Social Ties and the Delivery of Development Programs*

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Abstract

In village economies, dense social networks support cooperation and exchange between citizens. The global shift towards hiring agents from *within* communities to deliver programs implies that the networks these agents are embedded in may affect delivery. We examine this using a randomized evaluation of an agricultural extension program in Uganda where we randomly pick one of two potential local delivery agents and map ties between delivery agents and farmers, between delivery agents and between farmers. Consistent with a model of favor exchange in social networks we find that (i) farmers tied to the chosen delivery agent are more likely to be treated than those tied to the counterfactual agent, (ii) this preferential treatment disappears when the two potential agents are tied by friendship, family or politics and (iii) when this is not the case the delivery agent actively prevents program benefits from diffusing to the ties of of the counterfactual agent. These results reveal the deep influence that social networks have on program delivery and help us to understand the highly unequal pattern of effects of the program both *within* and *across* villages.

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1 Introduction

Consider a set of villages in a poor economy. An organization wishes to implement a program to reduce poverty in these villages. Up to the 1990s the standard approach would be to recruit agents centrally and send them to the villages to deliver the program. Since the 1990s there has been a dramatic shift towards the localization of delivery (World Bank (2004); Casey (2018)). The World Bank, for example, spent $85 billion on participatory development programs between 2003 and 2015, which was a radical departure from expenditures in the prior two decades (Mansuri and Rao (2012)). Governments and NGOs across the world now use local community workers to deliver a whole range of services ranging from agricultural extension to health (World Bank (2004); Mansuri and Rao (2012)).

A key tenet of the localised model is that local delivery agents recruited from *within* the community are better placed to identify and serve beneficiaries due to the informational and motivational advantages. The idea that social ties can be exploited to improve the delivery of development programs has been at the heart of the recent literature on social networks in developing countries (Beaman et al. (2015); BenYishay and Mobarak (forthcoming)). [1]

Running against these positives is the concern that heterogeneity of local agents and beneficiaries raises issues of scalability and comparability, that is, the model might be less robust to variation in local conditions. This adds to the worry that those unconnected to or disliked by the local delivery agent may be excluded (either directly though delivery or indirectly via diffusion). Local agents may attempt to pile program benefits on less deserving, richer ties who are better able to reciprocate favors (Bardhan and Mookherjee (2006); Mansuri and Rao (2012); Jackson et al. (2012); Alatas et al. (2013); Xu (2018); Deserranno et al. (2017); Basurto et al. (2017)).

To examine the link between social networks and program delivery we employ a field experiment evaluating an agricultural extension program in Uganda. As is often the case with localized delivery there is only a handful of candidates capable of delivering the program.[2] In each village we randomly picked one of two potential local delivery

[1] Here being connected or having more ties is seen as a positive particularly where programs have a public good element such as is the case for agricultural extension. In these situations having a better connected agent might not only improve delivery but also enhance diffusion of better practices to a wider set of citizens that are not directly treated.

[2] In our setting there was, on average, two women farmers in each village that met the criteria

agents and map ties between delivery agents and farmers, between delivery agents and between farmers.

Randomization is powerful here as it creates a set of farmers linked to the chosen delivery agent and another set linked to the counterfactual delivery agent which are *ex ante* observationally equivalent. We can then run the experiment forward and check whether these two sets of ties are treated symmetrically as would be expected if an impartial outside bureaucrat was implementing the program on behalf of the development organization.

Our results clearly reject this no bias null. Farmers connected to the delivery agent are significantly more likely to be trained and receive seeds than those connected to the counterfactual agent. In effect, equally deserving beneficiaries do not have the same probability of receiving agricultural extension services which we establish carry significant benefits in terms of agricultural output and household consumption. This is evidence that social ties within the village affect program delivery.

A key feature of our setting is that both the delivery agent and counterfactual agent reside in the same village. Besides allowing for causal identification, knowing the identity of the counterfactual agent allows us to provide evidence on whether program delivery hinges on ties between the two potential agents. To do this, we exploit our measurement of the relationship between the two potential agents. Agents are tied either by being friends or family, supporting the same political party or by being of the same religion. We find that the chosen delivery agent favors her ties relative to those of the counterfactual agent when she is rival. When agents are tied by friendship/family, politics or religion then the benefits of the program are spread evenly over ties of the delivery and counterfactual agents.

Our bias results are consistent with a literature that emphasizes the value of social networks in supporting cooperation and favor exchange in village economies (Srinivas (1976), Jackson et al. (2012)). Agents will favor farmers to whom they are directly or indirectly tied to because they are more likely to return the favor of being granted the program.[3] Even where citizens are not directly tied to the delivery agent favor exchanges can be supported and enforced by the tie between the two agents. In contrast, agents

stipulated by the organization (BRAC) for being local delivery agents.

[3]Our results are inconsistent with a model where a bias towards ties is the result of match specific factors which make treating ties easier or less costly (Beaman et al. (2015); BenYishay and Mobarak (forthcoming)) as in this case ties between the delivery agent and counterfactual agent should not matter for whether the delivery agent favors her ties.

will actively want to avoid giving the program to farmers tied to rival agents as they are unlikely to reciprocate. This intuition help us to understand why the pattern of delivery is so strikingly different in villages where agents are rival compared to where they are non-rival.

Agricultural extension relies on a diffusion model where farmers beyond those directly treated may benefit from the program by learning about new techniques and seeds from treated farmers. It is total adoption of techniques and seeds by poor farmers that the development organization ultimately cares about as this will determine how much poverty reduction is achieved by the program. If the agent has non-negative preferences over farmers and diffusion is passive as is assumed in most network models then diffusion will increase with the number of farmers treated. If, in contrast, delivery agents behave strategically and have negative preferences over farmers who are unlikely to reciprocate favors then things will go in the opposite direction.

To test for strategic diffusion we exploit our measure of ties between farmers to construct a measure of diffusion potential based on the share of farmers who report discussing agriculture with other farmers in a village at baseline. We find that where the delivery agent and counterfactual agent report supporting different parties the probability of being trained by the delivery agents *falls* with rising diffusion potential whereas it *rises* when the two agents support the same party. This is direct evidence that agents internalize diffusion potential and behave strategically to prevent diffusion when it benefits the ties of her rival and to encourage it when the two are non-rival.

Taken together this is evidence that social ties between agents, between farmers and between agents and farmers interact to shape program delivery and diffusion. The overall picture that emerges is one of agents acting strategically to focus program benefits on farmers that are likely to reciprocate the favor of receiving the program. This strategic behavior may lead to a dissonance with the objectives of the development organization which is to encourage poor farmers to engage in commercial agriculture as a means of reducing poverty in the treated villages.[4]

To look at this issue we begin by examining whether rich ties of delivery agents are favored over poor ties. Again the presence of a counterfactual agent (who her self has

[4]The bulk of the farmers in the villages we study, in common with the majority of villages in Sub-Saharan Africa, are engaged in subsistence agriculture and so adopting the techniques and seeds needed to grown commercial crops is seen as a first step towards increasing productivity and escaping poverty.

rich and poor ties) allows us to make this comparison in a precise fashion. We find, across a wide range of proxies – wealth, agricultural productivity, consumption and asset ownership – that rich ties are more likely to receive agricultural extension services than poor ties. This is evidence of the objectives of the delivery agent and development organization are misaligned. We also find that rivalry and strategic diffusion also drive a wedge between treatment and adoption. Diffusion and adoption rates are highest for villages in which agents are non-rival and where diffusion potential is high and lowest for villages where agents are rival and where diffusion potential is low.

Our paper thus helps bridge the diffusion and favoritism literatures. When delivery agents are non-rival we see results consistent with a diffusion model – there is no systematic bias and adoption is increasing in the number of connections between farmers. In contrast, when they are rival, agents pile favors on their ties and actively prevent ties to their rival from benefitting from the program. So it is the connections between the two farmers that determine whether the data is consistent with the diffusion view or the favoritism view. The key innovation of the paper is to identify both potential agents and the connections between them which, it turns out, is critical to understanding the pattern of service delivery we observe.

Rivalry between agents therefore leads to misalignment between the objectives of the agent and the organization – agents concentrate benefits on the few at the expense of the many. Whereas with non-rivalry we are closer to what might obtain in the case of an impartial (and hypothetical) outside bureaucrat implementing the program.

Our findings therefore help us to understand the highly unequal pattern of effects observed both *within* and *across* villages. Overall we find that the most productive and richest farmers benefit most from the program. But this masks considerable heterogeneity – in villages where the agents are non-rival and the diffusion potential is high then almost all villagers benefit from the program. In contrast when they are rival and diffusion potential is low benefits are concentrated amongst the most productive and richest farmers.

These results starkly highlight three things. The first is that the same program will have radically different impacts depending on the structure of social networks that the local agent is embedded in. The second is that pre-existing social divisions may lead to a dissonance between the objectives of the development agency and local agent. The third is that these divisions may exacerbate rather than reduce existing inequalities. The paper thus reveals the deep influence that social networks have on program delivery and diffusion that need to be taken into account in the design of programs that rely on local agents for delivery.

2 Framework

This section sets up a basic framework whose aim is to make precise the conditions under which social ties affect the delivery of development programs. The framework incorporates the two main roles of social ties highlighted by the literature—favoritism and diffusion—and provides a roadmap for the empirical analysis.

2.1 Set up

There are three sets of actors: the organization, potential delivery agents and potential beneficiaries. The organization chooses one agent out of the feasible set of potential agents to deliver a development program. This might entail distributing a fixed amount of a private good such; as cash, a discretionary amount of a public good such as information, or both.

Potential beneficiaries differ along three dimensions: the material returns they get from the program, ρ, wealth ω, and social ties τ. To simplify we assume that wealth only takes two values $\omega \in [0, 1]$ where $\omega = 0$ $(= 1)$ indicates poor (rich) individuals. Returns ρ can be high $(\rho = 1)$ or low $(\rho = 0)$. Finally, τ_i is a vector $1XN$ where N is the number of villagers and element j measures the ties between i and j, where $\tau_{ij} = 1$ if i and j are connected while $\tau_{ij} = 0$ if not.

We assume that even at their lowest, returns to the program are sufficiently high that all those who receive an offer of treatment accept it. The delivery agent chooses the beneficiaries, how to allocate between them and, if she has discretion over amounts, the total amount offered to maximise her utility.

2.2 The organization's first best

Treating beneficiary κ gives the organization benefit $\beta_\kappa = \beta(\omega_\kappa)$, that is benefits depend on the individual's wealth. Treating beneficiary κ costs $c + \varepsilon_\kappa$ where $c > 0$ represents the program cost and is common to all beneficiaries while ε_κ is an individual specific cost, with mean equal to zero and variance equal to one. ε_κ captures individual specific factors such as the beneficiary's taste for the program or anything else that determines how easily he can be treated. The objective function of the organization is to maximize benefits minus expected costs. Given that both benefits and costs are linear, individual κ is treated if and only if:

$$\beta(\omega_\kappa)\rho_\kappa - c \geq \varepsilon_\kappa \tag{1}$$

The probability that κ is treated is $p_\kappa = G(\beta(\omega_\kappa)\rho_\kappa - c)$ where $G(.)$ is the cumulative density of ε_κ. This is increasing in $\beta(\omega_\kappa)\rho_\kappa$. If the organization aims to treat the poor regardless of their returns then $\beta(\omega_\kappa = 0) = \frac{\beta}{\rho_\kappa} > c$ and $\beta(\omega_\kappa = 1) = 0$.[5] So, for any two individuals κ, κ', the probability that κ is treated is larger $p_\kappa > p_{\kappa'}$ if and only if $\omega_\kappa < \omega_{\kappa'}$.

2.3 Social ties and program delivery

We are interested in understanding the conditions under which social ties bias targeting away from the first best of the organization. There are two main classes of models that explain why this might happen. The first are diffusion models whereby information naturally flows between ties as a by-product of the tie itself rather than by a deliberate choice of the agent. One possible micro foundation is that the cost of transmitting information to a tie is close to zero because it occurs as part of an interaction that would take place anyway. These models typically predict that selecting the most central agent leads to faster diffusion. The allocation might still deviate from the organization's first best because two beneficiaries with the same wealth might be treated differently, that is $p_\kappa > p_{\kappa'}$ even if $\omega_\kappa = \omega_{\kappa'}$ and because the agent might treat wealthy individuals if she has ties with them.

The second class are favor exchange models whereby the agent strategically transmits information in exchange for future favors. In this case, ties help sustain the exchange in a repeated game so that it is easier to enforce the delivery of favors from ties. These models typically focus on direct bilateral ties and imply that favoritism benefits the agent and her ties at the expense of the organization.

[5]Note that this might create a schism between the objectives of the organization (to help the poorest and neediest) and the objective of a social planner that maximises aggregate production, as the latter will want to prioritize individuals with higher returns.

In the simplest model of either type, the agent's actions depend on her direct ties only. Formally define agent 1's benefit from treating κ as $\sigma_\kappa = \sigma(\omega_\kappa, \tau_{\kappa 1}.....\tau_{\kappa N})$, where $\tau_{\kappa i} = 1$ if κ and i are connected. In the simplest model $\frac{\partial \sigma_\kappa}{\partial \tau_{\kappa 1}} > 0$ and $\frac{\partial \sigma_\kappa}{\partial \tau_{\kappa i}} = 0$ for all $i = 2..N$. This might be due to lower cost of treating ties or favor exchange. In either case, social ties generate a misalignment of interests if $\beta_\kappa \neq \sigma_\kappa$ for at least one κ. We now derive the implications of this misalignment for program delivery and derive a roadmap for the empirical exercise. We begin by testing whether social ties affect targeting.

Test 1: Social ties bias Under the null of no bias, ties between potential beneficiaries and the agent do not affect the probability of receiving treatment, that is $\frac{\partial p_\kappa}{\partial \tau_{\kappa 1}} = 0$

Rejecting the null in favor of $p_\kappa \geq p_{\kappa'}$ implies $\sigma_\kappa \rho_\kappa > \sigma_{\kappa'} \rho_{\kappa'}$. Thus if $\rho_\kappa = \rho_{\kappa'}$ we can conclude that $\sigma_\kappa > \sigma_{\kappa'}$ namely the agents' benefits can be identified from observed targeting choices only if ties and non ties have the same returns. The fact that social preferences and returns have the same effect on the choices of the delivery agent is the main identification challenge for assessing the empirical relevance of favoritism and its implications on the welfare of the organization.

Returns can have an individual specific component ρ_κ that captures all individual traits that determine how much a person can benefit from a specific intervention and a match specific component, $\rho_{\kappa 1}$, which depends on the ties between person κ and the delivery agent 1. For instance if being connected allows the delivery agent to tailor her delivery to the specific needs of the beneficiary, or if the cost of treating a tie is lower then $\rho_{\kappa 1}(\tau_{\kappa,1} = 1) > \rho_{\kappa 1}(\tau_{\kappa,1} = 0)$. Our experimental design is such that individuals are identical but for connections to the delivery agent, thus the individual specific component ρ_κ is equal for all and we assume $\rho_\kappa = 1$ in what follows.

The match specific component is indistinguishable from favor exchange as both are specific to the tie between the agent and the potential beneficiary. However, if favor exchange is sustained through a network as in Jackson et al. (2012), then the existence of a common tie will affect how the agent treats her non-ties whereas this will be irrelevant if the observed difference between ties and non-ties is driven by differences in match specific costs.

In the most general model, the agents' benefits depend on the beneficiaries' social connections with everybody within reach of the program—for instance the village. Formally, $\sigma_\kappa = \sigma(\omega_\kappa, \tau_{\kappa 1}.....\tau_{\kappa N})$, where $\tau_{\kappa i} = 1$ if κ and i are connected and $\tau_{\kappa i} = 0$

otherwise; 1 indicates the delivery agent and $i = 2...N$ are other potential connections. In this case, the agent will take into account both the direct link between herself and person κ as well as the link between κ and i. We therefore test whether the probability of treatment depends on the existence of a common tie.

Test 2: Favor exchange networks Under the null, the existence of a common tie i between the agent and beneficiary κ does not affect the probability of treatment, that is $\frac{\partial p_\kappa}{\partial \tau_{\kappa i}} = 0$ for all $i = 2...N$

A second point of departure between favor exchange and diffusion models is that the former assumes that the agents choose beneficiaries to maximize some utility function whereas in the latter diffusion occurs as a by-product of ties. This is the main insight behind the result that centrality-–that is links to others who have many links—is the key dimension for the choice of seed or delivery agent. In our framework, the more beneficiaries the first link i has the larger the number of beneficiary the agent is indirectly connected to. When diffusion is a by-product of connections, centrality undoubtedly helps. When delivery agents choose the level of diffusion, however, whether centrality aids diffusion depends on the agent's incentives to treat the indirect links, which in turn depends on her preferences for i. Using the notation above, diffusion will depend on the number of ties between potential beneficiaries $\delta = \sum_\kappa \sum_j \tau_{\kappa j}$. If beneficiaries can themselves deliver the program- e.g. by transmitting information to others, then the choice of the agent will depend on whether she internalizes the diffusion process. This leads to:

Test 3: Strategic diffusion. Under the null of no strategic diffusion, the number of ties between beneficiaries does not affect the probability of receiving treatment.

If we reject the null, the sign of the derivative of the number of treated individuals with respect to δ will be informative of the sign of social preferences or the benefits that the agent receives when a given individual adopts. Indeed, if all σ are non-negative, higher diffusion potential δ increases the marginal benefit of treating one individual because this has the added benefit of reaching others. By the same logic, an increase in δ will reduce the the marginal benefit of treating one individual if and only if $\sigma_\kappa < 0$ for some k.

