact, and the ways in which their alleviation may affect household outcomes. The three constraints are the following:

Credit market inefficiencies: Farmers commonly cite lack of capital as a key constraint to adoption. Imperfect credit markets restrict the ability of farmers to borrow and in particular adopt technologies with sizeable upfront costs.

Incomplete input markets: Several studies have highlighted inefficiencies in input markets, demonstrating volatility in the availability of inputs particularly in more remote locations, and high prices driven by limited competition (e.g. Minten, 1999). Farmers cannot make profitable investments if the inputs they need for those investments are not available.

Information gaps: If smallholder farmers are unaware of the underlying distribution of returns to different agricultural practices and technologies, adoption may be limited. Even in

situations where farmers are aware of the benefits to certain practices, they may not have the proper knowledge to implement these practices effectively.

Many farmers may experience more than one of these constraints to production. Improving credit markets may give farmers better access to capital, but without access to the proper inputs or the knowledge of the most appropriate investments, productivity gains may be limited. Similarly addressing input markets will not be beneficial if farmers are capital constrained or lack information about the proper use of such inputs. Finally, reducing information gaps may not be helpful if farmers do not have access to the capital or inputs needed to make the recommended investments.

Our project implemented interventions designed to relax these constraints and study the ways in which they interact. The direct impact of these treatments should be around the amounts and types of agricultural investments farmers are making, as well as the adoption of certain agricultural practices. We hypothesize that changes in investments and adoption will lead to impacts on household agricultural production. Ultimately, we are interested in impacts on household welfare, driven by these changes in agricultural production.

3. Background and Project Design

The interventions were implemented by NASFAM, the largest smallholder association in Malawi, which provides farmers with both social and commercial services. Farmers self-organize into clubs of up to 15 members and pay an annual membership fee of approximately $8 per club. NASFAM provides farmers with an input starter package of seeds for a high-yielding variety of a cash crop suited to their region. Farmers are expected to repay NASFAM in seed at the rate of 1.5 to 2 times the quantity of seed received. The same repayment rate applies to all farmers within a specific year but varies from year to year. Farmers are provided with seed loans during their first two years as

NASFAM members, after which farmers are expected to be able to retain enough seed so as to not rely on seed loans. Excess seed is then used to support other new farmers.

For technical support, NASFAM primarily uses a lead farmer approach. NASFAM extension officers train a local farmer chosen by the group to be the key point of contact between NASFAM extension officers and farmers. The lead farmer is then responsible for disseminating knowledge to other farmers, largely through group activities, though they also maintain demonstration plots. NASFAM also helps organize marketing activities and negotiates rates with large buyers on behalf of farmers. NASFAM members have a guaranteed market for the supported cash crop but are not required to sell to NASFAM.

3.1. Experimental design

Interventions were conducted in Ntchisi and Dowa districts in central Malawi between August 2014 and August 2016. The experimental design and data collection activities are illustrated in Figure 1. The study site is characterized by high rates of rural poverty, with most households engaged in subsistence agriculture. The 120 newest farmer clubs in the region were selected to participate, excluding those that exclusively grow tobacco.[6] Groundnuts and soybeans were selected as focus crops in part due to explicit interest in diversifying risk in tobacco-reliant communities.

Using this sample, we implemented a 3x2 cross-cutting cluster-randomized design. The transfer component has three arms: cash only, an input-cash package, and control. The information component offers either intensive extension support or standard group extension support.

[6] The program focused on newly registered farmer clubs as they were the most likely to have not yet benefited from any NASFAM services.

3.2. Framed capital transfers

The first set of interventions directly targets potential credit and input market frictions. Transfers were only distributed during the first year of implementation. The total value of the transfers is equivalent to approximately $84, roughly equal to 15 percent of annual gross value of agricultural output (GVAO) at baseline. The transfer was intentionally large, with the goal of enabling farmers to make sustainable and substantive investments in their farms. The staggered payouts were designed to target resource gaps at strategic times of the year for agricultural investments.

Cash treatment condition: Cash transfers were given in three disbursements to farmers. The first disbursement (given in November 2014) was $36, the second was $22 (February 2015), and the final disbursement was $26 (April 2015). The cash transfers were heavily framed as being intended for the purchase of inputs similar to those provided in the input treatment. The timing of the cash disbursements is meant to ensure liquidity at critical time periods and alleviate labor constraints during high-demand, low-supply periods. The cash treatment condition directly relaxes the credit constraint but does not address information gaps or incomplete input markets.[7]

Input treatment condition: Input transfers were distributed at the same time as the cash transfers and were calibrated to be in equal in value to the disbursements received by the cash group.[8] Fertilizer in Malawi is already heavily subsidized through the national Fertilizer Input Subsidy program (FISP), thus key inputs provided in our treatment are seed, pesticides and (money for) *ganyu* labor. In the first disbursement, individuals assigned to the input group received seed, hoes, and inoculant.[9] In the second disbursement, they received cash for *ganyu* (day labor, the

[7] Because these are transfers and not loans, the transfers also reduce risk to a certain extent, but they do not provide insurance against a bad harvest.
[8] Data from the first follow-up survey demonstrate that the transfers were well implemented, refer to Appendix A for details.
[9] Inoculants encourage the development of high-nitrogen nodules on roots of legume plants, which both improve yields and the amount of nitrogen the plant can fix in the soil. Biologically, this process occurs by adding bacteria

relevant input at midseason), and in the third, sacks,[10] strings, and cash for harvest-related transportation and *ganyu* costs. Labor is a key input identified by NASFAM for these farmers, but because *ganyu* could not logistically be provided in-kind, the input group received approximately 50% of the total value of their transfer in cash. Providing inputs relaxes both input and credit market failures simultaneously. Inputs may be more useful than cash if input markets are not complete. There may also be an information component to input transfers, however given the framing in the cash condition that should be limited in our context. It should also be noted that if inputs are not easily transferable to cash the input transfer package could restrict farmers' profit-maximization by constraining their input choices.[11]

Control condition: Farmers in this group received only standard NASFAM services. No transfers were given, but if they were newly registered members, they received a seed loan equivalent to about two-thirds of the seed disbursement provided in the input treatment condition.[12]

For both the input and cash treatment conditions, a requirement linked to the first disbursement was that members repay twice the amount of seed received back to NASFAM at the end of the agricultural season. However, this repayment functioned as a savings mechanism instead of a loan because at the start of the second season, farmers received the full amount they had repaid earlier. At the end of the second season, they repaid the same amount as in the first year. They then reverted to the group extension approach, whereby farmers repay 1.5 to 2 times the amount given in the form of the same seed received at the beginning of the year.

(Rhizobium) to the soil that symbiotically work with the legume plant to take nitrogen from the air and make it useful to the plant.

[10] Treated sacks are provided to farms to facilitate improved storage and reduce post-harvest losses.

[11] This in-kind approach is also more commonly practiced by farmer's cooperatives than cash disbursements.

[12] 64 percent of farmers in the control group report receiving seed and were likely participating in the seed loan program.

3.3. Intensive extension services

The second set of interventions directly targets information gaps related to both technical agricultural skills and farm management. To address this constraint, we examine two modes of extension services.

Intensive extension condition: The intensive extension program was designed to alleviate information gaps by providing farmers with detailed and personalized advice regarding investments and technology adoption. Farmers assigned to the intensive extension condition received standard group extension services and additional individualized extension support from professional extension workers, including both technical agricultural services and farm management planning. Extension officers were expected to visit farmers three times. During the first visit at the beginning of the agricultural season, extension officers assisted farmers in developing a farm management plan covering several topics, including land allocation across crops, livestock production income (breeding and by-product revenue), crop production and livestock production expenses, and the appropriate timing of activities.[13] As part of this process, farmers chose three key farming goals for the year. Common goals set by farmers include the commitment to conduct farming activities sufficiently early, use more inputs, adopt specific farming techniques, purchase a specific number of and type of livestock, and to pay off loans. Many farmers also included vague goals to increase crop and livestock production. During follow-up visits, extension officers were expected to check in with farmers to assess progress relative to their management plan and provide assistance with any technical issues. In general, intensive extension services were implemented as designed, and Appendix A provides a detailed discussion.

Group extension condition: Farmers assigned to this treatment condition received group

[13] Refer to Appendix B for the Farm Business plan template.

extension services, following standard NASFAM extension guidelines. As described earlier these services follow the lead farmer approach.

To support the extension intervention, 15 additional extension officers were hired, seven of whom were female. Extension officers were relatively young (average age of 27), and all of them held a diploma.[14] Extension officers were responsible for providing, in their assigned catchment area, both the group extension support to all farmers and individualized support to farmers receiving the intensive extension services.

3.4. Randomization

Randomization was conducted at the club level, stratified by extension officer, an indicator for below versus above the median share of females in the club, and an indicator for below or above the modal club size. In the first year (starting in October 2014), clubs were randomized to receive one transfer treatment (control, cash, or inputs) and one extension treatment (group or intensive extension). As such, in the first year there are six unique treatment cells.

In the second year, clubs were re-randomized into the extension treatment, stratified by their year 1 extension treatment status. In other words, clubs (with equal probability) received intensive services in neither year, in the first year only, in the second year only, or in both years.

3.5. Data collection and timeline

In August and September 2014, farmers in the clubs identified by NASFAM participated in a baseline survey. All club members were targeted for inclusion in the baseline survey based on a club roster provided by NASFAM and updated through consultation with each farmer club chair. The baseline survey includes modules on socioeconomic characteristics, agricultural production and practices, livestock production, time use within agriculture, and employment-related

[14] NASFAM followed their standard recruitment protocols to fill these positions.

information by household member.

After the baseline survey, NASFAM assigned clubs to extension officers.[15] The first-year randomization occurred after this assignment. In August–October 2015, a complete follow-up survey was conducted (Follow-up survey 1). Year 2 activities began in October 2015 after Follow-up survey 1. No transfers were given in the second year, but extension services did continue, as dictated by the second-year randomization. All intervention activities concluded in August 2016. In August–October 2016, a second complete follow-up survey was conducted (Follow-up survey 2). The follow-up surveys are similar to the baseline, and additionally include modules on household enterprises, program implementation monitoring, and consumption. We also conducted a third follow-up survey in March 2018, which covered present consumption but the 2017 agricultural season.[16] The survey covered similar topics, but was conducted over the phone, and was thus necessarily more limited in scope. For example, agricultural investment and production decisions are only asked for four key crops: Maize, Tobacco, Groundnuts and Soy.