Note that both ties between agents and between potential beneficiaries will reduce the agent's incentive to favor her direct ties either because this implies hurting a friend's friend or because the program will be delivered to non-ties anyway. We discuss this in detail below.

3 Context and Evaluation

3.1 BRAC's Agriculture Extension Program

In Uganda, as in most of sub-Saharan Africa, agriculture is the main source of employment and income for a large fraction of the population and especially for the poor. BRAC's agricultural extension program aims to raise the productivity of the poorest women farmers and promote a shift from subsistence to commercial agriculture. The program targets women both because they tend to be the poorest and because of BRAC's stated objective to improve women's welfare. The program was launched in August 2008 and it currently operates in 41 districts of rural Uganda, engaging more than 800 delivery agents, and reaching over 40,000 women farmers per year (Barua (2011)).

The program provides training in modern techniques as well as improved seeds, thus addressing two fundamental market failures: lack of information on modern techniques and adverse selection in the seeds market. Training covers a bundle of five techniques of which three—zero tillage, line sowing and avoidance of mixed cropping—are rarely used by the sample farmers.[6] Improved seeds are well known,[7] but only 31% of the sample farmers has ever used them due to lack of reliable suppliers. Seeds sold in local shops are often of low quality: a recent study conducted in 120 local shops/ markets of rural Uganda finds that the most popular high-yield variety maize seeds contain less than 50% authentic seeds and document that such low quality results in negative average returns (Bold et al. (2017)). BRAC's solution to this problem is to produce improved seeds in their own farms and to sell them with a BRAC certification below market price.[8]

[6] The techniques are: 1. crop rotation (adopted by 93% of farmers at baseline), 2. intercropping (62%); 3. zero tillage (11%) 4. avoidance of mixed cropping (10%), 5. line sowing (44%).

[7] 93% of our sample farmers know what improved seeds are and 70% believe that the adoption of high-quality improved seeds has positive agriculture returns.

[8] BRAC sells marketable crops, defined as high value crops that are primarily cultivated to sell on the market (potato, eggplant, cabbage) but also crops typically grown for own consumption (maize and beans).

Techniques and seeds are complementary but either can increase productivity on its own. A key difference between the two is that information about techniques is not rival whilst seeds are a private good. This distinction will prove useful to interpret the findings that follow.

The program is delivered by agents who reside in the same communities as the farmers. BRAC employs one delivery agent per community selected on the basis of their business skills and their standing in the community. BRAC's program officers collect information on potential agents and contact the best-suited agent privately, that is other farmers cannot apply for the post. The selected delivery agents receive six days of training in crop production techniques, adoption of improved seeds, as well as follow-up monthly refresher courses. Their tasks are to train 15-20 farmers on modern agriculture practices and to sell improved seeds at the beginning of each growing season. The agents are offered an open ended contract and are compensated in kind with free training, free seeds worth 2000Sh (about $1) and with a commission on seeds sales. The commission ranges between 5% and 10% of the sale price depending on the season and the specific seed, and agents can purchase seeds wholesale from BRAC. Financial incentives are very weak, even if the agents were to sell the maximum quantity of seeds available to her (worth 40,000Sh) she would earn at most 4000Sh, which corresponds to 3% of yearly per capita consumption expenditures. In line with this, the main reason delivery agents report for doing the job is that they value the training provided by BRAC.[9]

3.2 The effect of the program on agriculture and consumption

Our study takes place during BRAC's expansion in four new branches of West-Uganda.[10] We collaborate with BRAC to randomize the roll-out of the program across the universe of 119 villages in the area: 60 treatment villages receive the program at the end of 2012 while 59 control villages do not receive it until 2015. We sample a random 20% of all female household heads in each community at baseline (in May-July 2012) and at endline (in April-May 2014). Figure A1 describes the timing. The sample contains 4,741 households, and the attrition between baseline and endline is 7%, balanced between treatment and control (see Tables A9 and A10).

[9] 64% of the delivery agents report doing the job to "gain agriculture knowledge and skills through the training", 7% report doing it to "earn money", 6% to "serve the community", 3% to "get free seeds."

[10] The four branches are Kabale and Muhanga (in Kabale district), and Rukungiri and Buyanja (Rukungiri district). Both Kabale and Rukungiri are 'chief towns' of their respective districts, and tend to have more trade and business activities than Muhanga and Buyanja.

Table 1 estimates the intent to treat (ITT) as:

$$y_{iv} = \alpha T_v + \eta_v + \varepsilon_{iv}$$

where y_{iv} are agricultural productivity and poverty of household i in village v at endline, $T_v = 1$ if the village is treated and η_v include the four stratification variables (BRAC office areas fixed effects, whether the village's distance to the closest market is above median, whether the village size is above median, and whether the proportion of farmers is above median). In all regressions, we also control for the baseline value of the outcome variable. Standard errors are clustered at the level of randomization—the village.

The parameter α identifies the intent to treat under the assumption of no contamination of controls, either directly or because of general equilibrium effects. We find no evidence of delivery agents selling to farmers in other villages regardless of whether they sell in theirs.[11] As we survey the universe of villages in the area we can thus rule out direct contamination. General equilibrium effects through prices are unlikely because the number of treated farmers is small relative to the farmer population and most of them do not sell their production on the market. Even if the agent were to treat the maximum number of farmers allowed by BRAC, that is 20, these would amount to less than 10% of farmers in the village, and a smaller share in terms of output.

Table 1 shows that the program succeeds in increasing the share of farmers engaged in commercial agriculture; in treatment villages farmers grow 17% more marketable crops, profits go up by 40% and per capita consumption expenditure by 22%, or $9.6 per person per month. To gauge the magnitude of these ITT estimates we need to assess treatment and diffusion rates. The average treatment rate is 4%, but this varies considerably across villages. Figure 2 shows that the delivery agents do not train or sell seeds to any sample farmers in half the villages, while treatment rates vary between 1% and 48% (mean 9%) in the remaining half. This echoes the findings on the adoption of pit planting in Malawi, where Beaman et al. (2015) report zero coverage in 45% of the villages. Figure 2 also shows that the share of farmers who adopt is larger than those who are directly treated, especially for techniques. This is evidence of diffusion, which is stronger for techniques—which can be taught farmer to farmer, than for seeds—which cannot be transmitted from farmer to farmer and are in limited supply.

[11] Adoption of BRAC improved seeds in control villages is found to be zero. This indicates that the delivery agent does not sell outside her community.

Despite these benefits, there is sizable variation in treatment both within and across communities. To examine distributional impact within communities we estimate quantile treatment effects (QTE) at each percentile for profits and consumption. Figure 1 reveals that the program only increases the top quartiles for both variables. This is associated with an increase in inequality at the village level as the Gini index for profits and consumption increase by 4.6 and 6.3, that is 20% and 16% of the control mean, respectively (Table A8).

Taken together, the evidence suggests that the program is effective at promoting commercial agriculture and improving welfare. However, benefits are unequally distributed both across and within villages. The rest of the paper will study how social ties shape the agents' choices of how many and which farmers to treat and how this affects the diffusion of better agricultural practices.

4 Social Ties and Program Delivery

4.1 Research design

To identify the effect of social ties on program delivery we need to compare the ties of the delivery agent to a counterfactual group of farmers that is identical but for the tie. For this purpose we create exogenous variation in the selection of the delivery agent. We follow BRAC's normal hiring protocol up to the final stage when we randomize the choice of the agent out of two most suitable candidates. The randomization creates variation in ties between two groups of *ex-ante* identical farmers, one of which ends up connected to the delivery agent and a counterfactual group that is connected to the other candidate.

The timing is as follows: first, BRAC identifies the two candidates; second, we survey sample farmers about their social ties to the candidates (without telling them that one will become a delivery agent to prevent strategic reporting), and survey the candidates themselves; third, we randomly select one of the candidates to serve as delivery agent. This is illustrated in Figure 3 where there are two groups of farmer exclusively tied to one of two potential candidates. The random choice of the delivery agent creates a treatment group (orange) and a control group (green), which are identical but for the tie to one or the other candidate.

The whole process, from candidate selection to delivery agent appointment lasts a couple of days in each village. The two candidates were informed that should there be more than one suitable candidate the delivery agent would be selected by lottery. Table 2 shows that the delivery agent and her counterfactual are balanced on socio-economic status and agricultural practices (columns 1-3). Both are strongly positively selected relative to general farmers on both dimensions (column 4): they are in the top 5% within the village for land ownership, in the top 2% for asset ownership and no lower than the top 15% for every agricultural practice including experience with improved seeds and modern techniques.

Table 2, Panel B, reports data on social ties between the agents and the farmers. We measure these before the delivery agent is selected by asking each farmer whether she knows the agents, whether she is friends with her or belongs to the same family and whether they discuss agriculture.[12] Three points are of note. First, the agents are well known in their villages: 61% the sample farmers know both the delivery agent and the counterfactual agent and 22% knows one or the other, half of which are close friends or family. Second, the agents are a source of information about agriculture pre-program: more than half of the farmers state regularly discussing agriculture with either the delivery agent or the counterfactual agent. Third, the two agents are equally well known in their communities both to the farmers and to each other.

The random selection of the delivery agent creates a treatment group made of farmers who are socially linked to the delivery agent, and a control group that is farmers who are connected to a similar individual who was randomly selected out. The identifying assumption is that the outcome of the control farmers, that is those connected to the counterfactual agent, is a valid counterfactual for the outcome of the treated in the absence of the program. Table 3 shows that these two groups are similar on a broad set of traits and outcomes.

4.2 The effect of social ties on program delivery

The theoretical framework provides a road map to identify the effect of social ties and the underpinning mechanisms through which these affect program delivery. We begin

[12] The wording of the questions is "Do you know [agent's name]"?; "For how many years have you known [agent's name]?"; "How would you best describe your relationship with [agent's name]?" and "Do you normally discuss about agriculture with [agent's name]?".

by assessing whether the delivery agent gives priority to her ties by estimating:

$$y_{iv} = \alpha + \gamma D_i + X_{iv}\delta + u_{iv} \tag{2}$$

where y_{iv}=1 if farmer i in village v is treated (either trained in the use of new techniques or given seeds), $D_i = 1$ if farmer i is connected only to the delivery agent (a "delivery agent tie"). X_{iv} contains: an indicator for whether the farmer is connected to both agents or to no agent; the distance (in walking minutes) from the farmer's house to the delivery agent's, BRAC branch office fixed effects. We report p-values from randomization inference as well as errors clustered by connection status and village. The causal effect of social connections is given by γ which compares the outcome variables for ties of the delivery agent and ties of the counterfactual delivery agent (the omitted group).

Using the notation from Section 2, $\gamma \propto (\sigma(\bar{\omega}, 1, 0..0) - \sigma(\bar{\omega}, 0, 1..0))$, that is the difference between two individuals who are identical but for the fact that one is connected only to the delivery agent ($\tau_1 = 1, \tau_{j\neq 1} = 0$) and the other is connected only to the counterfactual agent ($\tau_2 = 1, \tau_{j\neq 2} = 0$). Equation (2) then tests the simplest model of social ties where $\frac{\partial \sigma}{\partial \tau_i} = 0$ for all $i \neq 1$, that is the delivery agent's preferences solely depend on her direct connections to potential beneficiaries.

Table 4 estimates equation (2) using two definitions of ties. The broadest definition pools together close friends, family and acquaintances, the narrowest uses friends and family alone. In all cases the comparison groups are the corresponding ties of the counterfactual agent.

Table 4, columns 1-4 shows that relative to ties (close ties) of the counterfactual agent, the ties (close ties) of the delivery agent are 7.5pp (8.6pp) more likely to be trained, 6.4pp (6.1pp) more likely to receive seeds. The effect size is large relative to the counterfactual agent tie mean: delivery agent ties are 4.68 times more likely to be trained. We note that the size of the effect is invariant to closeness of ties. This indicates that to the extent that delivery agent cares more (or is better able to sustain cooperative agreements with) about friends and family this is not driving the results. We will use the broader definition of ties from now on, both because it is more conservative but also because it covers more people and thus has more power to estimate heterogeneous treatment effects.

The evidence in columns 1-4 rejects the null hypothesis that ties do not affect program delivery. This might be due to the fact that the agent deliberately targets ties because she derives a personal benefit, either because she puts more weight on their utility or because she can expect them to reciprocate favors in the future. Alternatively there might be unobservable match specific factors that makes treating ties less costly for the agent. For instance, although identical for the outside observer, farmers tied to the delivery agent might be easier to train because they are used to discuss agriculture, or they might be more receptive to new products because they trust the agent more. Columns 5 and 6 use information on whether the farmer discusses agricultural practices with the agent as a measure of ties. We find that these ties are more likely to be trained but the effect is half the size of the effect of social relations, which goes against the hypothesis that the delivery agent is more likely to target her ties because she can get through to them more easily, or that the farmers are more receptive to information that comes from the delivery agent.

4.3 Favor exchange networks

The evidence so far indicates that ties between the delivery agents and the set of potential beneficiaries affect program delivery. If favor exchange is sustained through a network as in Jackson et al. (2012) then the existence of a common tie will affect how the agent treats her non-ties. Using the notation introduced in Section 2, the agent's preferences for individual j depend on j's connections to other villagers $\sigma_j(1; \tau_{j1}, \tau_{j2} ..... \tau_{jN})$. Thus, the agent's ability to sustain cooperation with the ties of the counterfactual agent will depend on her ties to the counterfactual agent, who essentially enforces the favor exchange between the two.

To measure ties between delivery agents and counterfactual agents, we use the same friendship variables as those used between agents and beneficiaries as well as two measures of group identity that allow us to identify negative social preferences. Group identity has long been recognized as a key determinant of social preferences (Tajfel and Turner (1979)), and it is practically relevant in these villages where political and, to a lesser extent, religious cleavages run deep.

The first measure uses information on whether the delivery agent and counterfactual agent are friends or part of the same family, which they are in 75% of the villages.[13]

[13]We do not use acquaintance as a measure of tie because all delivery agents report knowing who the counterfactual agent is and vice-versa. This is not surprising as both are prominent figures in these communities.

The second is whether they belong to the same political party, which they do in 50% of the villages. Politics is the main source of cleavages: of the 60 village leaders we interview, 95% state that they identify themselves with a political party, 61% report politics as the most common source of disagreements in their communities while 33% report religion. This is our third measure of identity. Religion differs between delivery and counterfactual agent in 50% of the villages. Both politics and religion are binary: there are two parties (the incumbent NRM and the runner-up FDC) and two religions (Catholic and Protestant). Politics is conflictual to the point that agents are reluctant to reveal their political affiliation, we therefore only ask the delivery agent whether she and the counterfactual agent support the same party[14] and we ask both agents to take an implicit association test. Reassuringly, the two methods yield similar results.

The three measures (friendship, politics and religion) are correlated but, as shown in Figure 5, the overlap is far from perfect. We use all three to partly allay the concern that these capture village level traits rather than an alignment between the delivery agent's and the counterfactual agent's identity. Table A2 compares the infrastructure of villages in which the delivery agent and the counterfactual agent share same identity vs. villages in which they have different identity. Both types of villages are comparable on most measures of infrastructure and also on the DA's traits. Because they may still differ on unobservables, we will later control for village fixed effects to absorb all omitted factors correlated with the cohesiveness of the elites.

Table 5 then estimates:

$$y_{iv} = \alpha + \gamma^G D_i * G_v + \gamma^N D_i * (1 - G_v) + \rho_v + X_{iv}\delta + u_{iv}$$

where $G_v = 1$ in villages where the delivery agent and the counterfactual agent share a group identity. ρ_v are village fixed effect that absorb all omitted factors correlated with the cohesiveness of the elites.

The estimates in Table 5 show that the delivery agent favors her ties only in villages where she and the counterfactual agent belong to rival groups. Three points are of note. First, the precision of the estimates of γ^G, γ^N is very similar but γ^N is orders of magnitude larger, ranging from 12pp-13pp for training and 9pp-11pp for seeds. Second, the fact that the effects are similar across the three measures allays the concern that the measures capture some other village unobservable that is uncorrelated with preferences

[14] We do so without telling that the counterfactual agent was also considered for the position.

and nevertheless affects targeting. Third, the results point to a potential source of bias in estimates that only measure ties to the agent because ties to *other* agents will affect preferences over own ties. Taken together, the findings indicate that the effect of social ties between delivery agents and potential beneficiaries cannot be understood independently of the ties within the group of potential delivery agents and within the group of beneficiaries themselves.

Table A3 shows that the results are robust to adding a set of village-level controls interacted with ties: $D_i * X_v$, where X_v include village-level polarization (share of votes for the majority party in the 2011 presidential elections), village infrastucture (roads, electricity, newpaper access, distance to BRAC branch), population and density of ties.

4.4 Strategic diffusion

A key advantage of local agents is that they can leverage networks for diffusion. Most network models assume that this is passive, that is, it happens by virtue of the delivery agent being connected to many farmers who themselves are connected and the delivery agent herself does not internalise the effect of her actions on diffusion. Theory makes precise that if she does internalise potential diffusion, and if she has non-negative social preferences for all beneficiaries, then the possibility of spillovers will increase the number of farmers treated as each carries the extra benefit of transmitting the information to δ untreated farmers. However, if social preferences are negative, the opposite happens: the marginal benefit is lower because there is the risk that the information is transmitted to the person the delivery agent has negative preferences for. Likewise, if the delivery agent has negative preferences for the counterfactual agent, they will want to minimize diffusion to counterfactual agent ties. If we observe lower treatment rates when the potential for diffusion is larger, we can infer negative preferences.

To test this, we need a proxy for diffusion potential. Diffusion requires farmers to share information. We then use data on the share of farmers who report discussing agriculture with other farmers in the village at baseline. This varies between 24% at the 5th percentile to 91% at the 95th (see A2 for a plot of the density).