4. Data

4.1. Sample characteristics

Our sample is composed of the 1,259 households that were members of NASFAM clubs at baseline, immediately prior to the first year of activities. All sample members were targeted in each round of data collection, regardless of whether they had been previously interviewed. Figure 2 documents the sample size for each round of data collection used in this paper. Recall Follow-up 3 was conducted by phone, hence the lower sample size. Table 1, column 1 presents the

[15] The assignment was done to minimize travel time for the extension officers, so each extension officer worked in a relatively contained geographical area.

[16] It also collected selected information about the ongoing 2018 agricultural season, for example input purchases for the 2018 season which would have been almost complete by the time of the survey.

summary statistics for a subset of key variables as reported on the baseline survey, for each of the follow-up survey samples. NASFAM members tend to be female (63 percent) and married (83 percent), and on average they are 41 years old.[17] They have little education: 70 percent either have never been to school or have not completed primary school. In almost half the households (47 percent), the NASFAM member is not identified as the household head. Household heads are slightly older than the NASFAM member on average (44 years old), have limited formal education, and only 14 percent are female.

Households grow a diverse set of crops; on average, households grew 4.5 distinct crops in the previous agricultural season. Common crops grown include maize (almost universally grown at 98 percent), groundnuts, soybeans, tobacco, pumpkins, and common beans. The GVAO at baseline is approximately $600 per year.[18] GVAO per acre captures overall agricultural productivity and averages $128.[19] Livestock ownership is low. The average household reports owning livestock valued at about $200, representing less than one tropical livestock unit.[20] In Ambler, de Brauw, and Godlonton (2018a), we compare, to the extent possible, characteristics of our sample relative to the full sample of the nationally representative Integrated Household Survey (IHS) data, as well as a restricted sample of only those IHS respondents resident in Dowa and Ntchisi districts. The farmers studied here are more likely to be engaged in agriculture, growing a

[17] The gender distribution of members is important because productivity gaps are particularly pronounced for female farmers. Kilic, Palacios-Lopes, and Goldstein (2015) find that 82 percent of the productivity differential between male and female farmers can be explained by observable factors, particularly cash crop cultivation and male labor inputs. In addition, female farmers in Malawi are less likely to receive agriculture-related advice than male farmers (Ragasa and Niu 2017).

[18] The GVAO was calculated using a method similar to that for constructing consumption aggregates outlined in Deaton and Zaidi (2002). Details available in Appendix C.

[19] GVAO per acre uses the GVAO measure divided by total land area cultivated. Cultivated land area in acres includes any land owned, rented, borrowed, or sharecropped and used by the household for crop production in the previous season.

[20] As is standard in the literature, we use tropical livestock units to aggregate all the different animals to a common unit using exchange rates. Refer to Appendix C for details.

more diverse set of crops, on more land, with considerably higher gross sales revenue than comparison groups. However, conditional on growing cash crops, the average production in this sample is similar to that of other farmers in the same two districts.

4.2. Sample balance and attrition

The randomizations produced treatment groups that were reasonably balanced on observable characteristics; pairwise comparisons of a large set of baseline variables are presented in Appendix Table 1. Attrition across survey rounds is summarized in Figure 2. All attrition rates are calculated based on the sample of 1,259 confirmed club members who were interviewed at baseline.[21] Attrition rates are moderate across survey rounds (less than 10%), with the exception of Follow-up Survey 3 which was conducted by phone for budgetary reasons. As such, we could only contact those households for which we had a phone number collected in any of the previous survey rounds. Because the Follow-up Survey 2 was conducted 18 months prior to the phone survey, many farmers were no longer using the same phone number.

We further consider differential attrition. At the bottom of Table 1, we present p-values associated with a t-test for whether attrition for that survey round is differential by treatment group for each pairwise comparison of treatment groups. We do observe slightly higher attrition for the control group (transfer treatments) which leads us to reject that attrition in the control group is equal to that in the cash or inputs group in Follow-up 1, and to the cash group in Follow-up 2.[22] In Follow-up 3 we reject equality for the control and cash group comparison and the cash and input group comparison. Due to the small sample size and resulting implications for statistical power,

[21] For the purposes of this attrition analysis we restrict the sample to the original sample frame. Club rosters were updated to reflect changes in composition of the farmer clubs over time and all current and former farmer group members were targeted for interviews in each round.
[22] Additional details regarding attrition provided in Appendix D.

we primarily use the third follow-up survey results to provide suggestive evidence of medium-term effects post-intervention. Since there is evidence of differential attrition, we conduct robustness checks using weighted estimates to control for differential attrition (Fitzgerald, Gottschalk, and Moffitt, 1998).[23]

4.3. Empirical Strategy

Our analysis is divided into two sections. To begin, we focus solely on the transfer treatment conditions and investigate the role of transfer modality on smallholder livelihoods. We follow that analysis by examining the independent and joint impacts of the transfers and extension treatment conditions.

4.3.1 Transfer modality: cash vs inputs

To examine the impact of the transfers we estimate the following regression:

$$Y_{hj} = \alpha + \beta_1 Cash_j + \beta_2 Inputs_j + \tau Y_{h0} + \gamma X_{hj0} + \delta_s + \varepsilon_{hj}, \qquad (1)$$

where Y_{hj} is an outcome measure for household h in farmer group j. Outcomes are measured at three points in time: in the year following the transfer (Follow-up 1), as well as two and three years following the transfer (Follow-ups 2 and 3). $Cash_j$ is an indicator variable that takes the value of 1 if the respondent's club was assigned to the cash transfer, and $Inputs_j$ similarly indicates whether the farmer was assigned to receive the input transfer. In this case, we are interested in the direction and size of β_1 and β_2, and also the relationship between β_1 and β_2. If $\beta_1 = 0$, then credit constraints are not binding. Similarly, if $\beta_2 = 0$, it is evidence that input market inefficiencies do not constrain farmer decisions. A pattern in which $\beta_1 < \beta_2$ would be consistent with input market inefficiencies constraining farmer decisions more so than underlying credit constraints. Furthermore, if $\beta_1 = \beta_2 > 0$, then the possible distortionary effects from providing inputs rather

[23] Results not presented, available upon request.

than cash are negligible.

In this and all regression specifications that follow, X_{hj} is a vector of household baseline covariates that includes household size, whether the household head is polygamous, whether the NASFAM member is female, and a series of indicators for the NASFAM member's level of education.[24] We also control, when possible, for the baseline value of the outcome variable, Y_{hj0} and include stratification cell fixed effects (δ_s). Standard errors are clustered by farmer club.

Each table of results shows the separate impacts of the cash and input transfers relative to the control group, as well as the *p*-value testing the hypothesis that coefficients on each transfer type are equal. Given the cross-cutting randomization with the extension treatment conditions, both β_1 and β_2 capture the average treatment effect of receiving the transfers conditional on half the sample receiving group extension and the other half receiving intensive extension services. All continuous outcomes have been transformed using the inverse hyperbolic sine transformation (IHST). Across specifications, we present only the intent-to-treat results.

4.3.2 Credit constraints and information: independent and complementary effects

Given statistical power considerations, and further motivated by limited differences in the impacts of the two transfer modalities, we examine the independent and complementary effects of transfers and information using the following equation:

$$Y_{hj} = \alpha + \beta_3 IntExt_j + \beta_4 Transfer_j + \beta_5 Transfer\ and\ IntExt_j + \tau Y_{h0} + \gamma X_{hj} + \delta_s + \varepsilon_{hj}. \quad (4)$$

We use this specification across all three years because our goal is to understand complementarities of the two interventions across time.

[24] Results are robust to the exclusion of covariates.

We test several key hypotheses. First, we examine the independent impact of the intensive extension services. That is, we examine the impact of receiving intensive extension services only and test whether $\beta_3 = 0$. If $\beta_3 = 0$, it provides evidence that the mode of extension service provision does not affect farmer welfare either because farmers do not face an informational gap, or because both forms of extension service provision equally address any existing information gaps in the presence of existing credit constraints. However, if $\beta_3 > 0$, it is evidence that farmers face an informational friction and the tailored intensive extension mitigates the information gap. Finally, if $\beta_3 < 0$, it suggests farmers respond to the intensive extension by reducing investments in their farm. A key component of the NASFAM extension services is a focus on conservation agriculture, which could emphasize reducing current investments to increase the long-run production potential of the farm.

Second, by testing $\beta_3 = \beta_4$ we can directly compare the impact of intensive extension services relative to receiving a transfer. This allows us to compare the relative efficacy of programs targeting only information gaps or only relaxing credit constraints. Finally, we test the null hypothesis $\beta_3 + \beta_4 = \beta_5$, to determine whether intensive extension and transfers are complementary. Resolving information gaps while jointly alleviating credit constraints has the potential for larger gains to agricultural production than the impact of either in isolation.

4.3.3. Outcomes

As described in Section 3, we examine the impact of the interventions on measures of agricultural investment and technology adoption, production, and household welfare. The investment outcomes include the value of agricultural assets, expenditures on inputs, and expenditures on *ganyu* specifically for focal and non-focal crops. Technology adoption is measured by an agricultural practices index which is a simple count of whether farmers had

adopted 11 different agricultural practices or technologies, such as intercropping with legumes and crop rotation, in the most recent season. We also break this index into two sub-indices for labor- and capital-intensive practices.

Production is measured by the total value of focal crops and the gross value of agricultural output (GVAO). The GVAO provides a useful overall measure of crop production, incorporating all production, including the other main crops grown in our sample, maize and tobacco. Because we are ultimately interested in farmer wellbeing, we examine net farm revenues and overall consumption aggregates. Ideally, we would be able to accurately measure farm profits, but doing so would require making strong assumptions about land and labor markets. Instead, we follow Beaman et al. (2015) and focus on a more limited measure, that of net revenues (GVAO minus total input expenditures), which ignores the value of any changes to own household labor. The consumption aggregate is our preferred measure of household well-being and is measured using the standard IHS/LSMS approach. Detailed information on all variable construction is presented in Appendix C.

5. Results: Transfer modality

To begin, we examine whether and to what extent smallholder farmers changed their agricultural investments in response to the transfers. Table 2 Panel A presents these results. Both types of transfers increased investments as measured by both the value of agriculture-specific assets and input expenditures during the year of the intervention. While asset value is not statistically different across the cash and input groups, input expenditures are statistically larger in the cash group relative to both the control and the input group.[25] Looking beyond the aggregates, we find that

[25] Input expenditures include the value of all expenditures purchased with cash, paid for using in-kind payments, and received for free. In other words, it includes the value of seeds purchased by farmers in the cash treatment and received by farmers in the input treatment, if planted.

these results are primarily driven by increased adoption and use of *ganyu* on both focal (soy and groundnuts, Column 2) and non-focal crops (Column 3).

Complementary to agricultural investments, we also investigate the impact of the provision of transfers on the range and type of agricultural practices adopted by the smallholder farmers. Among the transfer control group, participants report using only 3.7 of the 11 practices on average at Follow-up survey 1 (Column 5). We find a robust increase in the number of different agricultural practices adopted for the cash group relative to the control. Disaggregating the agricultural practices into "labor-intensive" and "capital-intensive" practices, we find that this result is driven by labor-intensive practices, consistent with the large increases in *ganyu* expenditures. Relaxing credit constraints in peak labor demand periods dramatically relaxed seasonal labor constraints.

Figure 3 presents summary information on what farmers said they spent the cash transfers on and lends further support to these results. The most commonly reported categories are seeds for the November transfer and *ganyu* for the February and March transfers, consistent with the framing provided by NASFAM. Other common uses reported were food and tools. Tools include primarily hoes and sacks, with a few sickles and one oxcart. These findings are broadly consistent with our results, with the exception of a noticeable increase in pesticide expenditure in the self-reported data. The data presented here also support the idea that framing a cash transfer can effectively influence expenditures. Each transfer was framed as being intended for specific time-relevant input purchases, following the inputs given to households in the input transfer group. The data indicate farmers largely followed this framing.

To investigate whether these investments translated into welfare gains we consider the impact on production and consumption outcomes. Table 2 Panel B presents the main results. We focus on two aggregate measures of production: the combined value of groundnut and soybean

production using farmer self-reports (Column 1); and the GVAO (Column 2).

Panel B documents strong positive production impacts attributable to the transfers after the year in which the transfers were given. The combined value of groundnut and soybean production is larger for both transfer types relative to the control group; however, the coefficient is statistically larger for the cash group than for the input group. Further, we also observe a 25 percent increase in the GVAO for the cash group relative to the control, indicating that production increased overall in households that received cash.[26] The GVAO of the cash group is also statistically larger (p=0.084) than the GVAO of the input group.

Turning to overall household welfare, we examine net farm revenues (Column 3) and overall consumption aggregates (Column 4 and 5).[27] In general, the results for net revenue are (unsurprisingly given the issues with the net revenue measure described in Section 4) noisy and sensitive to the IHST transformation and other methods used to minimize the influence of outliers.[28] However, the impacts of the transfers on crop production are accompanied by sizable improvements in overall consumption both in the aggregate and as measured in per-capita terms for both the cash and input groups. Increased farm investments do appear to have meaningfully affected farmer welfare during the year of project implementation.

The short-run production and consumption impacts attributable to the transfers are promising but, if this type of program is to be effective in reducing poverty, the impacts need to be sustained. We examine whether the results were sustained in the second and third years

[26] We use the IHST on all continuous quantities. Thus, the estimated impact attributable to the cash and input transfers can be calculated as $(100 \times (e^{0.221} - 1))$ and $(100 \times (e^{0.083} - 1))$, respectively.

[27] In the working paper version, Ambler et al. (2018b) we examine the impacts of the transfer treatments on a broader set of welfare measures. In that paper we show that the impacts of the transfers on crop production are accompanied by sizable improvements in asset accumulation and total savings in the first year. In the second year, we estimate sustained asset wealth and savings in the form of livestock.

[28] In results not presented, the net revenue results are sensitive to the log transformation, and winsorizing net revenues at various percentiles.

following the transfers. We present the medium-run results on investments in Table 3 and on production and consumption in Table 4. In both tables, Panels A and B present results for Follow-up Surveys 2 and 3 respectively.

Despite the cessation of the transfers, farmers in both transfer groups continue to hold more agriculture-specific assets relative to the control group (Table 3, Column 1) in the second year (assets were not measured in the Follow-up 3 phone survey). They also appear to reinvest at least part of their production gains into input expenditures in both the second and third year after the disbursement of transfers (Table 3, Column 2). We observe larger input investments by the cash group relative to the control, although the difference is statistically significant in year 2 only (p-value in year 3 = 0.167). As in the year of disbursement, much of the increase in input expenditures is driven by increased expenditures on *ganyu*. Although the magnitude of the effect does decrease somewhat across the three years, it is still large in both years 2 and 3 (Columns 3 and 4). Follow-up Survey 3 also asked about inputs used in the ongoing 2017/18 agricultural season (i.e. in year 4), and we find further evidence of sustained increased *ganyu* use in the cash transfer group (results not shown). Consistent with the documented increases in *ganyu* expenditures, we also observe sustained increased use of labor-intensive agricultural practices (Column 6), though the effect is imprecisely estimated in year 3.

These persistent changes in agriculture-related investments translate into sustained production and consumption impacts (Table 4). In the second year, impact estimates on production are similar among the two transfer modalities. These point estimates are large; they indicate that the value of the combined production of soybeans and groundnuts approximately doubled among treatment households in year 2. The GVAO increases for both transfer types in the second year, by 25 percent for cash and 15 percent for inputs (Column 2). Across all outcomes, the input and

cash transfer impacts are not statistically different from one another in the second year. In year 3, we observe a similar pattern of results with respect to production, although they are not statistically precise. Estimated coefficients on focal crop production and GVAO are positive for both cash and inputs, but not statistically different from zero. Differences between modalities continue to be non-distinguishable. These results suggest continued persistence of the positive impacts on production into the third year.

For completeness, we also present the net revenue results (Column 3). Much like before these results are on average not significant and are sensitive to the IHST. We turn to focus on our preferred welfare measure, the consumption aggregates, presented in Columns 4 and 5.[29] We observe moderate, sustained increases in consumption both in the aggregate and in per capita terms. One potential drawback with the consumption estimates is that for Follow-up Surveys 1 and 2 consumption is measured in August, when households are least food deprived. The food consumption portion of the consumption module is based on the last seven days; thus, we are unable to draw conclusions about food security during the lean season. The results from Follow-up Survey 3, which was conducted in the lean season, suggest that our estimates in the first two years may underestimate of seasonal impacts of the cash and input transfer intervention on food consumption.

In sum, we find robust evidence that credit constraints are important in this context and constrain the agricultural potential of farmers. Further, substantially relaxing the credit constraint in one season has sustained positive impacts on smallholder farmer production and consumption. These production gains are primarily achieved through increased accumulation of agriculture-specific assets, increased adoption of *ganyu* labor, and thus the adoption of more labor-intensive

[29] Household size was not collected as part of Follow-up Survey 3, thus we are unable to show the per capita results for Follow-up Survey 3.

farming practices. Further, our results suggest that credit constraints are more binding than input market inefficiencies in this context. At the same time, our results do not indicate that the input transfers are distortionary; the size of the effects are largely comparable for the two modalities across outcomes. However, it is important to interpret these results with the background knowledge that all farmers may benefit from NASFAM-facilitated input and output market linkages and the ability of farmers to purchase necessary inputs may not hold in other settings, The cash transfers were also heavily framed for specific purchases, and do not speak to the impact of a cash transfer given without such strong guidance.

6. Results: Credit constraints and information

Our transfer results demonstrate the importance of credit constraints, but do not suggest a large role for input market inefficiencies. As such, we combine the two transfer treatments into one indicator to study the joint and independent effects of alleviating credit and information constraints.

We first examine the short run effects on investment and agricultural practices (Table 5, Panel A). First, we examine the independent impact of the intensive extension services. The intensive extension provided tailored technical and farm management advice that, if successful, may lead to farmers adopting specific agricultural practices and improving their allocation of resources, including increased investments. We observe a consistent negative pattern of results associated with receiving the intensive extension services alone. Farmers report owning fewer agricultural assets (Panel A, Column 1) and lower investment in input expenditures (Column 2) during the year of implementation. Lower input expenditures are primarily driven by lower reported *ganyu* expenditures on focal crops relative to those receiving group extension only (Column 3). Consistent with these results we also see less adoption of labor-intensive agricultural

practices, though this result is not statistically significant (Column 5).

We next examine the impact of only receiving the transfer. Across outcomes related to investment and agricultural production, the estimated impacts of receiving the transfers alone are positive, but statistically significant only for *ganyu* expenditures on the focal crops (Column 3). Conversely, we document large effects when we study the impact of receiving both the transfer and intensive extension in year 1. These farmers invest more in agricultural specific assets (Table 5 Panel A Column 1), and in input expenditures (Column 2), primarily *ganyu* expenditures. We additionally find increased *ganyu* expenditures beyond just the focal crops (column 4).[30] We also find that receiving both services led to an increase in agricultural practices adopted of about 8.5 percent relative to the control group (Column 5), and this effect is entirely driven by an increase in labor intensive practices (Column 6). In sum, these results are strong evidence that the transfers and intensive extension services are complementary to each other in influencing investments during the year of implementation; with the exception of the agricultural practices index, we consistently reject that the sum of the coefficients on intensive extension only (β_3) and transfers only (β_4) is equal to the coefficient on receiving both treatments (β_5).