To begin with, we estimate:

$$y_{iv} = \left(\sum_{j=0}^{1} \gamma^{jk} (1-j) G_v \sum_{k=0}^{1} (1-k) \Delta_v \right) D_i + X_{iv}\delta + \rho_v + u_{iv}$$

where Δ_v is the share of farmers who report discussing agriculture with other farmers at the village level at baseline. If the delivery agent does not internalise the diffusion potential, then $\gamma^{j1} = 0$. Again, village fixed effects ρ_v absorb all omitted variables correlated with diffusion potential. The estimates are in Table 7, marginal effects in Figures 6.

Figure 6.A reports the marginal effect of varying the potential for diffusion on the average farmer, whilst Figure 6.B-6.D reports the marginal effect for delivery agent ties, in both cases by group identity and with 95% confidence intervals. Both LHS panels are downward sloping, thus when delivery agents are divided the probability of treating the average farmer and the average tie is lower when diffusion is likely. In contrast, both RHS panels are upward sloping. Thus, when delivery agents are united, the probability of treating the average farmer and the average tie is higher when diffusion is more likely. The evidence thus indicates that the delivery agent internalises the diffusion potential, and behaves strategically, so as to stifle it in villages where it would benefit the ties of her rival, and to strengthen it where it would not.

In summary, social ties between agents, between farmers and across agents and farmers all interact to shape program delivery. In particular social ties between agents and farmers lead to favoritism and targeting bias only if there are no ties (or negative ties) between potential agents and between farmers. When potential agents are cohesive, there is no favoritism and ties lead to diffusion. These interactions can potentially explain variation in program coverage and effectiveness across otherwise similar villages. The next section provides evidence.

5 Welfare Implications of Social Ties

5.1 Targeting bias

The fact that the agent gives priority to her ties and strategically limits diffusion is inconsistent with the stated objective of the organisation because identical farmers are treated differently. In this section we test whether the agent's strategy violates the key goal of the program, which is to target disadvantaged farmers.

To provide evidence, Table 8 estimates:

$$y_{iv} = \alpha + \gamma^P D_i * P_i + \gamma^R D_i * (1 - P_i) + \rho P_i + X_{iv}\delta + u_{iv} \quad (3)$$

where $P_i = 1$ if the farmer is in the bottom quartile of wealth, agricultural productivity, consumption or assets. γ^P is the effect of poor ties while γ^R is the effect of rich ties.

The estimates in columns 1-10 show that we reject the null of no targeting bias. We find that $\gamma^P = 0$ and $\gamma^R > 0$, that is poor ties are equally likely to be treated but rich ties are more likely to be treated relative to comparable counterfactual agent ties, and relative to the poorer ties. We note that this is not due to social distance being correlated with wealth or profitability. Indeed friends, family and acquaintances of the delivery agent are equally distributed across wealth and profitability quantiles.

That the delivery agent treats her rich ties over poor counterfactual agent ties, is in line with the finding that the program increases inequality overall. Importantly, the findings rule out that the delivery agent is better at identifying needs among her ties but not among others. If this were the case, we should find a large difference among poor ties and no rich treated. We find the opposite.

5.2 Adoption

The ultimate goal of the program is to foster the adoption of seeds and techniques. Table A5 provides evidence that social ties are more likely to adopt BRAC seeds. However, we find that adoption rates from other sources are of similar magnitude, 4.3% of all farmers get seeds from the BRAC branch office and 5% from any other outlet, including other farmers. This allays the concern that the findings are driven by demand, that is the farmers themselves only accepting the program when tied to the delivery agent, e.g. because of trust. Indeed, if this were the case, we should not see counterfactual agent ties buying seeds from BRAC. The finding also casts doubt on the possibility that the farmers themselves undo the allocation chosen by the delivery agent, indeed if her ties were to sell the seeds to the control farmers, the latter should have more seeds from external sources.

Table A5 also shows that delivery agent ties are twice as likely as counterfactual agent ties to adopt at least one of the new techniques. The effects are similar using self-reported number of techniques and that observed by the enumerators.[15] This rules out that results are driven by the farmers' desire to help the delivery agent by strategically reporting treatment. In line with the treatment results, the delivery agents' ties are more likely to adopt only when the two agents have no link or a negative link.

Table 10 evaluates the effects of social ties on cross-village differences in program coverage and adoption. We begin by estimating:

$$t_v = \alpha^D T_v^D + \alpha^T T_v^T + X_v \gamma + u_v \tag{4}$$

where t_v is the outcome of interest (treatment and adoption of both seeds and techniques) in village v. T_v^D is the number of exclusive delivery agent ties and T_v^T is the total number of exclusive (delivery agent and counterfactual agent) ties in the village. X_v are village population and branch fixed effects. To identify the effect of ties on coverage we exploit the cross village variation in the number of farmers connected to the delivery agent only. Given that the delivery agent is chosen randomly, this variation is exogenous conditional on the total number of delivery agent and counterfactual agent exclusive ties in the village. Figure 4 shows that there is substantial variation in the share of delivery agent exclusive ties (line) which is uncorrelated with the total number of exclusive ties in the village (histogram). This variation is uncorrelated with village infrastructure and uncorrelated with delivery agent's traits.

Table 10 shows that, in line with the individual results, delivery agents with more ties train and give seeds to more people: having one more tie increases the number trained by .25 and the number receiving seeds by .23.[16] Also in line with the individual results, ties only affect delivery if the agents have no link (Table A7). The impact on aggregate adoption is muted, and we can never reject the null of zero effect. Thus it must be that on average the diffusion process partly undoes the delivery agent's targeting strategy.

[15] We asked enumerators to check the plot of land of a random 60% of the respondents. We consider adoption of all techniques except "crop rotation" (rotation of crops from one season to another) because its adoption cannot be "observed" by the enumerators over one season only.

[16] The results are robust to controlling for a set of DA characteristics, potentially correlated with the fact that a DA has more or fewer ties (Table A4).

5.3 Spillovers

The possibility of farmers teaching other farmers creates a wedge between treatment and adoption. Table 11 estimates adoption as a function of treatment, allowing for heterogeneity by elite ties and farmers' ties. We find a strong correlation between treatment and adoption only in villages where the elite farmers are rivals and farmers' ties are rare. In particular, treated farmers are 21% more likely to adopt at least one technique and 15% more likely to adopt seeds when the elite farmers are rival, whereas the correlation is zero when they are not.

Finally, Figure 7 illustrates how the two forces we have identified—the link between the two agents and the potential for diffusion—explain the variation of coverage and adoption at the village level. The Figure shows that the delivery agent's effort is highest—10% of farmers trained—in villages where the two potential delivery agents belong to different groups and the potential for diffusion is low, and lowest—close to 0%—in villages where the potential for diffusion is high. That is, when the delivery agent is not tied to the counterfactual agent she treats her ties as long as the chance that they treat the counterfactual agent ties is minimal. Finally, when the delivery agent and counterfactual agent belong to the same group, training is more common but, as we know from the earlier regressions, this is not due to the delivery agent treating more ties.

The fact that the delivery agent internalises the impact of her choices on diffusion implies that adoption rates are highest in villages where the two agents share a group identity and the potential for diffusion is high (9% of farmers adopt) and lowest (2%) where they do not and the potential for diffusion lowest.

5.4 Do social ties generate inequality?

The evidence so far indicates that social ties explain some of the cross-village variation. To conclude, we return to the first layer of our experiment to test whether ties can also explain the distribution of benefits within village. Figure 8 estimates the quantile treatment effect on consumption and profits for the two polar cases we identified above, that is villages where the agents are divided and most farmers isolated and villages where the agents and most farmers are linked. In the first set of villages (bottom red line in the figure) only 20% of the population experiences an increase in consumption whereas in the second set of villages everybody does, in line with the earlier findings that diffusion is larger in these villages. Since the increase at the top decile is similar in magnitude, the program increases inequality in villages that are already divided to start with. The pattern for profits is similar but more pronounced. In the first set of villages (bottom red line in the figure) only 25% of the population experiences an increase in profits whereas in the second set of villages more than half of the farmers do.

6 Conclusion

The success of development programs depends on the choices of the agents hired to deliver them. We have shown that the choices of local agents are shaped by the structure of social ties in a way that reconciles existing evidence of negative effects through favoritism and positive effects through diffusion. In line with previous studies on capture and bias (Bardhan and Mookherjee (2006); Mansuri and Rao (2012); Alatas et al. (2013); Hjort (2014); Basurto et al. (2017); Xu (2018)), the agent favors her ties over observationally identical farmers tied to an observationally identical potential agent. However, favor exchange is at the network level so when the agents themselves are tied, favoritism disappears. In line with previous studies on diffusion via social networks, we have shown that connections facilitate diffusion (Beaman et al. (2015); BenYishay and Mobarak (forthcoming)). However, diffusion is not a by-product of ties, but a strategic choice of the agent, who prevents it to avoid benefitting a rival group or encourages it to benefit her own group.

The fact that the agents targeting choices reflect existing cleavages exacerbates inequalities both across and within villages, and appears to be an important drawback of relying on social ties as motivators for program delivery. This echoes recent findings on community driven development programs leading to divisions that reduced network based economic activities in Gambia (Heß et al. (2018)).

The effect on inequality and cleavages should therefore inform the choice of the mode of delivery of development programs. When training costs are low, one option is to hire several agents or even target several beneficiaries directly and to rely on their connections to ensure diffusion. In simple contagion models this has been shown to yield the same adoption rates as targeting the optimal seed without having to pay the cost of identifying such seed (Akbarpour et al. (2018)). Our findings provide an additional reason for targeting beneficiaries directly as delivery agents might strategically prevent diffusion.

The influence of social motives is likely to interact with other motives, such as financial incentives. Evidence from the private sector indicates that sufficiently strong monetary incentives mute social incentives, and such crowd-out is desirable when social incentives lead to an inferior outcome (Ashraf and Bandiera (2017); Bandiera et al. (2009)). The issue is that many organizations might not be able to afford the required level of financial incentives, but there is evidence that even small financial reward can motivate all but the richest agents (BenYishay and Mobarak (forthcoming)). Also the cost of these incentives may be low relative to the lost benefits identified in this paper.

What we have uncovered is that relying solely on social motives makes the success of development programs dependent on pre-existing social divisions that can potentially exacerbate existing inequalities, against all best intentions. We are left with the open question of whether it is possible to create a professional cadre of local agents that retains the desirable features of the local model – better information, lower turnover – while aligning the interests of the agents with those of the development agency. This model might combine some features of professional centralized bureaucracies – meritocratic selection, common training, common mission, structured careers and regular compensation – with the virtues of local delivery. Understanding whether and at what cost this can be achieved is a prerequisite for choosing the optimal delivery mode and achieving the stated goal of helping the poor.

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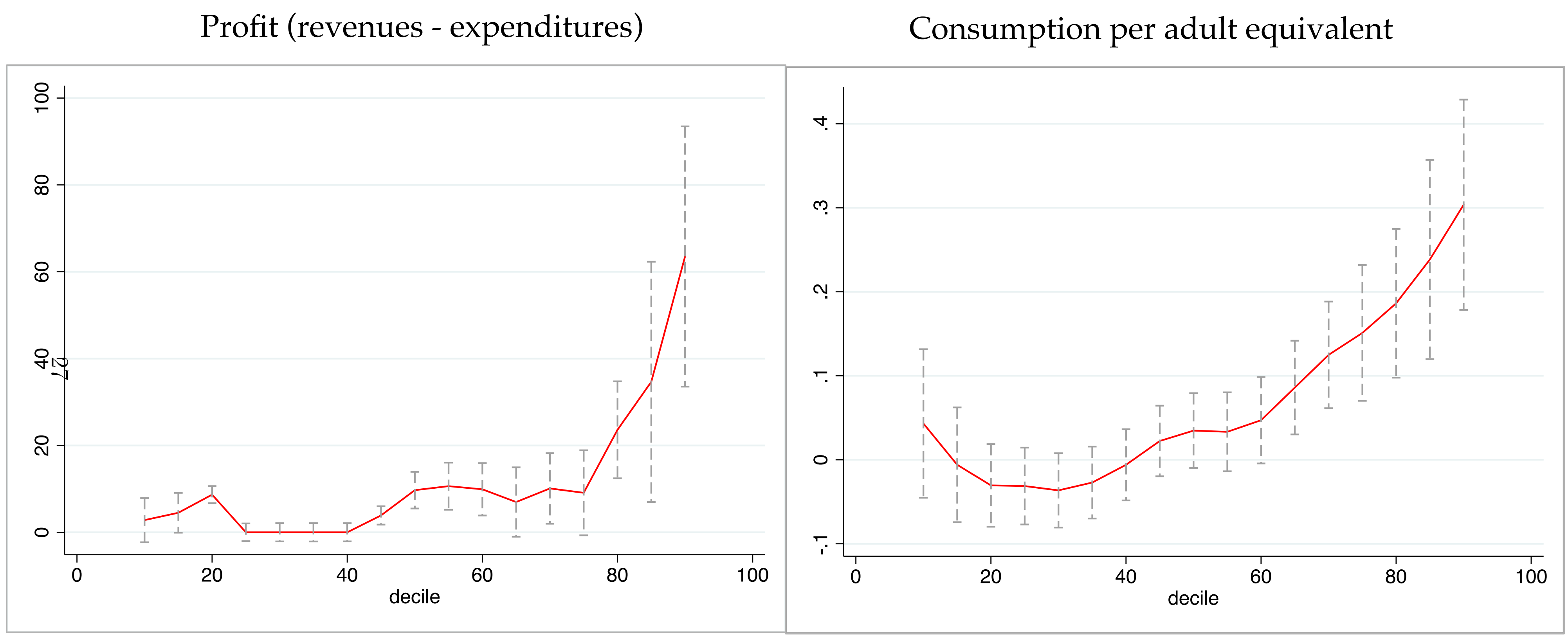
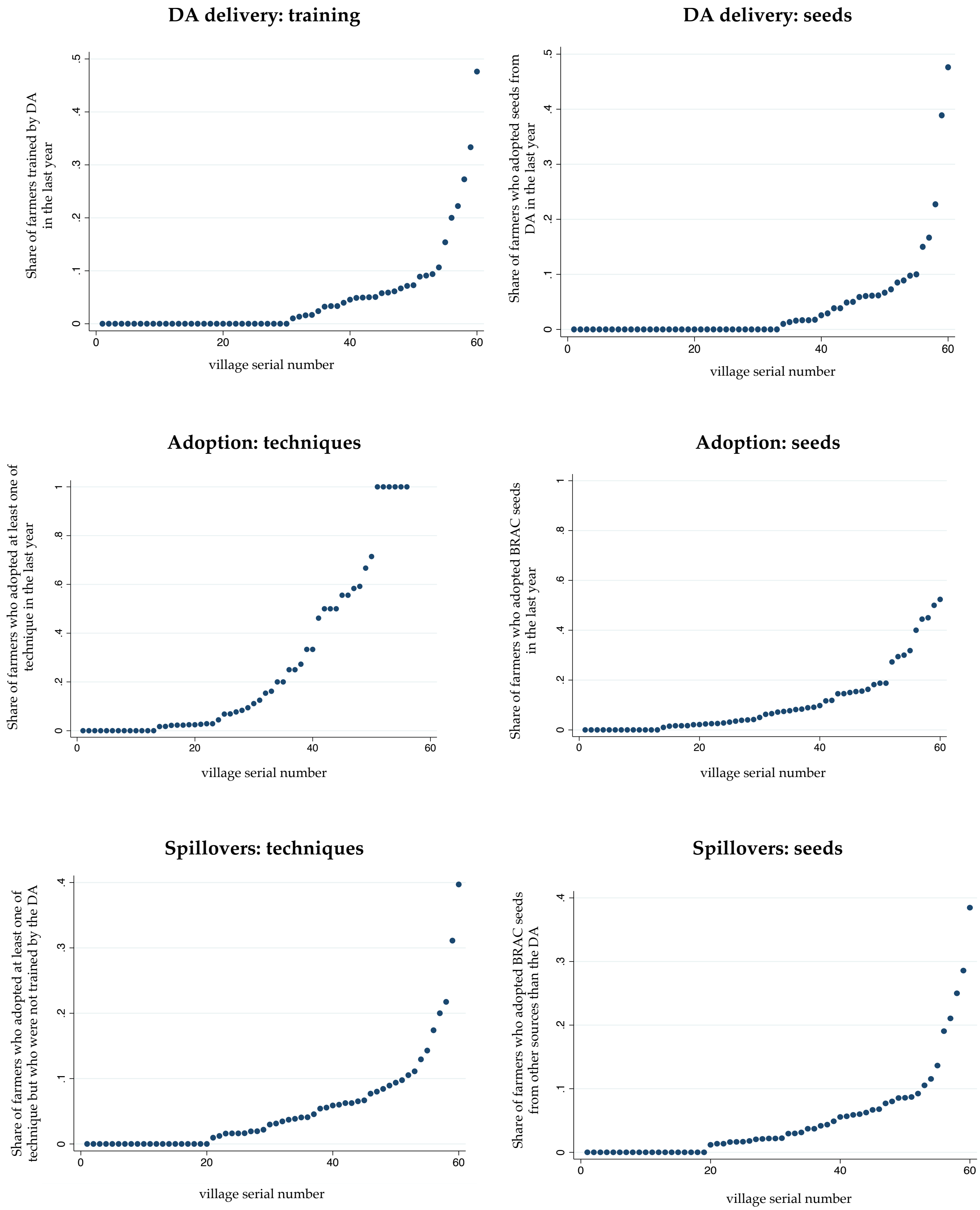
Figure 1: Quantile Treatment effects



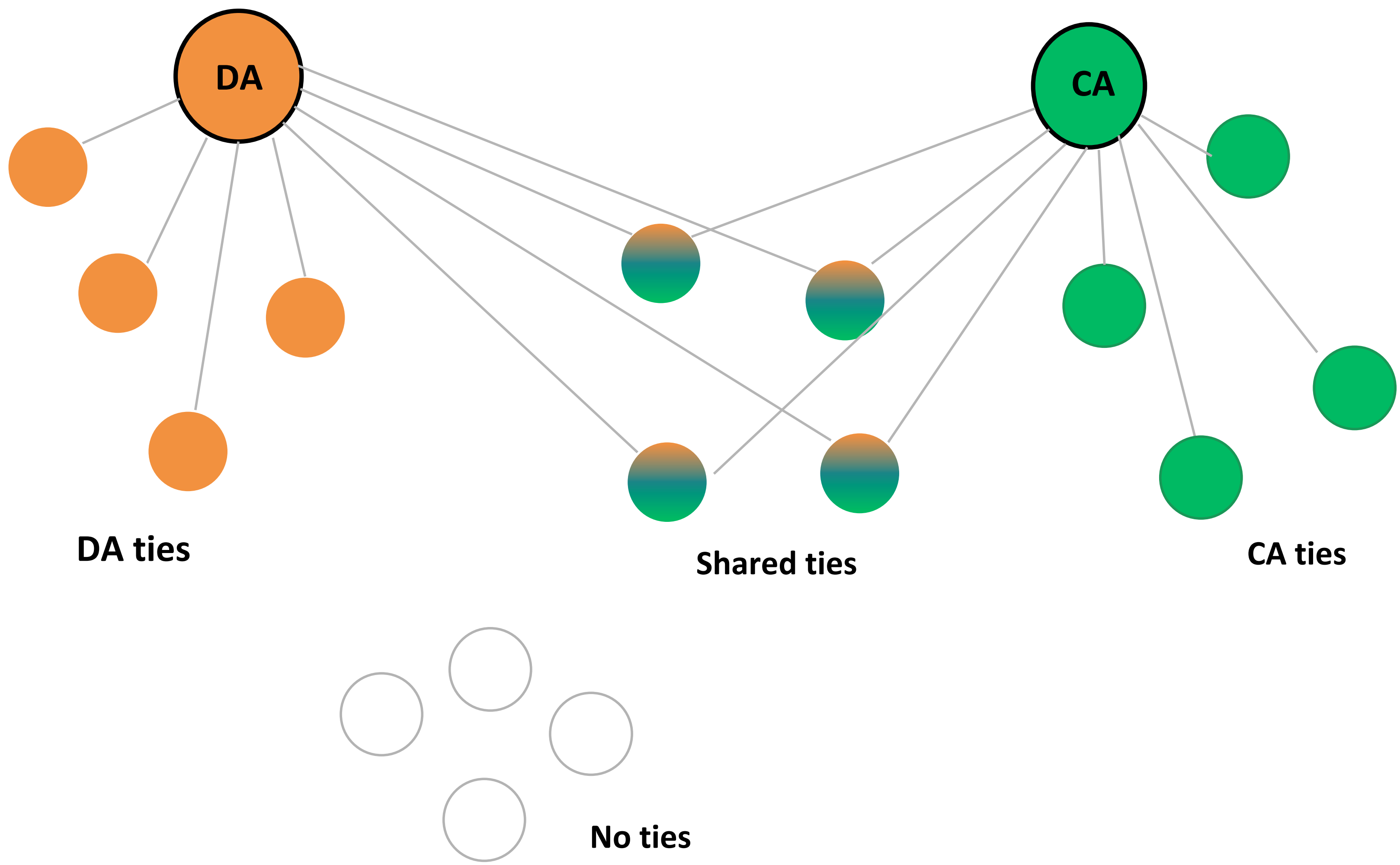
Notes: Quantile regressions. All regressions control for the four stratification variables (branch fixed effects, above median market distance, above median village size, above median proportion of farmers). "Profits" are equal to total revenues from selling agriculture output minus expenditures in the last season (in thousand of UGX). "Consumption per adult equivalent" is the log consumption per adult equivalent; which equals the household's monthly per capita consumption of food, non-durables and semi-durables (children below 18 are given a weight of 0.5 and adults a weight of 1) in thousand of UGX. All monetary values are truncated above and below two standard deviations from the mean.

Figure 2: Variation in delivery agent Delivery, Adoption and Spillovers Across Villages



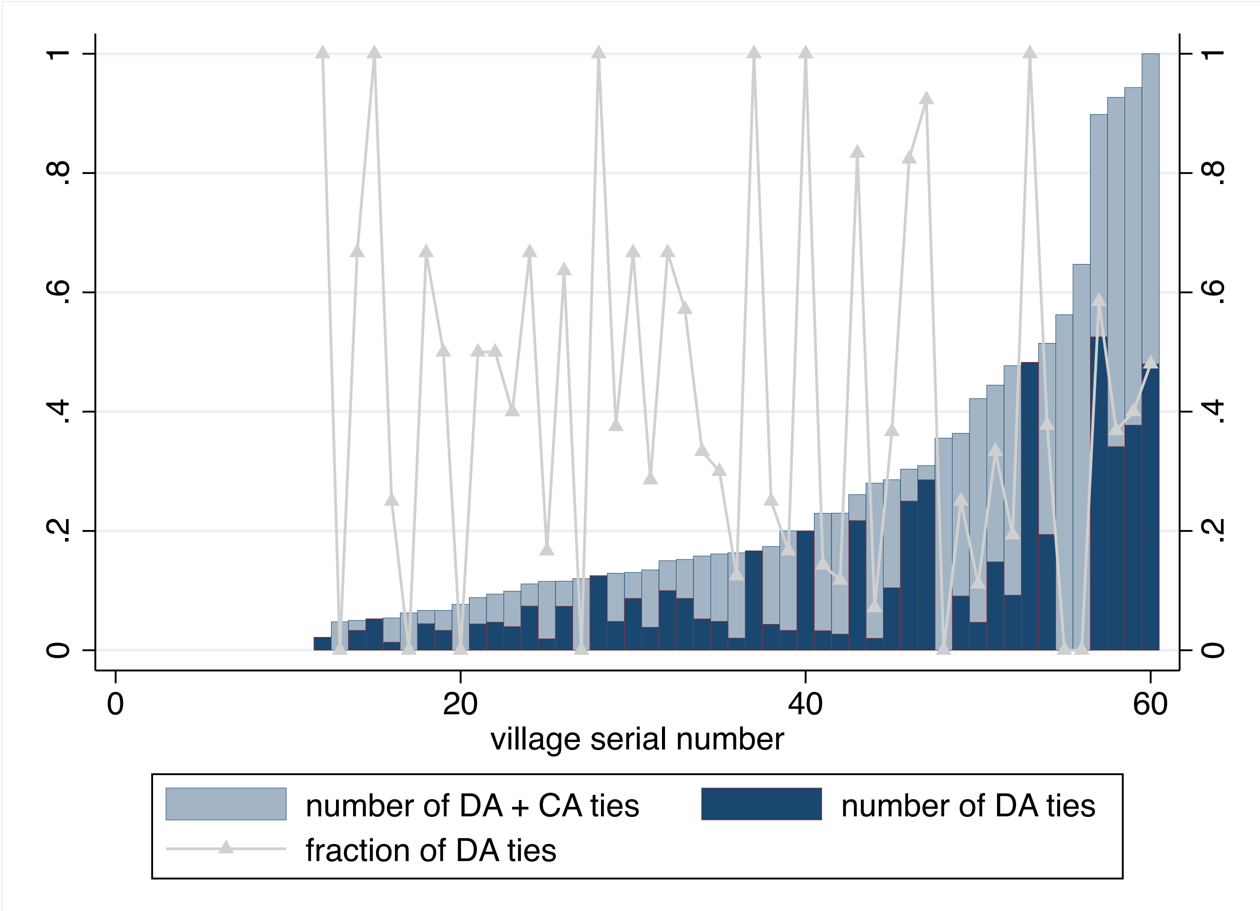
Notes: The top two graphs plot the distribution of DA delivery across villages at endline (one dot per village sorted from lowest to highest); where DA delivery = "share of farmers trained by DA in the past year" and "share of sample farmers who adopted seeds in the past year." The middle two graphs plot the distribution of adoption across villages; where adoption = "share of sample farmers who are adopted at least one technique (out of 4) in the past year" and "share of sample farmers who adopted seeds from BRAC (either the DA or other BRAC sources) in the past year." The bottom two graphs plot the distribution of spillovers. In all graphs, villages are sorted from lowest to highest, and the village serial number indicates the village "ranking" in terms of that specific variable.

Figure 3: Research Design



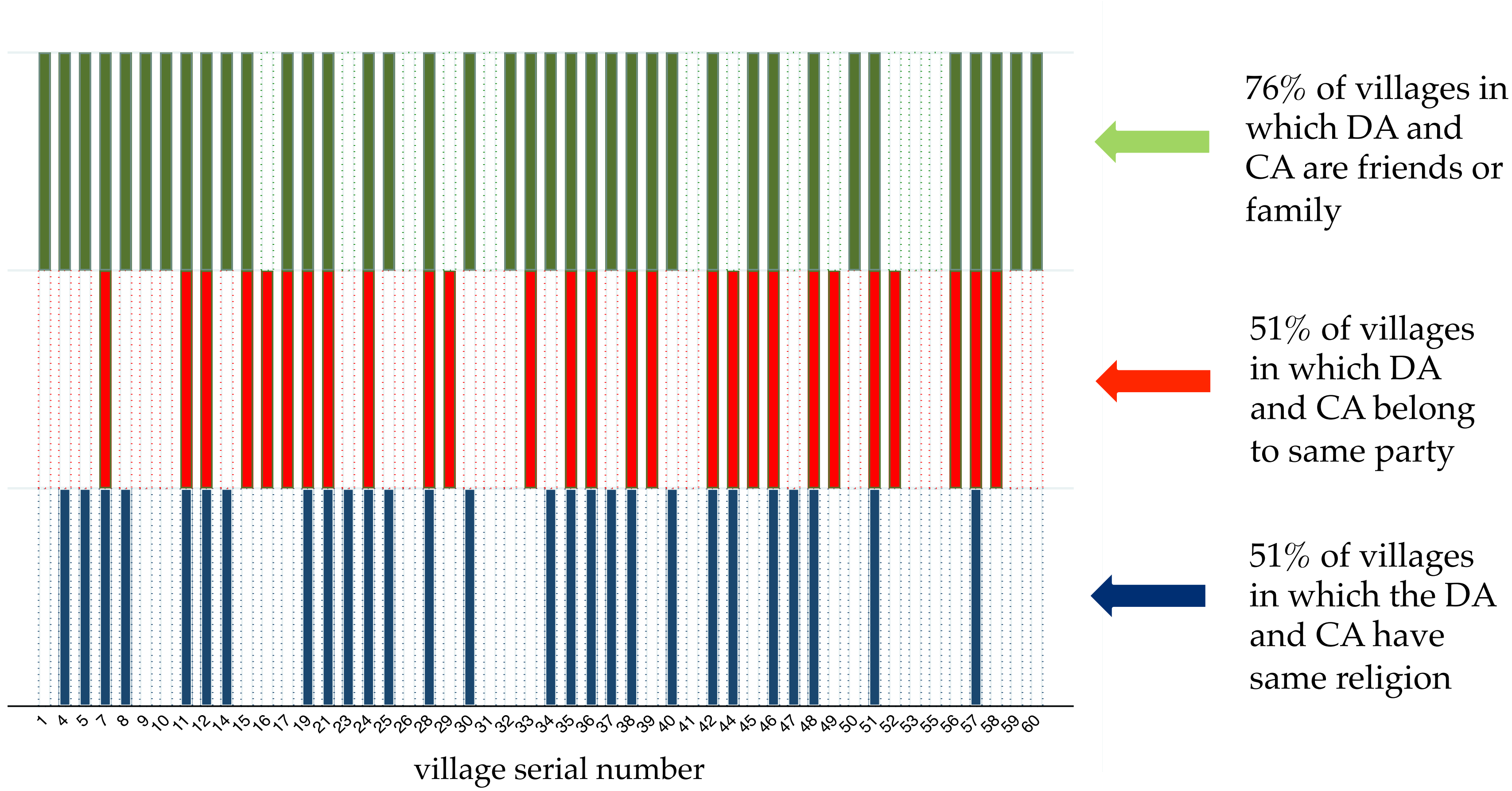
Notes: In each village we randomly select the delivery agent out of two potential candidates. Farmers can be divided into 4 types based on their ties: "DA ties"= farmers tied to the actual delivery agent (DA) only. "CA ties" = farmers tied to the counterfactual non-selected delivery agents (CA) only. Shared ties= farmers tied both to the DA and the CA. No ties= farmers tied neither to the DA nor the CA.

Figure 4: Variation in exclusive delivery agent and counterfactual agent Ties across Villages



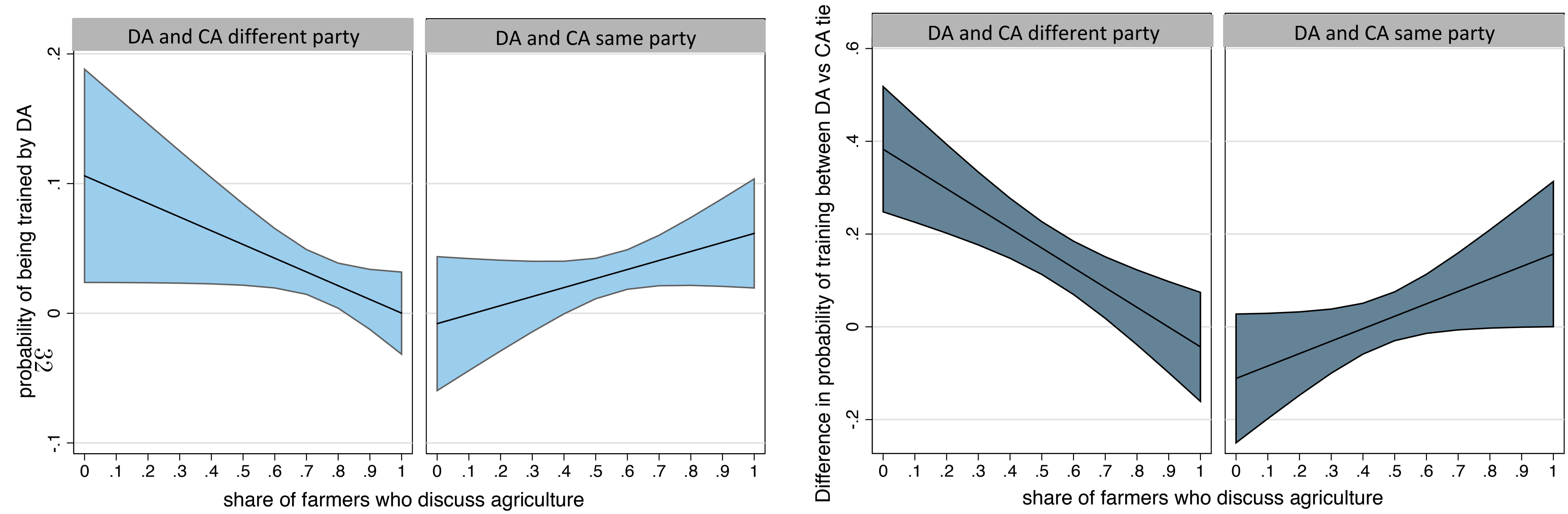
Notes: The light blue histogram is the number of exclusive DA+CA ties in the village. The dark blue is the number of exclusive DA ties in the village. The grey line is the share of the latter on the former. Villages are sorted from smallest to highest number of exclusive DA+CA ties.