In Table 5, Panel B we show the results related to production and consumption in the first year, which mirror the investment results. For those that received intensive extension only, lower levels of agricultural investment appear to harm farmers' production potential in the short run, as their GVAO substantially decreases relative to the group extension program (Column 2). Lower overall production also corresponds with lower net revenues (Column 3) and lower overall consumption (Column 4 and 5). Undoubtedly, these negative impacts of receiving extension alone are of concern and suggest that farmers receiving new information about agricultural technologies

[30] In results not shown we find increased *ganyu* use and *ganyu* expenditures on both maize and tobacco.

or new skills to manage their farm might be unable to respond appropriately to information given binding credit constraints or other related market failures. However, reducing production in the short term to increase the long-term productivity potential of one's farm may be a positive response to the new information provided. Conservation agriculture is a key component of NASFAM agricultural technical advice, as such, the medium-term production and consumption impacts of this extension treatment are critical to a full understanding of these patterns.

Receiving the transfer only increases the production of the project focal crops (Column 1), but does not change overall production or consumption. For those that received both transfers and extension, the increased investments documented in Panel A translate into increased production of the focal crops (Column 1) and GVAO (Column 2) relative to the sum of the groups receiving either intervention alone, though the GVAO result is not statistically different from the control group. More impressively, these gains translate into robust consumption benefits relative both to the control group and the sum of the groups receiving either intervention (Columns 4 and 5). These consumption gains persist even when adjusting for household composition changes, as they remain sizeable when measured in per capita terms (Column 5).

The medium-term results are presented in Tables 6 (investment) and 7 (production and consumption). In general, we find that patterns displayed in year 1 are sustained in subsequent years. First examining investment, we find that receiving extension only in year 1 led to continued lower levels of agricultural assets (measured in year 2 only) and input expenditures, particularly *ganyu* labor. We also document that they engage in fewer labor-intensive agricultural practices (not statistically significant in year 3). There is little impact of receiving the transfers only in years 2 and 3, with the exception of *ganyu* expenditures on focal crops in year 2. Finally, we find that the investment behavior among those who received both interventions in the first year is sustained

into years 2 and 3. In particular, we find large increases in total input expenditures (Column 2), driven by expenditures on *ganyu* (Columns 3 and 4). The coefficients on labor intensive practice adoption are positive, but not statistically significant in either year.

The production and consumption results (Table 7) follow a similar pattern. Receiving extension only in the first year results in statistically significantly reduced GVAO relative to the control group in both years 2 and 3. Consumption is also lower, statistically significantly so in year 3. If the intensive extension services encouraged specific activities with perceived long-term productivity benefits, three years may be an insufficient time period to pick up such effects.

There is little impact of the transfers only, with the exception of increased production of focal crops in year 2. Receiving both in the first year however, led to increased production of focal crops (Column 1) and GVAO (Column 2) in year 2, which results in increased household consumption (Column 4). GVAO and consumption are both statistically significantly different than the sum of intensive extension only and transfer only. In the third year we observe a similar pattern with the production of focal crops and GVAO, but suffer from reduced power. We do find a sustained increase in household consumption that is significant at the ten percent level. We can also reject that the effects for GVAO and consumption are equal to the sum of the two independent treatments.[31]

Given the importance of the intensive extension paired with the transfers during the year of disbursement, we use the re-randomization of extension services in year 2 to examine whether intensive extension services in the second year influence the extent to which impacts are sustained. To do so, we split the sample by whether households received intensive extension services in year

[31] In Appendix E, we conduct a cost benefit analysis focused on the impact of the group receiving both intensive extension and transfers relative to those receiving no transfer and no extension and estimate a rate of return of 52 percent (benefits exceed costs by 52 percent).

2, and examine the medium run effects: those not receiving intensive extension services in the second year are in Table 8, and those who did receive intensive extension services in the second year are in Table 9. In both tables, Panel A includes investment outcomes and Panel B includes production and consumption outcomes. The positive impacts in the second year of receiving both transfers and extension in the first year are almost entirely concentrated among those who received a second year of intensive extension. This is true of the input expenditure outcomes, as well as production, revenues, and consumption, suggesting that continued support for reducing information gaps is key to making productive investments even in year 2. Examining the coefficients on the transfer only group provides more evidence of complementarities. While the impacts for those that did not receive extension in year 2 (Table 8) continue to be small and not statistically significantly different from zero, those that did receive extension in year 2 exhibit increased expenditures on *ganyu*, increased production of focal crops, and increased per-capita consumption (marginally significant). Though farmers in this group did not have large production gains in year 1, they did have the advantage of the large seed bank deposit that almost all transfer group farmers made at the end of year 1.[32]

Given the evidence of differential attrition presented in Section 4, we conduct robustness checks for our main results (Tables 2 – 7) using weighted estimates to control for differential attrition following Fitzgerald, Gottschalk, and Moffitt (1998). To do so, we first predict the probability of attriting from a particular survey round using the treatment indicators in the specification as well as the set of basic controls used in the analysis and the baseline value of the variable, if available. Using these predicted probabilities, we construct propensity score weights for each individual. We then rerun the regressions applying these weights. All results are consistent

[32] There is no consistent pattern suggesting that the negative impact of receiving intensive extension alone in the first year varies in year 2 by whether extension was received again.

with the main specifications presented here (results available upon request). We additionally address the issue of multiple hypothesis testing. First, we note that all our main outcomes are indices or composite measures, thereby reducing the number of tests performed. We additionally conduct corrections for the family-wise error rate (FWER) using the method described in Romano and Wolf (2005), correcting across the family of investment outcomes and the family of production and consumption outcomes in each year. We find that most of our main results are robust to this correction, with the exception of consumption which is most sensitive to the FWER correction (results available upon request).

7. Discussion

The results presented in Section 6 indicate that simultaneously alleviating information and credit constraints can change investment behavior and improve the livelihoods of smallholder farmers. However, the negative impacts of the intensive extension when implemented without the transfers suggest that extension can be potentially harmful if credit constraints are not also considered. To further understand these conflicting results related to the intensive extension we analyze farmer behavior that may have been affected by the extension advice. We focus on identifying whether farmers are learning new information and whether farmers may be reducing investments in the interest of maintaining the long-term productivity potential of their farms.

To explore how farmer knowledge was affected, we start with a deeper examination of the two core components of the intensive extension service: technical knowledge and farm management indicators. To supplement the agricultural practice indices presented in the main results, we construct a number of additional indices to capture general knowledge of agricultural

practices, the adoption of such practices, and crop-specific knowledge and actions (Table 10).[33] The agricultural practices knowledge index is a simple count of whether farmers reported having heard of 11 different agricultural practices or technologies. Overall knowledge of the practices is relatively high; participants in the standard extension group report knowledge of 9.48 out of 11 different practices on average, leaving little scope for knowledge changes.[34] Unsurprisingly, therefore, we find no evidence of an impact on agricultural practice knowledge among those in either group that received intensive extension services during the year of implementation (Table 10 Column 1). There is some evidence that receiving the transfers only reduces knowledge in the first year and increases it in the second year, but these effects are small relative to the control mean and only marginally statistically significant.

Beyond general agricultural practices, extension officers were expected to provide crop specific support to farmers guided by a set of best practice guidelines for soy and groundnuts. Using these best practices, we construct two crop-specific indices that count the number of crop specific guidelines the farmer recalls correctly (knowledge; Columns 2 and 4 for groundnuts and soy, respectively) and reports implementing correctly (use; Columns 3 and 5). In general, there is some evidence that all three treatment groups had small increases in both groundnut measures in both years, but these are small and not consistently statistically significant. However, most farmers were familiar with groundnuts prior to the project implementation, so there may be more room for improvement in the soy-related measure. There is evidence that knowledge and implementation improved for soy for those that received both the transfer and extension in the first year, and these

[33] The variables underlying these outcomes were not collected in Follow-up Survey 3.
[34] There is an overall increase in respondents' knowledge of and use of the list of practices across the two follow-up survey rounds (increasing to 10.16 out of 11 for those receiving standard extension; and increasing use from 3.6 practices to 4). Furthermore, other research has shown that surveys themselves are a conduit for providing information (Zwane et al. 2011).

gains persisted into the second year. Suggestive gains in the first year for the intensive extension only and transfer only groups do not persist into year 2. It appears that receiving transfers in combination with the extension advice caused farmers to learn and implement techniques more appropriately. This may be because farmers paid more attention when they knew that they had the resources to implement these practices, or extension agents may have varied their advice based on whether the farmer received a transfer.

We also study indicators related to the implementation of the farm management plan. In Follow-up Surveys 1 and 2, we collected information on whether a plan was completed, the expansiveness of topics covered and whether the plan was followed. We find that receiving intensive extension alone or together with a transfer leads to increases in all three measures. In the first year, the impacts are similar in size, though there is some evidence that those that received both transfers and extension included more topics on their plans. In short, those that received both may have implemented the farm management plan in a different way from those that did not receive transfers, but given that both groups do report implementation this alone cannot explain the differences in the main results. However, because the plans were personalized, the advice offered may have differed.

Finally, we consider an outcome which may show ways in which the advice received by those that received transfers and those that did not differed. Conservation agriculture, and specifically reducing planting, is a technique advocated by NASFAM as a strategy to increase the long-term productivity potential of their land and may have been advocated for farmers with fewer resources to invest. We show suggestive evidence for this point in Table 11. Specifically, we examine how much land farmers planted overall, and different measures to capture the extent of diversification of their land to different crops. We find a reduction in the total amount of land

planted during the year of implementation for those that received intensive extension only, and in particular a reduction in the land allocated to the focal crops. This reduction persists into the subsequent season.[35] Planting less land in any particular year may allow farmers to reap soil fertility benefits in the future and devote more resources to a smaller plot of land. However, if this led to positive impacts on production or household well-being during the three years of study we are not able to discern them here. We do not observe that farmers that received both intensive extension and transfers engaged in similar behavior, and this may be evidence of extension officers tailoring advice to the situation of each farmer. Ultimately, extension officers were more effective when farmers also had access to capital.