Figure 5: Variation in delivery agent-counterfactual agent Link



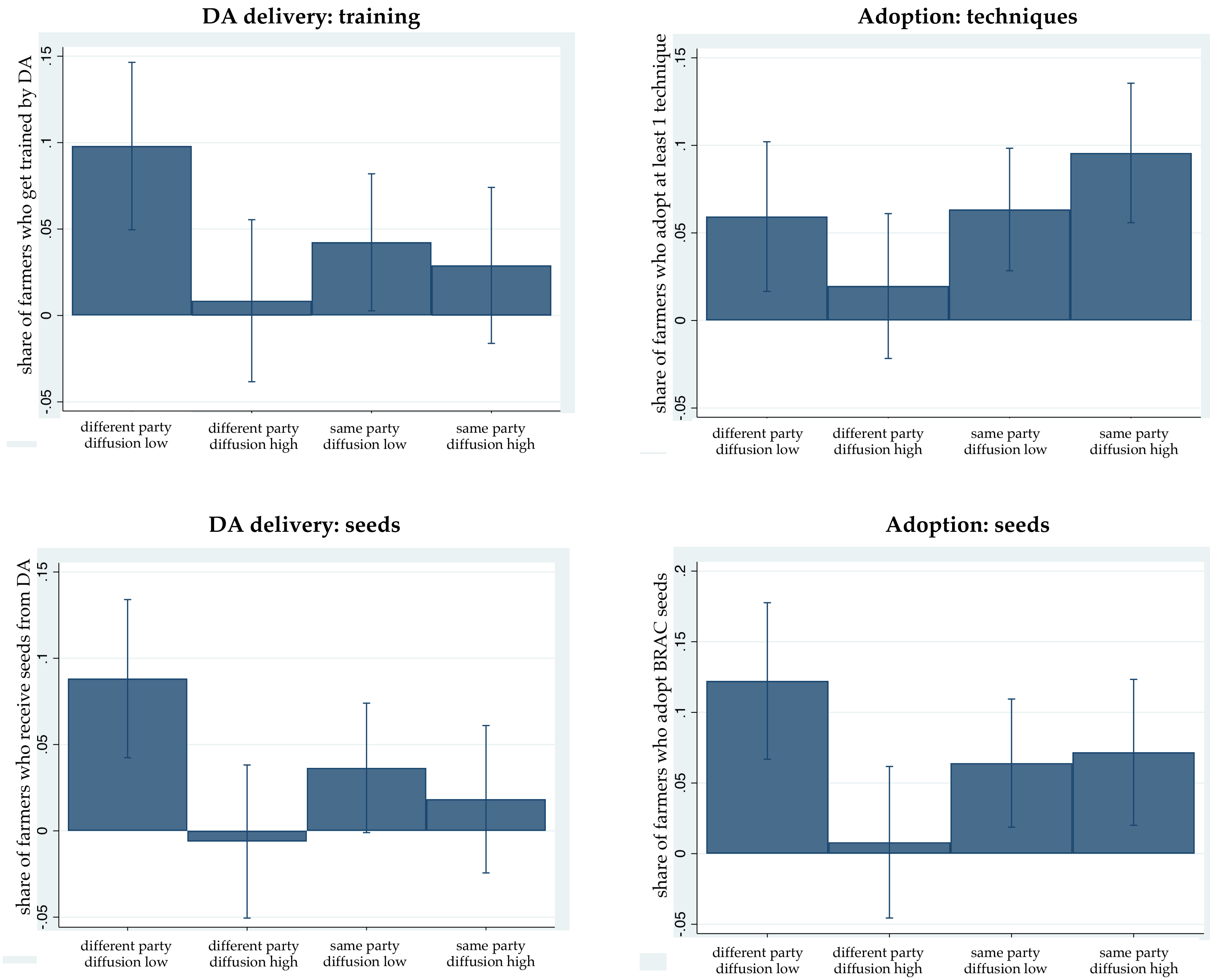
Notes: Solid green, red and blue bars indicate that the village is one where the DA and the CA are friends/family, belong to the same party (as self-reported) or follow the same religion. The DA and CA report knowing each other (either acquaintance or friend/family) in all 60 villages.

Figure 6: Treatment and Diffusion



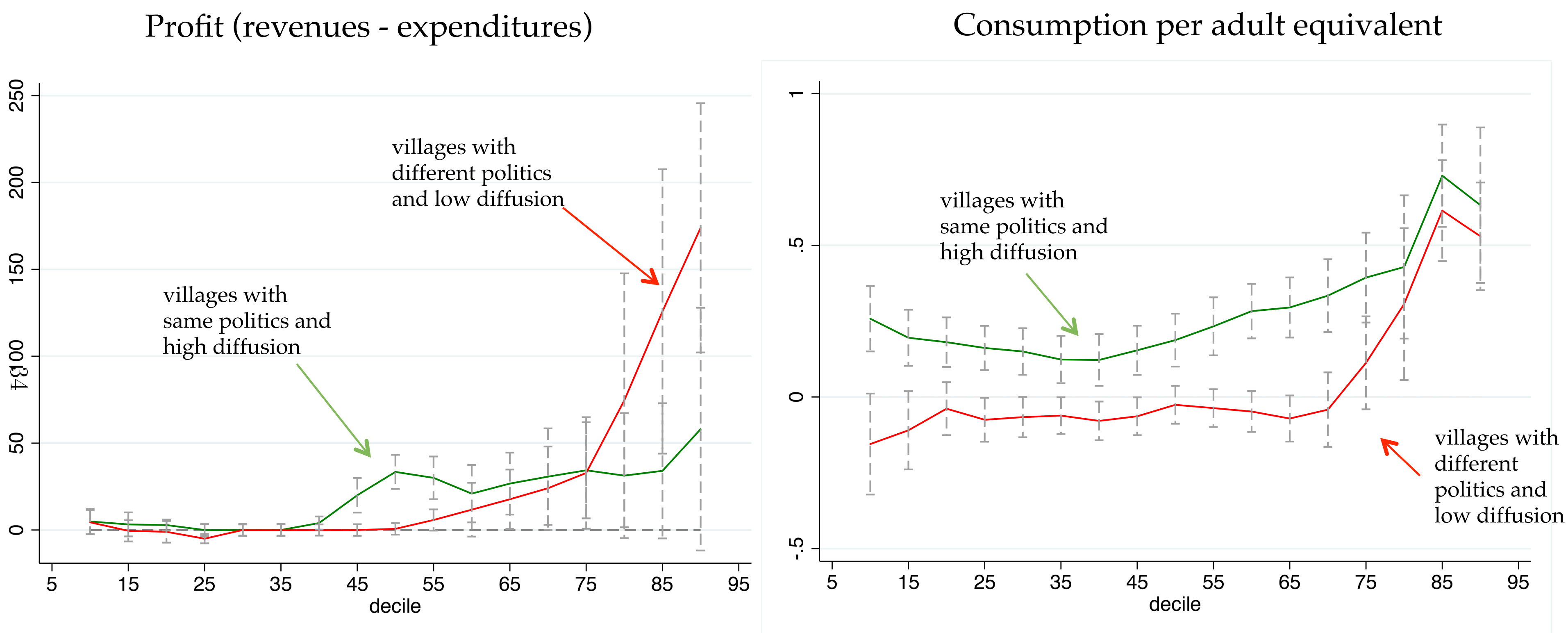
Notes: The figures plot the relationship between the probability that a farmer is trained by the DA (left graph) or the difference between the likelihood of training for DA vs CA ties (right graph) and the village-level share of farmers who report discussing agriculture with other farmers, separately for villages in which the DA and CA have a different party vs. the same party. These relationships are estimated through an OLS regression that regresses "being trained" on three triple interactions: ties type (one of three dummies) * share of farmers who discuss agriculture (village level continuous variable) * DA-CA same party (village-level dummy). The regression controls for branch fixed effects and for the walking distance to DA home. The blue area around the line represents the 95% confidence interval, based on robust standard errors clustered at the connection status*village level.

Figure 7: Aggregate Coverage and Adoption



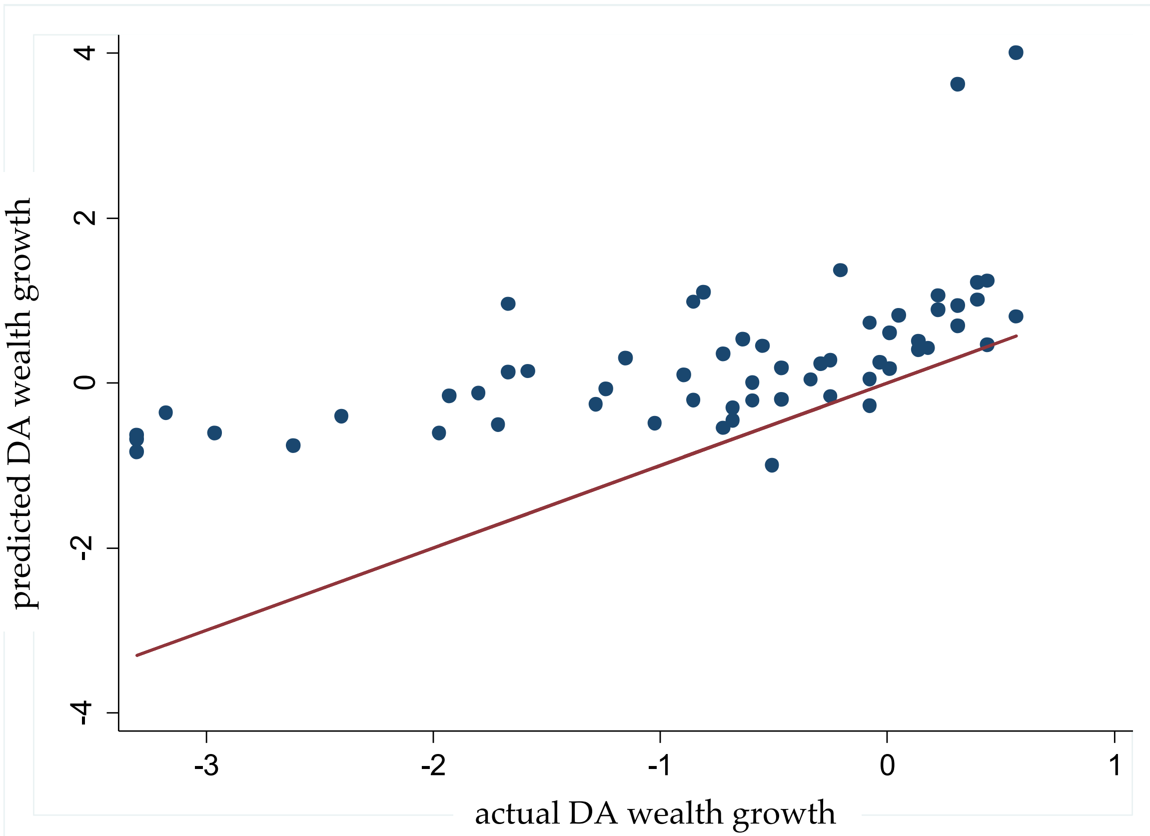
Notes: Each graph presents average DA delivery and adoption in 4 types of villages = {DA&CA different party*low diffusion; DA&CA different party*high diffusion; DA&CA same party*low diffusion; DA&CA same party*high diffusion}. DA& CA different party =1 if the DA and CA support different parties (as self-reported). High diffusion =1 if the share of farmers who report discussing agriculture with other farmers of the village is above median (i.e., above 62%). DA delivery = "number of sample farmers trained by DA in the past year" and "number of sample farmers who received seeds from DA in the past year." Adoption = "number of sample farmers who are adopted at least one technnique (out of 4) in the past year" and "number of sample farmers who adopted seeds from BRAC (either the DA or other BRAC sources) in the past year." 95% confidence intervals are also presented.

Figure 8: Quantile Treatment Effects by Diffusion and DA-CA link



Notes: Quantile regressions. QTE are estimated for 2 different types of villages: (a) those in which the DA candidates have same party affiliation and have high diffusion (green line), and (b) those where DA candidates have different affiliations and low diffusion (red line). High diffusion= above median number of farmers in the village who report discussing with other farmers in the village ."Profits" are equal to total revenues from selling agriculture output minus expenditures in the last season (in thousand of UGX). "Consumption per adult equivalent" is the log consumption per adult equivalent; which equals the household's monthly per capita consumption of food, non-durables and semi-durables (children below 18 are given a weight of 0.5 and adults a weight of 1) in thousand of UGX. All monetary values are truncated above and below two standard deviations from the mean.

Figure 9: DA predicted vs. actual wealth growth



Notes: This graph plots the actual wealth growth between baseline and endline; and the predicted wealth growth for each DA in our experiment (n=60). Wealth is measured with the total number of assets. See the text in the paper for more details on how "predicted wealth growth" is computed.

Table 1: ITT of the Agriculture Extension Program

	(1)	(2)	(3)	(4)	(5)	(6)
	Agriculture activity in the last cropping season					
	Acres of land cultivated	Number of marketable crops grown	Output value	Involved in commercial farming	Profits (revenues-expenditures)	Consumption per adult equivalent
Agri Extension Program	0.0964	0.2105*	60.5146*	0.0682**	33.5798**	24.0868*
	(0.06)	(0.11)	(36.16)	(0.03)	(14.17)	(13.27)
Observations	*4,204*	*4,410*	*4,247*	*4,309*	*3,968*	*4,333*
R-squared	*0.081*	*0.200*	*0.103*	*0.085*	*0.039*	*0.028*
Mean in Control	*1.138*	*1.243*	*337.4*	*0.566*	*76.96*	*110.6*
Randomization inference						
p-value (DA tie=0)	*0.152*	*0.072*	*0.092*	*0.020*	*0.010*	*0.156*

Notes: ANCOVA regressions with robust standard errors clustered at the village level. P-values from randomization inference using 500 random permutations are presented in italic at the bottom of the table. All regressions control for the four stratification variables (branch fixed effects, above median market distance, above median village size, above median proportion of farmers) and for the baseline value of the dependent variable. *** p<0.01, ** p<0.05, * p<0.1. Marketable crops include all crops except cereals and staple food. "Output value" is the total agriculture production (in thousand of UGX) in the last season. "Involved in commercial farming" equals 1 if the farmer's revenues from selling agriculture output are positive. "Profits" are equal to total revenues from selling agriculture output minus expenditures in the last season (in thousand of UGX). "Consumption per adult equivalent" equals the household's monthly per capita consumption of food, non-durables and semi-durables (children below 18 are given a weight of 0.5 and adults a weight of 1) in thousand of UGX. All monetary values are truncated above and below two standard deviations from the mean.

Table 2: Descriptives and Balance Checks – Agents Traits

	(1)	(2)	(3)	(4)
	Delivery agent (DA)	Counter-factual delivery agent (CA)	p-value DA = CA	Percentile of the DA within her own village
Panel A: Socio-economic characteristics and agriculture activity				
Acres of land owned	2.95	2.87	0.832	94.41
	(2.51)	(2.31)		(5.01)
Total number of assets owned	42.82	39.55	0.396	98.83
	(32.33)	(29.67)		(2.13)
Ever adopted improved seeds (1=yes)	0.84	0.80	0.442	86.57
	(0.37)	(0.40)		(3.67)
Number techniques ever adopted (out of 4)	1.59	1.67	0.498	94.39
	(0.79)	(0.63)		(2.42)
At least 1 technique ever adopted	0.72	0.78	0.200	87.83
	(0.45)	(0.42)		(4.54)
Acres of land cultivated	1.58	1.76	0.340	95.00
	(1.09)	(1.36)		(4.22)
Number of marketable crops grown	2.52	2.87	0.048	95.17
	(1.61)	(1.53)		(5.82)
Output value	654.08	696.04	0.784	97.50
	(952.06)	(934.38)		(2.52)
Involved in commercial farming	0.88	1.00	0.256	86.25
	(0.35)	(0.00)		(3.54)
Profits (revenues-expenditures)	471.88	585.88	0.744	98.75
	(327.63)	(708.68)		(2.31)
Panel B: Social ties				
% farmers who know the [DA/CA] (acquaintance, friend or family)	0.701	0.746	0.674	-
	(0.28)	(0.27)		
% farmers who are friends or family of [DA/CA]	0.344	0.342	0.304	-
	(0.23)	(0.23)		
% farmers who discuss agriculture with [DA/CA]	0.538	0.567	0.542	-
	(0.29)	(0.30)		
# years farmers have known the [DA/CA] for	10.734	10.365	0.042	-
	(5.52)	(5.67)		
% farmers who know only the [DA/CA] (and not the other)	0.088	0.133	0.674	-
	(0.13)	(0.17)		
% farmers who are only friends or family of the [DA/CA] (and not the other)	0.047	0.061	0.604	-
	(0.09)	(0.10)		
% farmers who discuss agriculture only with the [DA/CA] (and not the other)	0.109	0.137	0.459	-
	(0.13)	(0.16)		
Number of observations	*60*	*60*		*60*

Notes: The table presents summary statistics of DA characteristics (col.1) and CA characteristics (col.2), with one observation per village. The p-value reported in col.3 tests the equality of DA and CA traits (estimated with randomization inference using 500 random permutations). Col.4 presents summary statistics for the percentile of DA trait within her own village (example: the DA belongs to the 90th percentile if her trait is higher than 90% of the sample farmers in her village). "Number techniques ever adopted" calculates the number of good techniques ever adopted (out of 3: inter cropping, line sowing; zero tillage) and the number of bad techniques never adopted (out of 1: mixed cropping). "At least 1 technique ever adopted" equals 1 if the farmer has adopted at least one good technique or not adopted the bad technique. These adoption variables are self-reported. Marketable crops include all crops except cereals and staple food. "Output value" is the total agriculture production (in thousand of UGX) in the last season. "Involved in commercial farming" equals 1 if the farmer's revenues from selling agriculture output are positive. "Profits" are equal to total revenues from selling agriculture output minus expenditures in the last season (in thousand of UGX). We do not report the balance test for "Total consumption per adult equivalent" because this variable was collected for general farmers but not for the DA and the CA. All monetary values are truncated above and below two standard deviations from the mean.

Table 3: Balance Checks – Household Traits by Social Ties

	(1)	(2)	*(3)*	(4)	(5)	*(6)*	(7)	(8)	*(9)*
Definition of "ties" =>	**Acquaintance or friend/family**			**Friend/family**			**Discusses agriculture**		
	DA tie	CA tie	*p-value DA tie= CA tie*	DA tie	CA tie	*p-value DA tie= CA tie*	DA tie	CA tie	*p-value DA tie= CA tie*
Acres of land owned	2.47	2.55	*0.983*	2.16	2.66	*0.368*	2.18	2.54	*0.647*
	(4.57)	(5.15)		(2.82)	(5.54)		(4.17)	(5.49)	
Total number of assets owned	17.98	17.90	*0.805*	17.72	17.23	*0.707*	18.69	17.90	*0.414*
	(8.08)	(8.29)		(8.22)	(7.56)		(8.40)	(7.94)	
Ever adopted improved seeds (1=yes)	0.22	0.23	*0.387*	0.22	0.22	*0.370*	0.31	0.30	*0.314*
	(0.42)	(0.42)		(0.41)	(0.41)		(0.47)	(0.46)	
Number techniques ever adopted (out of 4)	1.34	1.13	*0.139*	1.37	1.05	*0.105*	1.39	1.18	*0.182*
	(0.96)	(0.93)		(0.99)	(0.90)		(0.95)	(0.92)	
At least 1 technique ever adopted	0.44	0.36	*0.202*	0.51	0.32	*0.030*	0.49	0.37	*0.096*
	(0.50)	(0.48)		(0.50)	(0.47)		(0.50)	(0.48)	
Acres of land cultivated	1.22	1.26	*0.958*	1.22	1.36	*0.352*	1.18	1.18	*0.463*
	(0.94)	(1.06)		(0.93)	(1.22)		(0.85)	(0.93)	
Number of marketable crops grown	1.10	1.19	*0.313*	1.05	1.13	*0.477*	1.26	1.20	*0.962*
	(0.97)	(0.91)		(0.95)	(0.84)		(0.90)	(0.91)	
Output value	441.10	489.29	*0.608*	433.47	540.32	*0.275*	445.33	504.12	*0.465*
	(1070.09)	(1074.97)		(1361.87)	(1366.13)		(1102.71)	(1231.83)	
Involved in commercial farming	0.53	0.58	*0.369*	0.54	0.55	*0.926*	0.59	0.58	*0.868*
	(0.50)	(0.49)		(0.50)	(0.50)		(0.49)	(0.49)	
Profits (revenues-expenditures)	82.92	77.62	*0.786*	81.38	80.72	*0.913*	86.71	65.45	*0.499*
	(314.03)	(266.86)		(343.84)	(300.58)		(336.93)	(257.19)	
Total consumption per adult equivalent	182.72	150.59	*0.311*	188.28	129.47	*0.209*	136.91	155.06	*0.406*
	(271.05)	(226.39)		(260.77)	(138.66)		(160.37)	(295.70)	
Distance from DA (in walking minutes)	1.43	2.17	*0.060*	1.43	2.50	*0.046*	1.28	2.00	*0.084*
	(3.34)	(6.84)		(3.47)	(7.46)		(2.71)	(5.84)	
Number of observations	*262*	*400*		*139*	*189*		*241*	*315*	

Notes: The table shows means and standard deviations in parentheses for DA vs CA ties. DA tie = knowing the DA only (col. 1 and 2); being a friend or family member of the DA only (col. 4 and 5); discussing agriculture with the DA only (col. 7 and 8). The p-values test the equality of DA and CA ties; with standard errors clustered at the connection status*village level, and controlling for branch fixed effects."Number techniques ever adopted" calculates the number of good techniques ever adopted (out of 3: inter cropping, line sowing; zero tillage) and the number of bad techniques never adopted (out of 1: mixed cropping). "At least 1 technique ever adopted" equals 1 if the farmer has adopted at least one good technique or not adopted the bad technique. These adoption variables are self-reported. Marketable crops include all crops except cereals and staple food. "Output value" is the total agriculture production (in thousand of UGX) in the last season. "Involved in commercial farming" equals 1 if the farmer's revenues from selling agriculture output are positive. "Profits" are equal to total revenues from selling agriculture output minus expenditures in the last season (in thousand of UGX). "Total consumption per adult equivalent" equals the household's monthly per capita consumption of food, non-durables and semi-durables (children below 18 are given a weight of 0.5 and adults a weight of 1) in thousand of UGX. All monetary values are truncated above and below two standard deviations from the mean.

Table 4: Social Ties and Targeting Bias

	(1)	(2)	(3)	(4)	(5)	(6)
Definition of "tie" =>	**Acquaintance or friend/family**		**Friend/family**		**Discusses agriculture**	
Dep. Var. =>	Trained by the DA	Received seeds from the DA	Trained by the DA	Received seeds from the DA	Trained by the DA	Received seeds from the DA
DA tie (vs CA tie)	0.0748***	0.0638***	0.0848***	0.0609**	0.0369	0.0395**
	(0.03)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)
Observations	2,423	2,430	2,423	2,430	2,089	2,095
R-squared	0.017	0.014	0.014	0.010	0.015	0.012
Mean Dep. Var. for CA tie	0.016	0.008	0.023	0.017	0.024	0.014
Randomization inference						
p-value (DA tie=0)	*0.000*	*0.000*	*0.000*	*0.000*	*0.004*	*0.002*

Notes: OLS regressions with robust standard errors clustered at the connection status*village level in parenthesis. P-values from randomization inference using 500 random permutations are presented in italic at the bottom of the table. The definition of "DA tie" varies across columns. DA tie = knowing the DA only (col. 1 and 2); being a friend or family member of the DA only (col. 3 and 4); discussing agriculture with the DA only (col. 5 and 6). All regressions control for branch fixed effects, for the walking distance to DA home, for whether the farmer is tied to both the DA and the CA ("shared tie") or to neither of them ("no tie"). The omitted group are farmers tied only to the CA ("CA tie"). "Trained by the DA" equals 1 if the respondent was trained by the DA in the past year. "Received seeds from the DA" equals 1 if the respondent bought seeds from the DA in the past year. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Favor exchange network

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Elites farmers are united if they are/belong to =>	**Friends or family**		**Same party (self-reported)**		**Same party (IAT)**		**Same religion**	
Dep. Var. =>	Trained by the DA	Received seeds from the DA	Trained by the DA	Received seeds from the DA	Trained by the DA	Received seeds from the DA	Trained by the DA	Received seeds from the DA
DA tie vs CA tie in villages where:								
(1) elite farmers are united	0.0175	0.0208	-0.0025	0.0036	0.0144	0.0200	0.0227	0.0353
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)
(2) elite farmers are divided	0.1092***	0.1005***	0.0975***	0.0878***	0.1137***	0.0934***	0.0942***	0.0704**
	(0.04)	(0.04)	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Observations	2,245	2,252	2,218	2,225	2,067	2,074	2,218	2,225
R-squared	0.139	0.142	0.137	0.142	0.143	0.141	0.136	0.140
Mean Dep. Var.	0.038	0.034	0.038	0.034	0.038	0.034	0.038	0.034
p-value (1)=(2)	0.056	0.062	0.007	0.006	0.014	0.040	0.089	0.349
Village FE	Y	Y	Y	Y	Y	Y	Y	Y
Randomization inference								
p-value (CA tie = DA tie) if elites united	*0.098*	*0.034*	*0.900*	*0.790*	*0.446*	*0.232*	*0.540*	*0.170*
p-value (CA tie = DA tie) if elites divided	*0.000*	*0.000*	*0.002*	*0.004*	*0.002*	*0.000*	*0.002*	*0.012*

Notes: OLS regressions with robust standard errors clustered at the connection status*village level. P-values from randomization inference using 500 random permutations are presented in italic at the bottom of the table. "DA tie" equals 1 if the farmer knows who the DA is but does not know who the CA is. "Elites are united" is a village-level dummy for whether the DA and the CA are linked; where "being linked" = {being a friend or a family member; belonging to the same party (self-reported); belonging to the same party (based on an implicit association test (IAT))}. All regressions control for village fixed effects, for the walking distance to DA home, for whether the farmer is tied to both the DA and the CA ("shared tie") or tied to neither of them ("no tie") and for the interaction of the latter 2 variables with "DA-CA link". The omitted group are farmers tied only to the CA in villages in which the DA and CA have no link. "Trained by the DA" equals 1 if the respondent was trained by the DA in the past year. "Received seeds from the DA" equals 1 if the respondent bought seeds from the DA in the past year. The two randomization inference p-values are estimated by comparing "DA ties" vs. "CA ties" within the sample of villages with and without a DA-CA link separately. Given the political tensions in Uganda, we did not ask the DA and the CA about their political affiliation openly. Instead, we asked each of the agents to report whether they share the same political affiliation as the other agent. We define 2 agents to have different political affiliation (as self-reported) if both report that they do not belong to the same party. We also asked each agent to take an implicit association test (IAT) that tells us the extent to which they are biased towards the incumbent party (NRM, IAT score>0) or the opposition party (FDC); IAT score<0). Based on the IAT score, we define 2 agents to have different political affiliation if both DA agents are biased toward different parties (i.e., IAT scores have opposite signs). *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Strategic Diffusion

	(1)	(2)
Dep. Var. =>	Trained by the DA	Received seeds from the DA
DA tie	0.1424**	0.1219**
	(0.06)	(0.06)
DA tie * Share of farmers who discuss agriculture	-0.1548	-0.1350
	(0.10)	(0.09)
Observations	2,423	2,430
R-squared	0.128	0.134
Mean Dep. Var.	0.038	0.034
p-value DAtie + DAtie*Share	0.777	0.724
Village FE	Y	Y
Randomization inference		
p-value (DA tie=0) if Share who discuss agriculture > median (62%)	*0.002*	*0.006*
p-value (DA tie=0) if Share who discuss agriculture <=median (62%)	*1.000*	*1.000*

Notes: OLS regressions with robust standard errors clustered at the village level. "Share of farmers who discuss agriculture" is the proportion of sample farmers in the village who report discussing and asking advice on agriculture to other farmers in the village (median is 62%). All regressions control for village fixed effects, for the walking distance to DA home, for whether the farmer is tied to both the DA and the CA ("shared tie") or tied to neither of them ("no tie") and for the interaction of the latter 2 variables with "the share of farmers who discuss agriculture". P-values from randomization inference using 500 random permutations are presented in italic at the bottom of the table. "Trained by the DA" equals 1 if the respondent was trained by the DA in the past year. "Received seeds from the DA" equals 1 if the respondent bought seeds from the DA in the past year. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Strategic Diffusion

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample of villages: DA and CA are/have [...] =>	friend / family	not friend / family	friend / family	not friend / family	same party (self-reported)	different party (self-reported)	same party (self-reported)	different party (self-reported)
Dep. Var. =>	Trained by the DA		Received seeds from the DA		Trained by the DA		Received seeds from the DA	
DA tie	0.0191	0.3395***	0.0479	0.3171***	-0.1181*	0.2991***	-0.0545	0.2836***
	(0.05)	(0.08)	(0.04)	(0.07)	(0.06)	(0.05)	(0.05)	(0.05)
DA tie * Share of farmers who discuss agriculture	-0.0043	-0.4167***	-0.0538	-0.3916***	0.2209*	-0.3751***	0.1125	-0.3633***
	(0.08)	(0.14)	(0.06)	(0.14)	(0.13)	(0.08)	(0.10)	(0.07)
Observations	1,607	638	1,613	639	1,194	1,024	1,200	1,025
R-squared	0.169	0.086	0.173	0.076	0.084	0.197	0.068	0.232
Mean Dep. Var.	0.038	0.038	0.034	0.034	0.038	0.038	0.034	0.034
p-value DAtie + DAtie*share	0.717	0.314	0.801	0.308	0.183	0.045	0.333	0.017
Village FE	Y	Y	Y	Y	Y	Y	Y	Y

(continued)

	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Sample of villages: DA and CA are/have [...] =>	same party (IAT)	different party (IAT)	same party (IAT)	different party (IAT)	same religion	different religion	same religion	different religion
Dep. Var. =>	Trained by the DA		Received seeds from the DA		Trained by the DA		Received seeds from the DA	
DA tie	0.0877	0.1816**	0.0792	0.1690**	0.0143	0.3078***	0.0049	0.2934***
	(0.07)	(0.07)	(0.07)	(0.08)	(0.06)	(0.07)	(0.06)	(0.05)
DA tie * Share of farmers who discuss agriculture	-0.1293	-0.1435	-0.1047	-0.1578	0.0156	-0.3749***	0.0600	-0.3936***
	(0.09)	(0.14)	(0.09)	(0.15)	(0.13)	(0.10)	(0.11)	(0.08)
Observations	980	1,087	984	1,090	1,220	998	1,225	1,000
R-squared	0.056	0.193	0.047	0.197	0.107	0.174	0.105	0.199
Mean Dep. Var.	0.038	0.038	0.034	0.034	0.038	0.038	0.034	0.034
p-value DAtie + DAtie*share	0.186	0.618	0.409	0.885	0.673	0.154	0.256	0.002
Village FE	Y	Y	Y	Y	Y	Y	Y	Y

Notes: OLS regressions with robust standard errors clustered at the village level. "DA-CA same (different) party" is a village-level dummy for whether the DA and the CA belong to the same (different) party. The latter variable is either self-reported or measured through an implicit association test. "Share of farmers who discuss agriculture" is the proportion of sample farmers in the village who report discussing and asking advice on agriculture to other farmers in the village (median is 62%). All regressions control for branch fixed effects, for the walking distance to DA home, for whether the farmer is tied to both the DA and the CA ("shared tie") or tied to neither of them ("no tie") and for the interaction of the latter 2 variables with "the share of farmers who discuss agriculture". "Trained by the DA" equals 1 if the respondent was trained by the DA in the past year. "Received seeds from the DA" equals 1 if the respondent bought seeds from the DA in the past year. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Targeting Bias

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
"VAR1" = Bottom quartile of [..] =>	**Consumption per adult equivalent**		**Skips meals or eats reduced portions less than once a week**		**Total value of assets owned**		**Number techniques known**		**Number techniques who are believed to have positive returns**		**Knows improved seeds**		**Believes improved seeds have positive returns**		**Number techniques ever adopted**		**Number of marketable crops grown**	
Dep. Var. =>	Trained by the DA	Received seeds from the DA	Trained by the DA	Received seeds from the DA	Trained by the DA	Received seeds from the DA	Trained by the DA	Received seeds from the DA	Trained by the DA	Received seeds from the DA	Trained by the DA	Received seeds from the DA	Trained by the DA	Received seeds from the DA	Trained by the DA	Received seeds from the DA	Trained by the DA	Received seeds from the DA
VAR1	0.0033	-0.0007	0.0022	-0.0110	-0.0020	-0.0086	-0.0012	-0.0055	-0.0027	-0.0038	-0.0127	-0.0270***	0.0119	0.0147	-0.0017	-0.0037	0.0034	-0.0050
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
DA tie * VAR1	0.0363	0.0309	-0.0173	0.1108	0.0190	0.0331	0.0289	0.0402	0.1635*	0.0683*	0.1102**	0.0713	0.1027	0.1085	-0.0218	-0.0083	0.0363	0.0531
	(0.03)	(0.02)	(0.02)	(0.10)	(0.02)	(0.02)	(0.04)	(0.04)	(0.09)	(0.04)	(0.05)	(0.04)	(0.11)	(0.11)	(0.02)	(0.01)	(0.04)	(0.04)
DA tie * VAR0	0.0865***	0.0739***	0.0787***	0.0617***	0.0935***	0.0742***	0.0797***	0.0660***	0.0632**	0.0632***	0.0716***	0.0623***	0.0739***	0.0623***	0.0776***	0.0658***	0.0815***	0.0663***
	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)
Observations	2,423	2,430	2,423	2,430	2,423	2,430	2,423	2,430	2,423	2,430	2,423	2,430	2,423	2,430	2,423	2,430	2,423	2,430
R-squared	0.018	0.015	0.018	0.014	0.020	0.016	0.017	0.014	0.019	0.014	0.017	0.015	0.017	0.015	0.018	0.015	0.017	0.014
Mean Dep. Var. for CA tie*VAR0	0.014	0.007	0.017	0.009	0.018	0.011	0.019	0.010	0.016	0.006	0.012	0.009	0.017	0.008	0.015	0.009	0.018	0.009
pvalue (CA tie = DA tie) if VAR1=1	0.246	0.153	0.547	0.229	0.392	0.075	0.488	0.271	0.059	0.074	0.016	0.033	0.425	0.407	0.522	0.870	0.492	0.205
pvalue (VAR1 = VAR0) if DA tie=1	0.063	0.036	0.002	0.624	0.024	0.192	0.234	0.496	0.257	0.905	0.356	0.844	0.792	0.664	0.001	0.004	0.352	0.767
pvalue (DA tie*VAR0 = CA tie*VAR1)	0.005	0.003	0.011	0.007	0.002	0.002	0.004	0.003	0.016	0.010	0.003	0.000	0.064	0.119	0.008	0.007	0.009	0.005
Randomization inference																		
p-value (CA tie = DA tie) if VAR1=1	*0.154*	*0.118*	*0.946*	*0.018*	*0.270*	*0.008*	*0.100*	*0.926*	*0.012*	*0.926*	*0.044*	*0.028*	*0.160*	*0.196*	*0.100*	*0.926*	*0.096*	*0.032*
p-value (CA tie = DA tie) if VAR1=0	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*

Notes: OLS regressions with robust standard errors clustered at the connection status*village level. P-values from randomization inference using 500 random permutations are presented in italic at the bottom of the table. "DA tie" equals 1 if the farmer knows who the DA is but does not know who the CA is. "VAR1" equals 1 if the farmer is in the bottom quartile of the baseline distribution of variable X; where variable X = {the number of techniques ever adopted at baseline; the number of marketable crops ever grown; food consumption per adult equivalent; food security (skipping meals or eating reduced portions less than once a week--the median is 1 and "being in the bottom quartile" indicates being food insecure); total value of asset owned (in thousand of UGX)}. All regressions control for branch fixed effects, for the walking distance to DA home, for whether the farmer is tied to both the DA and the CA ("shared tie") or to neither of them ("no tie"). The omitted group are farmers tied only to the CA who are not in the bottom quartile of variable X. "Trained by the DA" equals 1 if the respondent was trained by the DA in the past year. "Received seeds from the DA" equals 1 if the respondent bought seeds from the DA in the past year. The two randomization inference p-values are estimated by comparing "DA ties" vs. "CA ties" within the sample of "VAR1" farmers and "VAR0" farmers separately. *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Adoption