8. Conclusion

In this paper we study a program that implemented framed cash and input transfers, cross-randomized with intensive agricultural extension services, to study how farmers in our context respond to the alleviation of credit market constraints, input market inefficiencies, and information gaps. We find that framed transfers of both cash and inputs led to increases in farm related investments, particularly the increased use of *ganyu*, matched with increased adoption of more labor-intensive agricultural practices. These changes in investment and practices led to production and consumption gains. While the results are largest during the year of implementation, there is strong evidence of sustained impacts. These sustained benefits due to a one-season transfer are persuasive evidence that such transfers can be an important component of social protection strategies that are often focused on continued consumption support. Overall, we find limited differences due to the modality of the transfers, suggesting that credit constraints are binding in

[35] We also observe a reduction in overall land planted by those in the transfer only group, but it is significantly smaller than that for the intensive extension only group and is largely indicative of shifting from maize and tobacco to soy and groundnut production.

this context, but that inefficiencies in input markets are not. At the same time, providing inputs instead of cash does not appear to be overly distortionary.

Considering the separate and joint impacts of the program elements, we find that the impact of the intensive extension services, when received without the benefit of the transfers, result in worse outcomes for farmers, both in the first year and in the subsequent two years. Receiving the transfers alone is not harmful, but we do not document a consistent pattern of improvements in investment or household welfare. Ultimately, we find that it is those farmers who received both program elements who benefit, and we document changes in investment behavior and household well-being up to three years after the program began.

Our results suggest that both credit constraints and information gaps are real constraints for the farmers in our sample, and that one cannot be effectively addressed without consideration of the other. Further, the sustained impacts beyond the year of implementation are driven by farmers that continue to receive intensive extension support after the transfers have ended. Taken together, this set of results highlights the importance of multiple market failures and the extent to which addressing multiple constraints jointly is important both in the short and medium run. The results also contribute to our understanding of why the results in the literature that studies large cash transfers in agriculture are mixed: the extent to which information gaps exist vary across countries and sub-groups and as such transfers may generate different impacts when implemented as a stand-alone intervention. Our results are also specific to this context in other ways. Our sample is composed of farmers self-organized in groups related to cash cropping; results may differ in a program that targeted different or individual farmers. Variations in weather conditions also are important to acknowledge when interpreting the results, conditions during the first year were poor; while in the second year weather conditions were considered good.

There is a large existing literature examining government-run social protection programs in Malawi. The Malawi Social Cash Transfer, a consumption-oriented transfer given every two months to very poor households, had been shown to improve food security, consumption, health, and education (Miller, Tsoka, and Reichert 2011; Luseno et al. 2014; Handa et al. 2015; Handa et al. 2016), as well as moderate positive impacts on agricultural indicators (Covarrubias, Davis, and Winters 2012; Boone et al. 2013).[36] Conversely, the other large social protection initiative, the Public Works Program, has not been found to be successful in improving food security or fertilizer use (Beegle, Galasso, and Goldberg 2017). Our results suggest that both programs could be made more effective if paired with intensive extension support to reduce knowledge gaps. More generally, our results echo calls elsewhere in the literature for more evidence exploring complementarities between interventions in the agricultural sector.

[36] Pace et al. (2017) evaluate the combined impacts of the social cash transfer program and FISP and find that each program has incremental impacts on agricultural outcomes.

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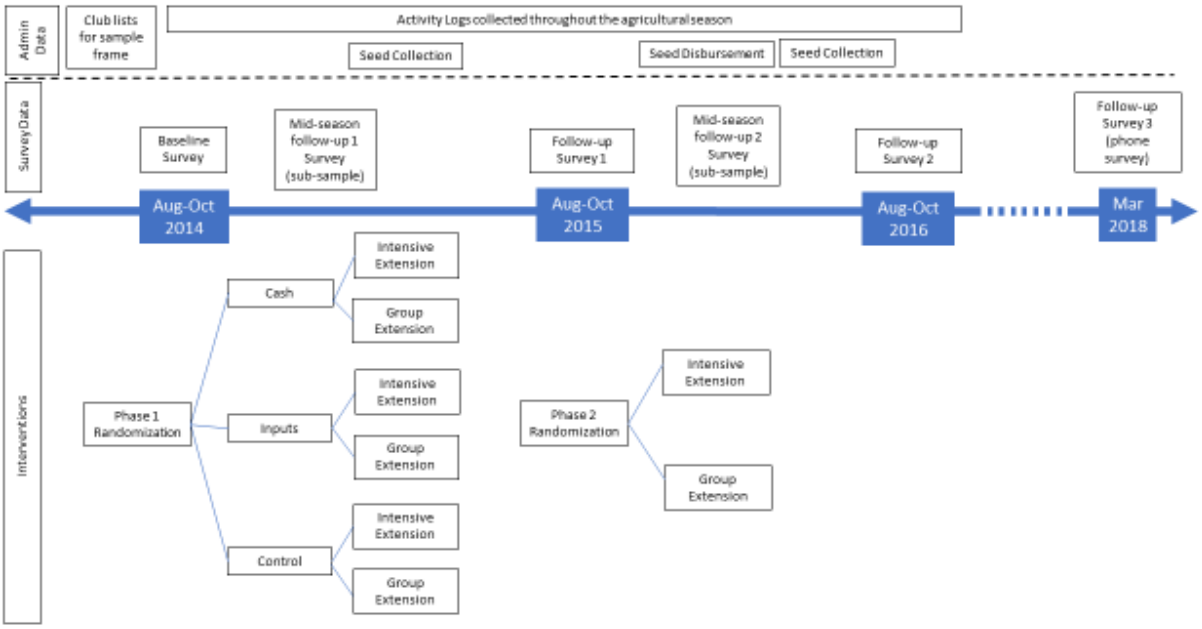
Figure 1. Timeline of Activities



Note. All surveys were conducted in person unless otherwise indicated.

Figure 2. Sample size determination

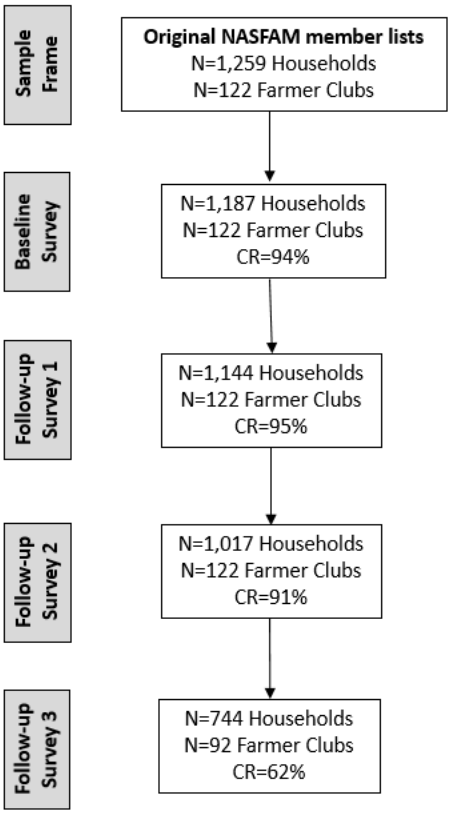


Figure 3: Self-reported use of transfers

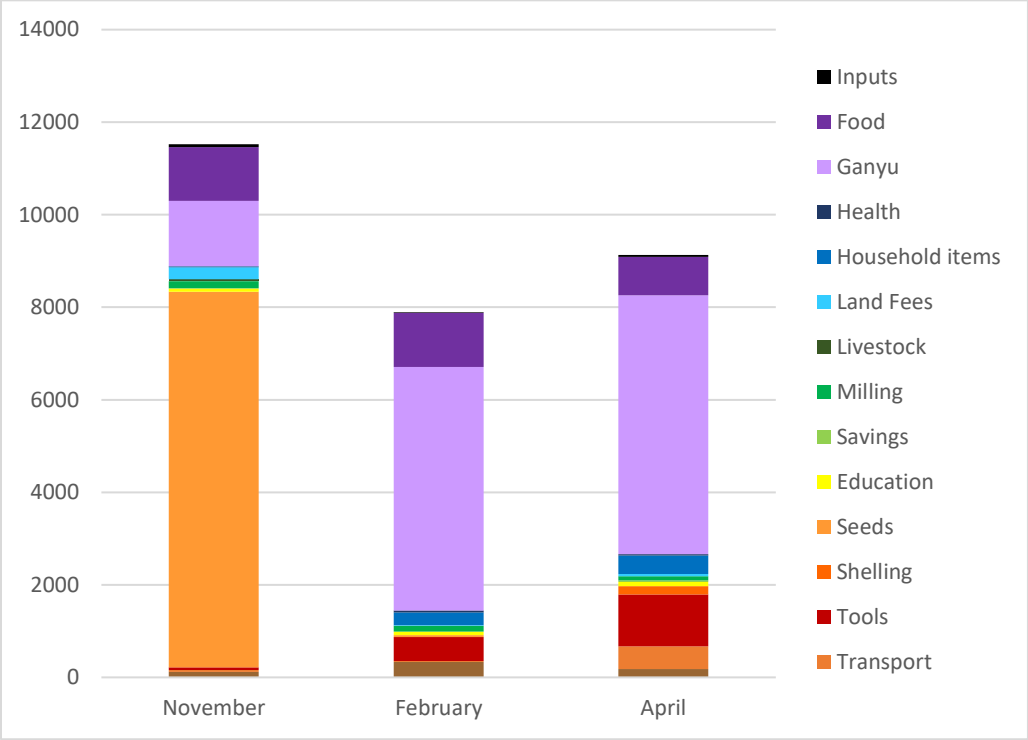


Table 1. Baseline summary statistics across survey samples

Panel A. Summary Statistics	Baseline	Follow-up	Follow-up	Follow-up
NASFAM Member Characteristics	Survey	Survey 1	Survey 2	Survey 3
Age	41.026	41.368	41.609	40.437
Is female	0.633	0.638	0.654	0.620
Is married	0.828	0.823	0.829	0.844
No education	0.170	0.181	0.182	0.160
Some primary	0.536	0.539	0.539	0.516
Completed primary	0.161	0.156	0.153	0.169
Some secondary	0.083	0.077	0.077	0.084
Completed secondary or higher	0.050	0.048	0.049	0.071
Household Head Characteristics				
Age	44.338	44.530	44.747	43.832
Is female	0.144	0.151	0.147	0.130
Household Characteristics				
Household size	5.546	5.526	5.620	5.684
Land Owned (Acres)	4.138	4.084	4.151	4.223
Agricultural Production and Agricultural Inve				
Number of crops	4.537	4.218	3.906	4.350
Value of soy and groundnut production	170.340	162.242	160.515	172.448
GVAO(USD)	600.123	594.289	593.107	662.634
GVAO(USD) p/acre	128.279	126.462	125.359	135.396
Value of agricultural assets (USD)	36.583	37.207	36.009	40.988
Input expenditures (USD)	147.190	144.400	139.871	168.800
Livestock				
Livestock units	0.759	0.709	0.657	0.796
Value of total livestock (USD)	196.434	202.106	209.115	225.362
Panel B. Attrition		Testing for differential attrition		
Year 1 Interventions				
Intensive vs Lead Farmer		0.386	0.557	0.393
Cash vs Control		0.021	0.014	0.042
Cash vs Input		0.948	0.150	0.058
Input vs Control		0.057	0.303	0.914
Year 2 Interventions				
Intensive vs Lead Farmer		0.813	0.076	0.460

Notes: All monetary amounts are expressed in USD.