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. Var. =>	Adopted seeds from any BRAC source			Adopted at least one technique (observed)			Adopted at least one technique (self-reported)		
Sample of villages =>	All	Same party	Different party	All	Same party	Different party	All	Same party	Different party
DA tie (vs CA tie)	0.0341	-0.0812*	0.1157**	0.0811	0.0176	0.0728	0.0675	0.0458	0.0764
	(0.04)	(0.04)	(0.05)	(0.05)	(0.08)	(0.06)	(0.05)	(0.07)	(0.07)
Observations	2,448	1,211	1,030	1,327	670	572	1,327	670	572
R-squared	0.011	0.015	0.028	0.021	0.034	0.014	0.026	0.046	0.012
Mean Dep. Var. for CA tie*no link	0.086	0.134	0.061	0.069	0.113	0.033	0.098	0.085	0.098
Randomization inference									
p-value (CA tie = DA tie)	*0.180*	*0.008*	*0.006*	*0.122*	*0.010*	*0.846*	*0.180*	*0.052*	*0.604*

Notes: OLS regressions with robust standard errors clustered at the connection status*village level. Regression are run on the full sample of villages; in the sample of village where the DA and CA have same party (as self-reported) and where they have different parties. P-values from randomization inference using 500 random permutations are presented in italic at the bottom of the table. "DA tie" equals 1 if the farmer knows who the DA is but does not know who the CA is. All regressions control for branch fixed effects, for the walking distance to DA home, for whether the farmer is tied to both the DA and the CA ("shared tie") or tied to neither of them ("no tie"). The omitted group are farmers tied only to the CA in villages. "Adopted seeds from any BRAC source" equals 1 if the respondent bought seeds from either the DA, the program assistant or any other BRAC staff in the past year. "Adopted at least one technique (observed)" equals 1 if the respondent adopted properly at least one of the 4 techniques in the past year, as measured with enumerator observation. *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Aggregate treatment and adoption

	(1)	(2)	(3)	(4)
	DA delivery		**Adoption**	
Dep. Var. =>	Total number of farmers trained	Total number of farmers DA sold seeds to	Total number of farmers who adopted seeds from any BRAC source	Total number of farmers who adopted at least one technique
Number of DA Ties	0.2478***	0.2310***	0.1842	0.1528
	(0.08)	(0.07)	(0.11)	(0.11)
Observations (# villages)	60	60	60	60
Rsquared	0.214	0.213	0.334	0.329
Mean Dep Var	1.550	1.367	3.467	2.617
Randomization inference				
p-value (Number of DA Ties=0)	*0.000*	*0.000*	*0.124*	*0.046*

Notes: OLS regressions with robust standard errors in parenthesis. P-values from randomization inference using 500 random permutations are presented in italic at the bottom of the table. All regressions control for the number of exclusive ties (DA+CA ties), total number of sampled farmers in the village and branch fixed effects. Total number of farmers trained (sold seeds to) equals the sum of the sample farmers who report being trained by (sold seeds by) the DA. Total number of farmers who adopted at least one technique is based on enumerators observations. Total number of farmers who adopted seeds is the sum of farmers who report getting seeds from the DA or other BRAC sources. The number of DA ties is the sum of sample farmers who know the DA. *** p<0.01, ** p<0.05, * p<0.1.

Table 11: Spillovers

Dep.Var. = Adopted at least one technique (observed)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
DA-CA Link =>			**Friends or family**		**Same party (self-reported)**		**Same party (IAT)**		**Same religion**	
Trained by the DA	0.0828	0.1024	0.0834	0.1697	0.2117***	0.1741**	-0.0281	-0.0072	0.1408*	0.1531
	(0.06)	(0.08)	(0.10)	(0.12)	(0.07)	(0.08)	(0.07)	(0.08)	(0.08)	(0.10)
High Diffusion		-0.0291		-0.0645		-0.0630*		-0.0327		-0.0467
		(0.03)		(0.04)		(0.03)		(0.04)		(0.03)
Trained * High Diffusion		-0.0693		-0.2024		0.1397		-0.0980		-0.0611
		(0.13)		(0.16)		(0.16)		(0.17)		(0.15)
DA-CA link			-0.0146	-0.0300	0.0529***	0.0162	-0.0166	-0.0328	0.0039	-0.0155
			(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
Trained * DA-CA link			-0.0620	-0.1140	-0.2785**	-0.1886	0.1374	0.1911	-0.1736	-0.1553
			(0.13)	(0.14)	(0.11)	(0.15)	(0.12)	(0.14)	(0.12)	(0.14)
DA-CA link * High Diffusion				0.0160		0.0569		0.0321		0.0408
				(0.04)		(0.04)		(0.04)		(0.03)
Trained * DA-CA link * High Diffusion				0.0187		-0.2721		-0.1229		-0.0400
				(0.22)		(0.23)		(0.23)		(0.23)
Observations	1,312	1,312	1,246	1,246	1,229	1,229	1,205	1,205	1,229	1,229
R-squared	0.247	0.248	0.253	0.259	0.280	0.283	0.269	0.273	0.271	0.274
Mean Dep. Var. for omitted group	0.110	0.081	0.088	0.053	0.044	0.045	0.077	0.071	0.115	0.093
p-value trained + trained* high diff		0.441								
p-value trained + trained* DA-CA link			0.538		0.045		0.314		0.140	

Notes: OLS regressions with robust standard errors clustered at the connection status*village level. "High diffusion" =1 if the share of farmers reporting to discuss agriculture with others is above the median. "DA-CA link" is a village-level dummy for whether the DA and the CA are linked; where "being linked" = {belonging to the same party (self-reported); belonging to the same party (based on IAT); being a friend or a family member}. *** p<0.01, ** p<0.05, * p<0.1.

Figure A1: Timeline

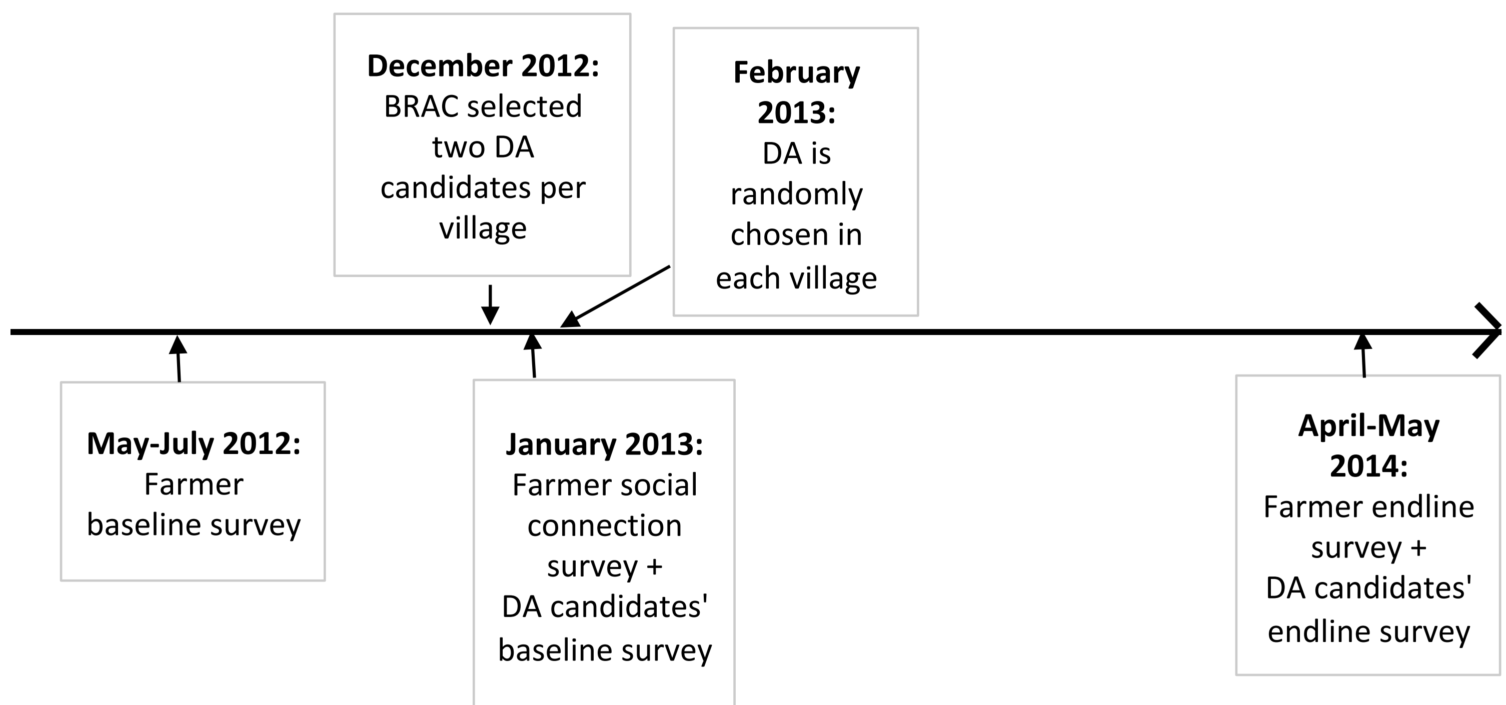
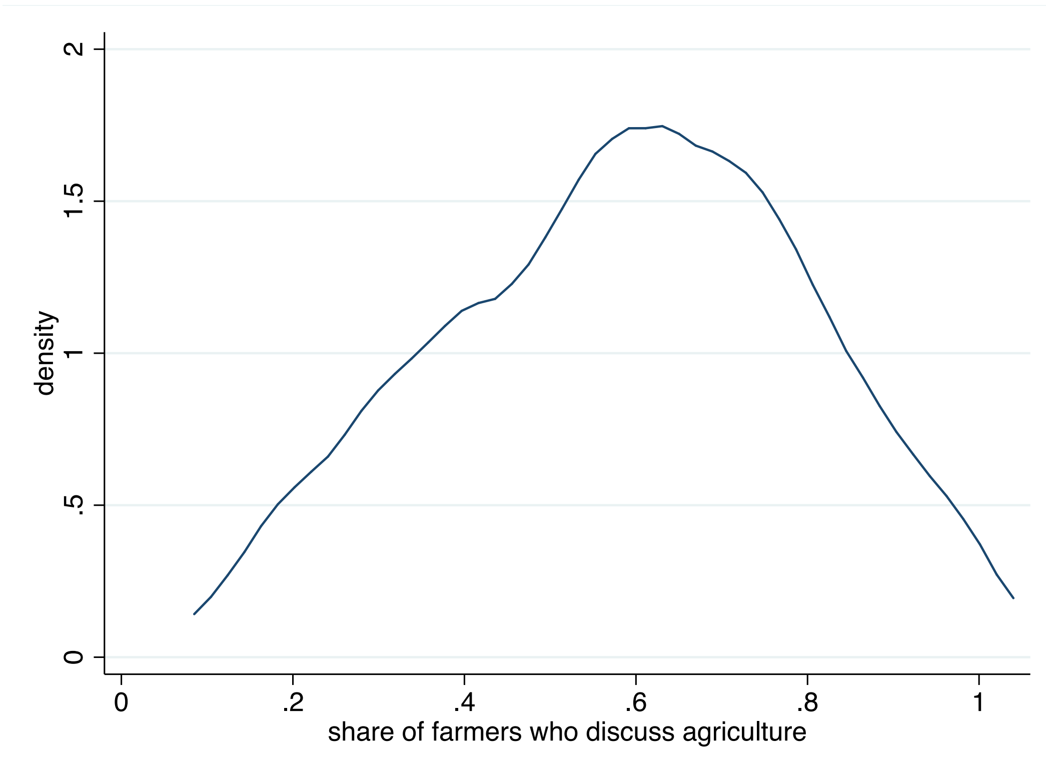


Figure A2: Density of farmers connectedness



Notes: Kernel density of the village-level share of farmers who report discussing agriculture with other farmers in their own village (n=60 villages). Optimal brandwidth.

Table A1: Balance Checks – Household Traits by Social Ties

	(1)	(2)	(3)	(4)	(5)
	Tie = Acquaintance or friend / family				
	No tie (neither DA nor CA)	One tie (DA or CA)	Shared tie (DA and CA)	p-value One = No	p-value One = Shared
Acres of land owned	2.20	2.52	1.97	0.198	0.011
	(2.21)	(4.93)	(2.29)		
Total number of assets owned	19.23	17.93	18.09	0.180	0.791
	(8.78)	(8.20)	(8.44)		
Ever adopted improved seeds (1=yes)	0.23	0.23	0.38	0.887	0.001
	(0.42)	(0.42)	(0.49)		
Number techniques ever adopted (out of 4)	1.24	1.21	1.33	0.755	0.126
	(0.86)	(0.95)	(0.89)		
At least 1 technique ever adopted	0.37	0.39	0.45	0.699	0.148
	(0.48)	(0.49)	(0.50)		
Acres of land cultivated	1.21	1.24	1.18	0.734	0.377
	(0.95)	(1.01)	(1.02)		
Number of marketable crops grown	1.25	1.15	1.26	0.220	0.114
	(0.86)	(0.93)	(0.87)		
Output value	399.27	470.22	534.88	0.225	0.475
	(826.54)	(1072.49)	(1861.38)		
Involved in commercial farming	0.55	0.56	0.58	0.799	0.598
	(0.50)	(0.50)	(0.49)		
Profits (revenues-expenditures)	81.57	79.72	81.97	0.928	0.895
	(307.24)	(286.19)	(315.95)		
Total consumption per adult equivalent	198.26	163.39	150.03	0.127	0.413
	(328.61)	(245.46)	(310.57)		
Distance from DA (in walking minutes)	1.66	1.88	1.54	0.519	0.209
	(5.10)	(5.72)	(5.62)		

Notes: Columns 1=3 show means and standard deviations in parentheses. Column 4-5 report the p-value of the test of equality of means based on standard errors clustered at the connection status*village level and controlling for branch fixed effects. "No tie" = farmers who know neither the DA nor the CA. "One tie" = Farmer who know either the DA or the CA. "Shared tie" = farmer who know both the DA and the CA. "Number techniques ever adopted" calculates the number of good techniques ever adopted (out of 3: inter cropping, line sowing; zero tillage) and the number of bad techniques never adopted (out of 1: mixed cropping). "At least 1 technique ever adopted" equals 1 if the farmer has adopted at least one good technique or not adopted the bad technique. These adoption variables are self-reported. Marketable crops include all crops except cereals and staple food. "Output value" is the total agriculture production (in thousand of UGX) in the last season. "Involved in commercial farming" equals 1 if the farmer's revenues from selling agriculture output are positive. "Profits" are equal to total revenues from selling agriculture output minus expenditures in the last season (in thousand of UGX). "Total consumption per adult equivalent" equals the household's monthly per capita consumption of food, non-durables and semi-durables (children below 18 are given a weight of 0.5 and adults a weight of 1) in thousand of UGX. All monetary values are truncated above and below two standard deviations from the mean.

Table A2: Balance Checks – Village Infrastructure by delivery agent-counterfactual agent Tie