Table 2. Short term transfer treatment impacts

Panel A. Impacts on farm investments and agricultural practices

Dependent variable:	Total value of agricultural assets	Total input expenditures	Ganyu expenditures (focal crops)	Ganyu expenditures (non-focal crops)	Agricultural practices index (used)	Labor intensive agricultural practices (used)	Capital intensive agricultural practices (used)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cash	0.247	0.700	4.339	1.201	0.403	0.373	0.024
	(0.083)	(0.126)	(0.333)	(0.404)	(0.152)	(0.098)	(0.067)
Inputs	0.282	0.450	3.850	1.271	0.172	0.205	-0.034
	(0.074)	(0.124)	(0.335)	(0.443)	(0.133)	(0.088)	(0.070)
Observations	1,143	1,144	1,144	1,142	1,143	1,138	1,135
R-squared	0.302	0.280	0.260	0.113	0.135	0.142	0.116
Control mean	44.133	119.846	15.373	13.522	3.694	1.557	1.586
P-value: Cash = Inputs	0.683	0.037	0.142	0.867	0.103	0.072	0.389

Panel B. Impacts on farm production, revenue and consumption

Dependent variable:	Total value of focal crops	GVAO	Net Revenue	Consumption	Consumption p/capita
	(1)	(2)	(3)	(4)	(5)
Cash	0.797	0.221	0.013	0.118	0.111
	(0.135)	(0.085)	(0.265)	(0.049)	(0.051)
Inputs	0.527	0.083	-0.425	0.125	0.088
	(0.151)	(0.087)	(0.311)	(0.050)	(0.048)
Observations	1,138	1,144	1,144	1,144	1,144
R-squared	0.233	0.370	0.098	0.189	0.233
Control mean	222.949	679.679	559.833	1,933.790	389.595
p-value: Cash = Inputs	0.036	0.084	0.131	0.903	0.673

Notes: Robust standard errors in parentheses are clustered by farmer club. All regressions include the baseline value of outcome when available, stratification cell fixed effects and controls for the orthogonal treatment conducted in year 2. All monetary amounts are in USD. All continuous outcomes have been transformed using the inverse hyperbolic sine transformation (IHST).

Table 3. Medium term transfer treatment impacts on farm investments

Panel A. Follow-up Survey 2

Dependent variable:	Total value of agricultural assets	Total input expenditures	Ganyu expenditures (focal crops)	Ganyu expenditures (non-focal crops)	Agricultural practices index (used)	Labor intensive agricultural practices (used)	Capital intensive agricultural practices (used)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cash	0.201	0.454	2.329	1.006	0.365	0.317	-0.002
	(0.091)	(0.102)	(0.343)	(0.387)	(0.136)	(0.091)	(0.074)
Inputs	0.250	0.219	1.858	1.488	0.167	0.207	-0.106
	(0.090)	(0.136)	(0.374)	(0.385)	(0.161)	(0.100)	(0.078)
Observations	1,017	1,017	1,017	1,017	1,017	1,017	1,017
R-squared	0.240	0.291	0.188	0.110	0.141	0.140	0.115
Control mean	30.104	113.772	4.985	9.835	4.081	1.531	1.788
p-value: Cash = Inputs	0.548	0.077	0.136	0.217	0.151	0.202	0.143

Panel B. Follow-up Survey 3

Dependent variable:	Total input expenditures	Ganyu expenditures (focal crops)	Ganyu expenditures (non-focal crops)	Agricultural practices index (used)	Labor intensive agricultural practices (used)	Capital intensive agricultural practices (used)
	(2)	(3)	(4)	(5)	(6)	(7)
Cash	1.437	1.573	1.880	0.353	0.186	0.089
	(0.397)	(0.530)	(0.453)	(0.251)	(0.143)	(0.109)
Inputs	0.960	0.470	1.125	-0.091	0.017	-0.231
	(0.390)	(0.533)	(0.467)	(0.287)	(0.144)	(0.119)
Observations	744	744	744	737	737	737
R-squared	0.269	0.156	0.187	0.194	0.191	0.151
Control mean	120.076	9.869	19.370	4.902	2.156	1.862
P-value: Cash = Inputs	0.163	0.029	0.125	0.134	0.265	0.011

Notes: Robust standard errors in parentheses are clustered by farmer club. All regressions include the baseline value of outcome when available, stratification cell fixed effects and controls for the orthogonal treatment conducted in year 2. All monetary amounts are in USD. All continuous outcomes have been transformed using the inverse hyperbolic sine transformation (IHST).

Table 4. Medium term transfer treatment impacts on production, and consumption

Panel A. Follow-up Survey 2

Dependent variable:	Total value of focal crops	GVAO	Net Revenue	Consumption	Consumption p/capita
	(1)	(2)	(3)	(4)	(5)
Cash	0.773	0.225	0.119	0.058	0.075
	(0.136)	(0.060)	(0.094)	(0.040)	(0.050)
Inputs	0.671	0.141	0.034	0.110	0.095
	(0.136)	(0.062)	(0.103)	(0.046)	(0.051)
Observations	1,016	1,017	1,017	1,017	1,017
R-squared	0.197	0.309	0.116	0.177	0.174
Control mean	246.390	746.390	632.618	1,777.309	346.045
p-value: Cash = Inputs	0.391	0.160	0.337	0.234	0.695

Panel B. Follow-up Survey 3

Dependent variable:	Total value of focal crops	GVAO	Net Revenue	Consumption
	(1)	(2)	(3)	(4)
Cash	0.077	0.151	0.001	0.212
	(0.167)	(0.107)	(0.305)	(0.095)
Inputs	0.197	0.059	0.277	0.246
	(0.157)	(0.125)	(0.321)	(0.084)
Observations	738	738	738	738
R-squared	0.188	0.245	0.085	0.228
Control mean	159.240	436.131	313.921	9,473.103
P-value: Cash = Inputs	0.514	0.467	0.383	0.704

Notes: Robust standard errors in parentheses are clustered by farmer club. All regressions include the baseline value of outcome when available, stratification cell fixed effects and controls for the orthogonal treatment conducted in year 2. All monetary amounts are in USD. All continuous outcomes have been transformed using the inverse hyperbolic sine transformation (IHST).

Table 5. Transfer and extension treatment impacts in the short run

Panel A. Impacts on farm investments and agricultural practices

Dependent variable:	Total value of agricultural assets	Total input expenditures	Ganyu expenditures (focal crops)	Ganyu expenditures (non-focal crops)	Agricultural practices index (used)	Labor intensive agricultural practices (used)	Capital intensive agricultural practices (used)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intensive extension only	-0.290	-0.793	-1.019	-0.078	-0.173	-0.158	0.045
	(0.130)	(0.280)	(0.543)	(0.696)	(0.266)	(0.181)	(0.121)
Received transfer only	0.008	0.033	3.096	0.402	0.131	0.075	0.098
	(0.115)	(0.171)	(0.434)	(0.504)	(0.224)	(0.128)	(0.100)
Both	0.270	0.466	4.222	1.898	0.304	0.364	-0.057
	(0.087)	(0.115)	(0.378)	(0.376)	(0.134)	(0.084)	(0.078)
Observations	1,143	1,144	1,144	1,142	1,143	1,138	1,135
R-squared	0.306	0.287	0.264	0.122	0.134	0.145	0.118
Control mean	33.365	102.499	10.475	13.308	3.580	1.384	1.628
P-value: Ext Only = Tfer Only	0.004	0.000	0.000	0.473	0.175	0.140	0.562
P-value: Independent = Both	0.008	0.001	0.004	0.083	0.378	0.069	0.246

Panel B. Impacts on farm production, revenue and consumption

Dependent variable:	Total value of focal crops	GVAO	Net Revenue	Consumption	Consumption p/capita
	(1)	(2)	(3)	(4)	(5)
Intensive extension only	-0.222	-0.438	-1.186	-0.138	-0.075
	(0.235)	(0.149)	(0.475)	(0.080)	(0.081)
Received transfer only	0.537	-0.066	-0.608	-0.015	0.003
	(0.185)	(0.102)	(0.477)	(0.075)	(0.073)
Both	0.617	0.021	-0.721	0.137	0.129
	(0.192)	(0.101)	(0.353)	(0.046)	(0.049)
Observations	1,138	1,144	1,144	1,144	1,144
R-squared	0.230	0.374	0.101	0.194	0.236
Control mean	160.845	561.801	459.302	1,788.904	376.418
P-value: Ext Only = Tfer Only	0.000	0.002	0.040	0.072	0.255
P-value: Independent = Both	0.344	0.007	0.178	0.020	0.102

Notes: Robust standard errors in parentheses are clustered by farmer club. All regressions include the baseline value of outcome when available, stratification cell fixed effects and controls for the orthogonal treatment conducted in year 2. All monetary amounts are in USD. All continuous outcomes have been transformed using the inverse hyperbolic sine transformation (IHST).

Table 6. Medium term transfer and extension treatment impacts on farm investments

Panel A. Follow-up Survey 2

Dependent variable:	Total value of agricultural assets	Total input expenditures	Ganyu expenditures (focal crops)	Ganyu expenditures (non-focal crops)	Agricultural practices index (used)	Labor intensive agricultural practices (used)	Capital intensive agricultural practices (used)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intensive extension only	-0.324	-0.430	-0.387	-1.188	-0.464	-0.383	-0.073
	(0.158)	(0.219)	(0.595)	(0.601)	(0.266)	(0.160)	(0.135)
Received transfer only	0.035	0.050	1.508	0.308	0.037	0.011	-0.059
	(0.118)	(0.191)	(0.541)	(0.512)	(0.253)	(0.153)	(0.127)
Both	0.142	0.274	2.330	1.127	0.125	0.195	-0.098
	(0.095)	(0.105)	(0.453)	(0.384)	(0.186)	(0.122)	(0.092)
Observations	1,017	1,017	1,017	1,017	1,017	1,017	1,017
R-squared	0.243	0.292	0.189	0.113	0.141	0.145	0.114
Control mean	31.470	111.886	4.579	10.437	4.254	1.665	1.832
P-value: Ext Only = Tfer Only	0.006	0.005	0.000	0.008	0.001	0.000	0.878
P-value: Independent = Both	0.049	0.052	0.152	0.012	0.172	0.018	0.867

Panel B. Follow-up Survey 3

Dependent variable:	Total input expenditures	Ganyu expenditures (focal crops)	Ganyu expenditures (non-focal crops)	Agricultural practices index (used)	Labor intensive agricultural practices (used)	Capital intensive agricultural practices (used)
	(2)	(3)	(4)	(5)	(6)	(7)
Intensive extension only	-1.429	-0.850	-1.866	0.027	-0.075	0.059
	(0.660)	(0.873)	(0.677)	(0.526)	(0.291)	(0.231)
Received transfer only	0.035	-0.667	-0.585	0.222	0.052	0.088
	(0.555)	(0.728)	(0.644)	(0.320)	(0.183)	(0.146)
Both	1.145	1.911	1.938	0.089	0.094	-0.155
	(0.451)	(0.598)	(0.511)	(0.287)	(0.150)	(0.130)
Observations	744	744	744	737	737	737
R-squared	0.276	0.174	0.205	0.190	0.189	0.144
Control mean	112.276	7.991	18.810	4.957	2.203	1.855
P-value: Ext Only = Tfer Only	0.005	0.780	0.012	0.650	0.591	0.868
P-value: Independent = Both	0.005	0.007	0.000	0.824	0.761	0.331

Notes: Robust standard errors in parentheses are clustered by farmer club. All regressions include the baseline value of outcome when available, stratification cell fixed effects and controls for the orthogonal treatment conducted in year 2. All monetary amounts are in USD. All continuous outcomes have been transformed using the inverse hyperbolic sine transformation (IHST).

Table 7. Medium term transfer and extension treatment impacts

Panel A. Follow-up Survey 2

Dependent variable:	Total value of focal crops	GVAO	Net Revenue	Consumption	Consumption p/capita
	(1)	(2)	(3)	(4)	(5)
Intensive extension only	0.134	-0.238	-0.461	-0.056	-0.095
	(0.246)	(0.103)	(0.151)	(0.076)	(0.082)
Received transfer only	0.792	-0.002	-0.226	-0.009	0.009
	(0.180)	(0.091)	(0.153)	(0.058)	(0.068)
Both	0.770	0.167	-0.005	0.117	0.077
	(0.138)	(0.076)	(0.130)	(0.047)	(0.055)
Observations	1,016	1,017	1,017	1,017	1,017
R-squared	0.196	0.313	0.121	0.180	0.175
Control mean	228.813	736.909	625.023	1,743.168	359.283
P-value: Ext Only = Tfer Only	0.002	0.001	0.010	0.410	0.105
P-value: Independent = Both	0.610	0.005	0.002	0.070	0.144

Panel B. Follow-up Survey 3

Dependent variable:	Total value of focal crops	GVAO	Net Revenue	Consumption
	(1)	(2)	(3)	(4)
Intensive extension only	-0.328	-0.323	-0.283	-0.320
	(0.242)	(0.161)	(0.620)	(0.142)
Received transfer only	-0.121	-0.190	0.353	0.017
	(0.214)	(0.137)	(0.367)	(0.108)
Both	0.106	0.119	-0.286	0.166
	(0.163)	(0.112)	(0.371)	(0.094)
Observations	738	738	738	738
R-squared	0.189	0.252	0.087	0.231
Control mean	140.662	400.874	286.970	8,902.453
P-value: Ext Only = Tfer Only	0.353	0.423	0.170	0.010
P-value: Independent = Both	0.110	0.008	0.646	0.013

Notes: Robust standard errors in parentheses are clustered by farmer club. All regressions include the baseline value of outcome when available, stratification cell fixed effects and controls for the orthogonal treatment conducted in year 2. All monetary amounts are in USD. All continuous outcomes have been transformed using the inverse hyperbolic sine transformation (IHST).

Table 8. Medium term transfer and extension treatment impacts on farm investments
(Sample: No intensive extension in year 2)

Panel A. Impacts on farm investments and agricultural practices

Dependent variable:	Total value of agricultural assets	Total input expenditures	Ganyu expenditures (focal crops)	Ganyu expenditures (non-focal crops)	Agricultural practices index (used)	Labor intensive agricultural practices (used)	Capital intensive agricultural practices (used)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intensive extension only	-0.731	-1.330	-2.455	-3.203	-0.056	-0.354	0.205
	(0.339)	(0.494)	(1.200)	(1.276)	(0.502)	(0.368)	(0.241)
Received transfer only	0.004	-0.447	-0.258	-1.217	0.303	0.122	0.115
	(0.275)	(0.465)	(1.160)	(1.100)	(0.470)	(0.342)	(0.209)
Both	-0.026	-0.360	1.121	-1.133	0.088	0.338	-0.236
	(0.178)	(0.280)	(1.133)	(0.803)	(0.387)	(0.286)	(0.175)
Observations	492	492	492	492	492	492	492
R-squared	0.339	0.333	0.201	0.148	0.158	0.190	0.135
Control mean	23.541	121.784	5.060	14.486	3.932	1.438	1.699
P-value: Ext Only = Tfer Only	0.001	0.000	0.000	0.006	0.105	0.004	0.553
P-value: Independent = Both	0.159	0.061	0.024	0.079	0.812	0.232	0.116

Panel B. Impacts on farm production, revenue and consumption

Dependent variable:	Total value of focal crops	GVAO	Net Revenue	Consumption	Consumption p/capita
	(1)	(2)	(3)	(4)	(5)
Intensive extension only	-0.517	-0.440	-0.743	-0.144	-0.324
	(0.392)	(0.153)	(0.247)	(0.192)	(0.218)
Received transfer only	0.468	-0.093	-0.373	-0.055	-0.157
	(0.240)	(0.125)	(0.229)	(0.164)	(0.195)
Both	0.357	-0.146	-0.627	0.033	-0.079
	(0.244)	(0.101)	(0.268)	(0.105)	(0.137)
Observations	492	492	492	492	492
R-squared	0.235	0.344	0.130	0.174	0.177
Control mean	223.132	777.827	656.043	1,739.355	354.975
Ext Only = Tfer Only	0.003	0.000	0.000	0.344	0.072
Independent = Both	0.362	0.082	0.129	0.398	0.205

Notes: Robust standard errors in parentheses are clustered by farmer club. All regressions include the baseline value of outcome when available, stratification cell fixed effects and controls for the orthogonal treatment conducted in year 2. All monetary amounts are in USD. All continuous outcomes have been transformed using the inverse hyperbolic sine transformation (IHST).

Table 9. Medium term transfer and extension treatment impacts
(Sample: Received intensive extension in year 2)

Panel A. Impacts on farm investments and agricultural practices

Dependent variable:	Total value of agricultural assets	Total input expenditures	Ganyu expenditures (focal crops)	Ganyu expenditures (non-focal crops)	Agricultural practices index (used)	Labor intensive agricultural practices (used)	Capital intensive agricultural practices (used)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intensive extension only	-0.279	-0.141	0.155	-0.425	-0.581	-0.489	-0.140
	(0.141)	(0.298)	(0.694)	(0.652)	(0.380)	(0.216)	(0.172)
Received transfer only	0.040	-0.055	3.154	2.593	-0.084	-0.122	-0.109
	(0.145)	(0.226)	(0.752)	(0.673)	(0.335)	(0.224)	(0.177)
Both	0.135	0.314	3.468	2.392	0.166	0.183	-0.075
	(0.115)	(0.134)	(0.556)	(0.511)	(0.222)	(0.168)	(0.100)
Observations	525	525	525	525	525	525	525
R-squared	0.214	0.314	0.241	0.175	0.186	0.148	0.174
Control mean	36.137	106.059	4.296	8.053	4.444	1.798	1.911
P-value: Ext Only = Tfer Only	0.006	0.773	0.000	0.000	0.077	0.012	0.825
P-value: Independent = Both	0.069	0.233	0.888	0.783	0.161	0.025	0.554

Panel B. Impacts on farm production, revenue and consumption

Dependent variable:	Total value of focal crops	GVAO	Net Revenue	Consumption	Consumption p/capita
	(1)	(2)	(3)	(4)	(5)
Intensive extension only	0.122	-0.413	-0.496	-0.090	-0.027
	(0.298)	(0.113)	(0.119)	(0.099)	(0.098)
Received transfer only	0.940	-0.125	-0.099	0.098	0.175
	(0.279)	(0.140)	(0.152)	(0.090)	(0.096)
Both	1.180	0.269	0.228	0.196	0.171
	(0.220)	(0.091)	(0.115)	(0.078)	(0.075)
Observations	524	525	525	525	525
R-squared	0.235	0.332	0.255	0.228	0.226
Control mean	232.158	712.819	606.760	1,745.413	361.819
Ext Only = Tfer Only	0.006	0.033	0.002	0.011	0.059
Independent = Both	0.756	0.000	0.000	0.163	0.867

Notes: Robust standard errors in parentheses are clustered by farmer club. All regressions include the baseline value of outcome when available, stratification cell fixed effects and controls for the orthogonal treatment conducted in year 2. All monetary amounts are in USD. All continuous outcomes have been transformed using the inverse hyperbolic sine transformation (IHST).

Table 10. Impacts on crop specific knowledge and activities, and general farm planning

Panel A. Follow-up Survey 1

Dependent variable:	Agricultural practices knowledge	Groundnut knowledge	Groundnut action	Soy knowledge	Soy action	Developed FMP	FMP number topics	Followed FMP
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intensive extension only	-0.296	0.183	0.083	0.128	0.209	0.179	0.550	0.124
	(0.208)	(0.104)	(0.111)	(0.122)	(0.126)	(0.074)	(0.330)	(0.064)
Received transfer only	-0.312	0.125	0.121	0.177	0.199	0.066	-0.121	0.020
	(0.162)	(0.070)	(0.076)	(0.096)	(0.101)	(0.061)	(0.293)	(0.061)
Both	0.060	0.004	-0.003	0.245	0.267	0.190	0.897	0.160
	(0.146)	(0.068)	(0.073)	(0.074)	(0.082)	(0.051)	(0.266)	(0.048)
Observations	1,144	1,144	941	1,144	844	1,144	1,144	1,144
R-squared	0.103	0.102	0.080	0.085	0.105	0.089	0.092	0.090
Control mean	9.540	1.407	1.456	0.872	0.964	0.235	0.894	0.212
P-value: Ext Only = Tfer Only	0.922	0.504	0.664	0.584	0.909	0.060	0.006	0.017
P-value: Independent = Both	0.019	0.021	0.161	0.734	0.440	0.587	0.321	0.864

Panel B. Follow-up Survey 2

Dependent variable:	Agricultural practices knowledge	Groundnut knowledge	Groundnut action	Soy knowledge	Soy action	Developed FMP	FMP number topics	Followed FMP
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intensive extension only	-0.011	0.143	0.136	-0.166	-0.068	0.232	0.810	0.006
	(0.158)	(0.144)	(0.148)	(0.112)	(0.126)	(0.084)	(0.442)	(0.064)
Received transfer only	0.193	0.175	0.176	-0.112	-0.008	0.106	0.324	0.076
	(0.103)	(0.106)	(0.105)	(0.094)	(0.101)	(0.069)	(0.360)	(0.049)
Both	0.114	0.090	0.110	0.168	0.168	0.241	1.474	0.154
	(0.098)	(0.105)	(0.116)	(0.081)	(0.085)	(0.059)	(0.306)	(0.047)
Observations	1,017	1,017	819	1,017	797	1,017	1,017	1017
R-squared	0.165	0.188	0.179	0.130	0.144	0.108	0.109	0.202
Control mean	10.152	1.970	1.904	1.081	1.033	0.472	1.310	0.289
P-value: Ext Only = Tfer Only	0.118	0.795	0.773	0.501	0.573	0.068	0.128	0.109
P-value: Independent = Both	0.732	0.222	0.245	0.004	0.156	0.381	0.569	0.418

Notes: Robust standard errors in parentheses are clustered by farmer club. All regressions include the baseline value of outcome when available, stratification cell fixed effects and controls for the orthogonal treatment conducted in year 2. All monetary amounts are in USD. All continuous outcomes have been transformed using the inverse hyperbolic sine transformation (IHST).

Table 11. Transfer and extension treatment impacts in the short and medium run

Panel A. Impacts on changes to land allocation decisions in the short run

Dependent variable:	Land planted	Maize land	Soy and Groundnuts land	Tobacco land
	(1)	(2)	(3)	(4)
Intensive extension only	-1.033	-0.198	-0.229	-0.107
	(0.241)	(0.107)	(0.110)	(0.077)
Received transfer only	-0.578	-0.170	0.168	-0.154
	(0.220)	(0.090)	(0.084)	(0.068)
Both	-0.223	-0.086	0.237	-0.094
	(0.197)	(0.067)	(0.077)	(0.062)
Observations	1,140	1,144	1,144	1,143
R-squared	0.304	0.332	0.260	0.339
Control mean	4.613	1.840	1.385	0.526
P-value: Ext Only = Tfer Only	0.007	0.729	0.000	0.384
P-value: Independent = Both	0.000	0.064	0.047	0.104

Panel B. Impacts on land allocation in the medium run

Dependent variable:	Total land planted	Maize land	Soy and Groudnuts land	Tobacco land
	(1)	(2)	(3)	(4)
Intensive extension only	-1.265	-0.290	-0.258	-0.028
	(0.421)	(0.092)	(0.148)	(0.079)
Received transfer only	-0.407	-0.202	0.175	-0.064
	(0.330)	(0.079)	(0.107)	(0.056)
Both	-0.230	0.050	0.230	-0.006
	(0.287)	(0.063)	(0.092)	(0.050)
Observations	1,016	1,017	1,016	1,017
R-squared	0.214	0.270	0.213	0.353
Control mean	6.315	1.821	1.596	0.530
P-value: Ext Only = Tfer Only	0.019	0.168	0.000	0.598
P-value: Independent = Both	0.012	0.000	0.107	0.398

Notes: Robust standard errors in parentheses are clustered by farmer club. All regressions include the baseline value of outcome when available, stratification cell fixed effects and controls for the orthogonal treatment conducted in year 2. All monetary amounts are in USD. All continuous outcomes have been transformed using the inverse hyperbolic sine transformation (IHST).

Appendix Table 1: NASFAM member and household characteristics and balance

	Full Sample	NASFAM standard extension	Intensive extension	p-value: (2) = (3)	Control	Cash	Inputs	p-value for test: (5) = (6) = (7)
NASFAM Member Characteristics	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age	41.026	41.000	41.050	0.819	40.646	40.942	41.510	0.634
Is female	0.633	0.663	0.605	0.131	0.639	0.660	0.597	0.225
Is married	0.828	0.848	0.811	0.025	0.820	0.829	0.836	0.767
No education	0.170	0.165	0.175	0.942	0.149	0.156	0.206	0.028
Some primary	0.536	0.550	0.524	0.579	0.517	0.549	0.543	0.666
Completed primary	0.161	0.156	0.165	0.804	0.187	0.151	0.144	0.362
Some secondary	0.083	0.078	0.088	0.566	0.097	0.088	0.063	0.228
Completed secondary or higher	0.050	0.051	0.049	0.820	0.050	0.055	0.044	0.870
Household Head Characteristics								
Age	44.34	44.21	44.45	1.00	44.06	44.25	44.71	0.50
Is female	0.14	0.14	0.15	0.49	0.15	0.14	0.15	0.83
Household Characteristics								
Household size	5.55	5.75	5.36	0.00	5.45	5.65	5.55	0.45
Land owned (Acres)	4.14	4.16	4.11	0.54	4.08	4.26	4.07	0.19
Agricultural Production and Agricultural Investments								
Number of crops	4.54	4.54	4.53	0.51	4.52	4.68	4.41	0.19
Value of soy and groundnut production (	170.34	169.69	170.93	0.97	156.57	181.91	172.74	0.52
GVAO (USD)	600.12	538.16	656.60	0.14	550.71	597.02	654.95	0.45
GVAO (USD) p/acre	128.28	113.93	141.38	0.06	119.88	128.11	137.22	0.45
Value of agricultural assets (USD)	36.58	32.17	40.61	0.45	29.94	44.12	35.68	0.24
Input expenditures (USD)	147.19	131.55	161.39	0.13	147.50	151.46	142.44	0.93
Livestock								
Livestock units	0.76	0.67	0.84	0.26	0.72	0.89	0.66	0.22
	196.43	162.70	227.18	0.33	162.14	281.34	144.03	0.24
Attrition (relative to baseline)								
Followup survey 1	0.10	0.10	0.10	0.39	0.12	0.09	0.07	0.06
Followup survey 2	0.19	0.20	0.18	0.56	0.23	0.17	0.17	0.04
Followup survey 3	0.41	0.40	0.41	0.39	0.45	0.37	0.40	0.07

Notes: All values are from the baseline survey conducted in 2014. Sample is the 1,187 households interviewed at baseline. All monetary amounts expressed in USD.

Appendix Table 1: NASFAM member and household characteristics and balance (continued)

	No intensive extension	One year intensive (in Year 1)	One year intensive (in Year 2)	Two years intensive extension	p-value for test: (9) = (10) = (11) = (12)
NASFAM Member Characteristics	(9)	(10)	(11)	(12)	(13)
Age	41.576	41.033	40.502	40.969	0.567
Is female	0.538	0.659	0.677	0.666	0.085
Is married	0.832	0.852	0.788	0.844	0.033
No education	0.175	0.159	0.175	0.169	0.816
Some primary	0.535	0.556	0.512	0.546	0.758
Completed primary	0.166	0.152	0.165	0.159	0.995
Some secondary	0.070	0.067	0.106	0.088	0.291
Completed secondary or higher	0.054	0.067	0.043	0.037	0.141
Household Head Characteristics					
Age	44.430	44.245	44.479	44.180	0.978
Is female	0.139	0.133	0.158	0.146	0.602
Household Characteristics					
Household size	5.381	5.815	5.340	5.689	0.001
Land owned (Acres)	4.322	4.086	3.895	4.237	0.650
Agricultural Production and Agricultural Investments					
Number of crops	4.478	4.463	4.591	4.611	0.538
Value of soy and groundnut production (	180.665	182.953	160.683	157.687	0.730
GVAO (USD)	647.205	561.356	666.451	517.006	0.513
GVAO (USD) p/acre	132.571	112.899	150.535	114.862	0.188
Value of agricultural assets (USD)	42.885	30.501	38.218	33.695	0.317
Input expenditures (USD)	183.671	123.029	137.857	139.366	0.023
Livestock					
Livestock units	0.902	0.753	0.774	0.593	0.254
Value of total livestock (USD)	286.034	201.441	165.417	127.356	0.241
Attrition (relative to baseline)					
Followup survey 1					
Followup survey 2	0.214	0.196	0.145	0.203	0.265
Followup survey 3	0.434	0.389	0.386	0.409	0.401

Notes: All values are from the baseline survey conducted in 2014. Sample is the 1,187 households interviewed at baseline. All monetary amounts expressed in USD.