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
	Share of DA Ties among DA+CA Ties			**DA&CA friendship**			**DA&CA political affiliation (self-reported)**			**DA&CA political affiliation (IAT)**			**DA&CA religious affiliation**			**Share of farmers who discuss agriculture with others**		
Sample of villages =>	Share is below median (43%)	Share is above median (43%)	*p-value diff.*	Not friend/ family	Friend/ family	*p-value diff.*	Different Party	Same Party	*p-value diff.*	Different Party	Same Party	*p-value diff.*	Different Religion	Same Religion	*p-value diff.*	Share is below median (62%)	Share is above median (4362%)	*p-value diff.*
Number of villages	30	30		13	42		26	27		24	23		26	27		30	30	
Panel A: DA socio-economic characteristics and agriculture activity																		
Acres of land owned	0.687	0.791	0.807	2.500	1.994	0.073	2.079	2.049	0.856	2.076	2.243	0.050	1.919	2.202	0.418	2.007	2.075	0.951
	(18.37)	(18.93)		(0.70)	(0.68)		(0.81)	(0.74)		(0.53)	(0.92)		(0.80)	(0.72)		(0.88)	(0.57)	
Total number of assets owned	2.819	3.256	0.661	18.137	18.696	0.510	18.585	18.493	0.757	17.842	18.919	0.664	18.135	18.927	0.021	19.046	18.286	0.272
	(0.00)	(0.00)		(3.49)	(2.90)		(2.72)	(3.22)		(2.70)	(3.07)		(3.10)	(2.81)		(3.37)	(2.69)	
Number techniques ever adopted (out of 4)	0.319	0.304	0.611	1.400	1.325	0.513	1.346	1.310	0.220	1.294	1.343	0.506	1.371	1.286	0.103	1.267	1.404	0.743
	(0.41)	(0.47)		(0.31)	(0.32)		(0.28)	(0.31)		(0.30)	(0.31)		(0.30)	(0.28)		(0.31)	(0.31)	
Acres of land cultivated	0.235	0.277	0.510	1.306	1.153	0.135	1.193	1.135	0.491	1.231	1.138	0.723	1.068	1.256	0.027	1.122	1.196	0.356
	(1.19)	(1.24)		(0.22)	(0.24)		(0.29)	(0.24)		(0.22)	(0.28)		(0.28)	(0.22)		(0.28)	(0.23)	
Number of marketable crops grown	0.375	0.364	0.627	1.235	1.266	0.235	1.171	1.222	0.942	1.290	1.176	0.232	1.113	1.278	0.201	1.078	1.355	0.751
	(376.03)	(568.16)		(0.29)	(0.36)		(0.37)	(0.29)		(0.29)	(0.28)		(0.33)	(0.31)		(0.30)	(0.38)	
Output value	213.077	463.024	0.027	662.668	445.362	0.354	517.116	489.422	0.512	516.888	512.014	0.802	473.343	531.574	0.803	401.875	555.124	0.473
	(0.55)	(0.55)		(520.08)	(321.85)		(424.92)	(366.52)		(409.90)	(391.91)		(364.34)	(423.06)		(216.65)	(481.01)	
Involved in commercial farming	0.153	0.179	0.724	0.664	0.535	0.067	0.548	0.557	0.898	0.599	0.534	0.409	0.540	0.565	0.374	0.484	0.618	0.003
	(69.96)	(91.12)		(0.11)	(0.16)		(0.16)	(0.15)		(0.12)	(0.15)		(0.16)	(0.14)		(0.18)	(0.12)	
Profits (revenues-expenditures)	50.813	95.223	0.475	129.538	75.243	0.099	70.339	88.346	0.428	75.475	94.387	0.213	77.417	81.531	0.657	60.095	102.395	0.376
	(58.95)	(111.28)		(99.51)	(63.06)		(63.19)	(76.91)		(46.22)	(85.76)		(81.26)	(59.68)		(66.53)	(83.52)	
Panel B: Village characteristics																		
Number of farmers in the village	85.501	81.790	0.804	95.918	82.298	0.756	88.593	84.631	0.820	89.866	87.160	0.306	83.934	89.118	0.660	82.023	85.021	0.692
	(41.36)	(27.46)		(25.53)	(36.70)		(34.33)	(36.13)		(35.42)	(34.36)		(36.42)	(34.03)		(36.63)	(32.55)	
Minutes to the BRAC branch (walking)	106.670	94.247	0.868	130.331	93.762	0.459	107.098	95.447	0.759	117.322	95.809	0.925	94.504	107.574	0.796	100.910	99.178	0.129
	(54.35)	(60.58)		(63.76)	(53.86)		(60.14)	(56.83)		(56.20)	(59.81)		(60.47)	(56.33)		(63.78)	(51.81)	
Minutes to closest market (walking)	80.448	66.834	0.963	79.792	72.367	0.871	69.381	77.761	0.219	86.392	62.738	0.397	70.569	76.617	1.000	82.185	64.190	0.956
	(47.90)	(47.07)		(60.09)	(42.91)		(50.09)	(48.82)		(48.88)	(49.17)		(48.78)	(50.25)		(50.58)	(43.29)	
Minutes to main road (walking)	3.295	0.727	0.182	1.734	2.077	0.278	1.844	2.479	0.223	1.912	2.377	0.354	2.022	2.308	0.959	3.101	0.750	0.293
	(6.25)	(1.84)		(2.67)	(5.32)		(3.36)	(6.02)		(3.41)	(6.41)		(3.48)	(5.97)		(5.99)	(2.15)	
Road usable during rainy season (1=yes)	0.599	0.549	0.315	0.582	0.558	0.616	0.584	0.487	0.307	0.577	0.505	0.564	0.424	0.641	0.071	0.518	0.627	0.944
	(0.38)	(0.43)		(0.40)	(0.41)		(0.39)	(0.41)		(0.39)	(0.40)		(0.40)	(0.37)		(0.40)	(0.41)	
Microfinance (=1 if available)	0.008	0.082	0.136	0.077	0.044	0.395	0.054	0.054	0.859	0.042	0.071	0.978	0.054	0.054	0.775	0.054	0.041	0.528
	(0.04)	(0.26)		(0.28)	(0.17)		(0.20)	(0.21)		(0.20)	(0.23)		(0.20)	(0.21)		(0.20)	(0.19)	
Farmer cooperative (=1 if available)	0.294	0.319	0.571	0.071	0.360	0.007	0.215	0.362	0.151	0.197	0.336	0.528	0.310	0.270	0.668	0.253	0.363	0.367
	(0.34)	(0.40)		(0.16)	(0.37)		(0.31)	(0.39)		(0.31)	(0.37)		(0.36)	(0.36)		(0.34)	(0.40)	
SACCOs (=1 if available)	0.358	0.418	0.842	0.180	0.420	0.576	0.466	0.366	0.146	0.355	0.416	0.425	0.386	0.443	0.018	0.402	0.378	0.292
	(0.39)	(0.43)		(0.35)	(0.41)		(0.44)	(0.39)		(0.40)	(0.43)		(0.40)	(0.43)		(0.41)	(0.42)	
Electricity (=1 if available)	0.342	0.513	0.056	0.505	0.387	0.013	0.460	0.409	0.595	0.292	0.537	0.318	0.456	0.413	0.327	0.514	0.353	0.472
	(0.39)	(0.47)		(0.45)	(0.44)		(0.43)	(0.43)		(0.39)	(0.44)		(0.42)	(0.44)		(0.44)	(0.42)	
Television broadcast (=1 if available)	0.672	0.698	0.883	0.889	0.673	0.518	0.665	0.687	0.855	0.863	0.613	0.337	0.605	0.744	0.093	0.494	0.877	0.236
	(0.45)	(0.46)		(0.29)	(0.46)		(0.46)	(0.46)		(0.34)	(0.47)		(0.49)	(0.42)		(0.48)	(0.32)	
Newspapers (=1 if available)	0.085	0.143	0.266	0.168	0.074	0.269	0.147	0.091	0.518	0.096	0.129	0.838	0.098	0.139	0.333	0.170	0.062	0.132
	(0.23)	(0.32)		(0.37)	(0.20)		(0.33)	(0.23)		(0.29)	(0.25)		(0.23)	(0.33)		(0.32)	(0.22)	
Mobile coverage (=1 if available)	0.724	0.763	0.602	0.788	0.715	0.336	0.789	0.658	0.197	0.601	0.776	0.400	0.740	0.705	0.657	0.892	0.597	0.143
	(0.42)	(0.42)		(0.39)	(0.45)		(0.39)	(0.48)		(0.49)	(0.40)		(0.43)	(0.45)		(0.31)	(0.47)	
Share of votes to main party (inverse of polarizatic	0.600	0.645	0.235	0.621	0.622	0.813	0.624	0.615	0.133	0.606	0.617	0.865	0.616	0.623	0.418	0.612	0.635	0.643
	(0.06)	(0.08)		(0.08)	(0.08)		(0.08)	(0.08)		(0.07)	(0.08)		(0.07)	(0.08)		(0.08)	(0.08)	
Average distance from any farmer to DA	1.635	1.679	0.475	2.120	1.466	0.018	1.969	1.479	0.217	1.661	1.645	0.744	1.791	1.650	0.971	1.679	1.639	0.007
	(0.95)	(1.22)		(1.23)	(1.02)		(1.08)	(1.15)		(1.11)	(1.21)		(1.00)	(1.26)		(1.04)	(1.17)	
% DA ties	0.065	0.107	0.020	0.101	0.076	0.646	0.118	0.068	0.378	0.072	0.115	0.112	0.100	0.085	0.794	0.116	0.060	0.754
	(0.10)	(0.15)		(0.16)	(0.11)		(0.16)	(0.09)		(0.12)	(0.12)		(0.14)	(0.12)		(0.15)	(0.10)	
% CA ties	0.234	0.044	0.001	0.203	0.115	0.050	0.178	0.099	0.343	0.128	0.140	0.419	0.171	0.106	0.146	0.166	0.099	0.242
	(0.18)	(0.11)		(0.21)	(0.16)		(0.20)	(0.16)		(0.16)	(0.19)		(0.20)	(0.15)		(0.18)	(0.16)	
% Shared ties	0.554	0.665	0.583	0.621	0.609	0.653	0.582	0.596	0.792	0.668	0.499	0.010	0.540	0.637	0.291	0.580	0.646	0.911
	(0.28)	(0.37)		(0.38)	(0.33)		(0.34)	(0.34)		(0.32)	(0.35)		(0.34)	(0.32)		(0.33)	(0.33)	

Notes: p-values of the test of equality of means based on robust standard errors and controlling for branch fixed effects."Number techniques ever adopted" calculates the number of good techniques ever adopted (out of 3: inter cropping, line sowing; zero tillage) and the number of bad techniques never adopted (out of 1: mixed cropping). "At least 1 technique ever adopted" equals 1 if the farmer has adopted at least one good technique or not adopted the bad technique. These adoption variables are self-reported. Marketable crops include all crops except cereals and staple food. "Output value" is the total agriculture production (in thousand of UGX) in the last season. "Involved in commercial farming" equals 1 if the farmer's revenues from selling agriculture output are positive. "Profits" are equal to total revenues from selling agriculture output minus expenditures in the last season (in thousand of UGX). All monetary values are truncated above and below two standard deviations from the mean.

Table A3: Delivery by DA-CA link, with extra Controls (village characteristics interacted with ties)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Elites farmers are united if they are/belong to =>	**Friends or family**		**Same party (self-reported)**		**Same party (IAT)**		**Same religion**	
Dep. Var. =>	Trained by the DA	Received seeds from the DA	Trained by the DA	Received seeds from the DA	Trained by the DA	Received seeds from the DA	Trained by the DA	Received seeds from the DA
DA tie vs CA tie in villages where:								
(1) elite farmers are united	0.1258	0.2520	0.0758	0.1725	-0.1442	0.1453	0.1075	0.1863
	(0.16)	(0.19)	(0.20)	(0.23)	(0.19)	(0.24)	(0.20)	(0.22)
(2) elite farmers are divided	0.2807*	0.3991**	0.1387	0.1889	-0.0417	0.2009	0.1520	0.1709
	(0.16)	(0.20)	(0.21)	(0.22)	(0.20)	(0.25)	(0.20)	(0.21)
Observations	2,224	2,231	2,197	2,204	2,053	2,060	2,197	2,204
R-squared	0.174	0.170	0.172	0.168	0.177	0.170	0.172	0.169
Mean Dep. Var.	0.038	0.034	0.038	0.034	0.038	0.034	0.038	0.034
p-value (1)=(2)	**0.000**	**0.000**	**0.045**	**0.608**	**0.000**	**0.057**	**0.084**	**0.663**
Village FE	Y	Y	Y	Y	Y	Y	Y	Y
Village controls* Ties	Y	Y	Y	Y	Y	Y	Y	Y

Notes: OLS regressions with robust standard errors clustered at the connection status*village level. All regressions also control for village controls, each interacted with DA tie/CA tie/Shared tie. The village controls are: Village polarization (Share of votes to main party), Minutes to the BRAC branch, Minutes to closest market, Distance to main road, Road is usable during rainy season, Microfinance available in the village, Farmer cooperative present in the village, SACCOs present in the village, Village has electricity, Village has television broadcast, Village has access to newspapers, Village has mobile coverage, Average distance from any farmer to DA, Share of DA ties in the village, Share of CA ties in the village, Share of shared ties in the village. "DA tie" equals 1 if the farmer knows who the DA is but does not know who the CA is. "Elites are united" is a village-level dummy for whether the DA and the CA are linked; where "being linked" = {being a friend or a family member; belonging to the same party (self-reported); belonging to the same party (based on an implicit association test (IAT))}. All regressions control for village fixed effects, for the walking distance to DA home, for whether the farmer is tied to both the DA and the CA ("shared tie") or tied to neither of them ("no tie") and for the interaction of the latter 2 variables with "DA-CA link". The omitted group are farmers tied only to the CA in villages in which the DA and CA have no link. "Trained by the DA" equals 1 if the respondent was trained by the DA in the past year. "Received seeds from the DA" equals 1 if the respondent bought seeds from the DA in the past year. The two randomization inference p-values are estimated by comparing "DA ties" vs. "CA ties" within the sample of villages with and without a DA-CA link separately. Given the political tensions in Uganda, we did not ask the DA and the CA about their political affiliation openly. Instead, we asked each of the agents to report whether they share the same political affiliation as the other agent. We define 2 agents to have different political affiliation (as self-reported) if both report that they do not belong to the same party. We also asked each agent to take an implicit association test (IAT) that tells us the extent to which they are biased towards the incumbent party (NRM, IAT score>0) or the opposition party (FDC); IAT score<0). Based on the IAT score, we define 2 agents to have different political affiliation if both DA agents are biased toward different parties (i.e., IAT scores have opposite signs). *** p<0.01, ** p<0.05, * p<0.1.

Table A4: Coverage, with extra Controls (DA traits)

	(1)	(2)	(3)	(4)
	DA delivery		**Adoption**	
Dep. Var. =>	Total number of farmers trained	Total number of farmers DA sold seeds to	Total number of farmers who adopted seeds from any BRAC source	Total number of farmers who adopted at least one technique
Number of DA Ties	0.2296***	0.2279***	0.1762	0.0513
	(0.08)	(0.06)	(0.13)	(0.12)
Observations (# villages)	60	60	60	60
Rsquared	0.336	0.350	0.488	0.783
Mean Dep Var	1.550	1.367	3.467	2.617
DA controls (see list in notes)	Yes	Yes	Yes	Yes

Notes: OLS regressions with robust standard errors in parenthesis. All regressions control for the number of exclusive ties (DA+CA ties), total number of sampled farmers in the village and branch fixed effects and control for DA traits: Acres of land owned, Total number of assets owned, Ever adopted improved seeds (1=yes), Number techniques ever adopted (out of 4), At least 1 technique ever adopted, Acres of land cultivated, Number of marketable crops grown, Output value, Involved in commercial farming, Profits (revenues-expenditures). Total number of farmers trained (sold seeds to) equals the sum of the sample farmers who report being trained by (sold seeds by) the DA. Total number of farmers who adopted at least one technique is based on enumerators observations. Total number of farmers who adopted seeds is the sum of farmers who report getting seeds from the DA or other BRAC sources. The number of DA ties is the sum of sample farmers who know the DA. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A5: Adoption

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var. =>	Adopted seeds from any BRAC source	Adopted seeds from non BRAC source	Adopted at least one technique *(observed)*	Adopted at least one technique *(self-reported)*	Number of techniques adopted *(observed)*	Number of techniques adopted *(self-reported)*
DA tie	0.0381	-0.0035	0.0835*	0.0737*	0.1121**	0.0721*
	(0.04)	(0.02)	(0.04)	(0.04)	(0.05)	(0.04)
Observations	2,448	2,448	1,327	1,327	1,327	1,327
R-squared	0.030	0.100	0.249	0.216	0.297	0.275
Mean Dep. Var. for CA tie	0.086	0.051	0.069	0.098	0.088	0.118
Randomization inference						
p-value (DA tie=0)	*0.106*	*0.846*	*0.002*	*0.020*	*0.004*	*0.026*

Notes: OLS regressions with robust standard errors clustered at the connection status*village level. P-values from randomization inference using 500 random permutations are presented in italic at the bottom of the table. "DA tie" equals 1 if the farmer knows who the DA is but does not know who the CA is. All regressions control for branch fixed effects, for the walking distance to DA home, for whether the farmer is tied to both the DA and the CA ("shared tie") or to neither of them ("no tie"). The omitted group are farmers tied only to the CA ("CA tie"). "Adopted seeds from any BRAC source" equals 1 if the respondent bought seeds from either the DA, the program assistant or any other BRAC staff in the past year. "Adopted seeds from non BRAC source" equals 1 if the respondent bought improved seeds from any source other than BRAC in the past year. "Number of techniques adopted" counts the number of techniques adopted by the respondent in the past year out of 4 techniques : 3 good techniques (line sowing, zero tillage and intercropping) and 1 bad technique (mixed cropping). This is measured in two ways: (1) by asking enumerators to go check the plot of land of a random sub-sample of 60% of our endline respondents and report whether the technique was adopted ("observed"), (2) by asking respondents to self-report the number of techniques adopted. *** p<0.01, ** p<0.05, * p<0.1.

Table A6: Adoption by delivery agent-counterfactual agent Link

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
DA-CA Link =>	**Friends or family**			**Same party (self-reported)**			**Same party (IAT)**			**Same religion**		
Dep. Var. =>	Adopted at least one technique *(observed)*	Adopted at least one technique *(self-reported)*	Adopted seeds from any BRAC source	Adopted at least one technique *(observed)*	Adopted at least one technique *(self-reported)*	Adopted seeds from any BRAC source	Adopted at least one technique *(observed)*	Adopted at least one technique *(self-reported)*	Adopted seeds from any BRAC source	Adopted at least one technique *(observed)*	Adopted at least one technique *(self-reported)*	Adopted seeds from any BRAC source
DA-CA link	0.0057	-0.0243	0.0702**	0.0794	-0.0136	0.0729*	0.0124	0.0405	0.0459	-0.0444	-0.0673	0.0587
	(0.05)	(0.06)	(0.03)	(0.06)	(0.06)	(0.04)	(0.04)	(0.06)	(0.04)	(0.04)	(0.06)	(0.04)
DA tie * DA-CA link	0.0079	0.0906*	-0.0434	0.0175	0.0461	-0.0812*	0.1034	0.0493	-0.0001	0.0454	0.1121**	-0.0263
	(0.04)	(0.05)	(0.04)	(0.08)	(0.07)	(0.04)	(0.07)	(0.08)	(0.07)	(0.04)	(0.05)	(0.05)
DA tie * no DA-CA link	0.0572	-0.0294	0.1572*	0.0732	0.0754	0.1147**	-0.0161	0.0710	0.1017***	0.0572	0.0156	0.0965
	(0.07)	(0.07)	(0.08)	(0.06)	(0.07)	(0.05)	(0.03)	(0.05)	(0.04)	(0.07)	(0.08)	(0.07)
Observations	1,261	1,261	2,270	1,242	1,242	2,241	1,218	1,218	2,088	1,242	1,242	2,241
R-squared	0.027	0.034	0.020	0.054	0.040	0.021	0.055	0.049	0.018	0.028	0.028	0.018
Mean Dep. Var. for CA tie*no link	0.064	0.103	0.054	0.033	0.098	0.061	0.048	0.057	0.058	0.085	0.128	0.061
p-value (DA tie = CA tie) if link=1	0.977	0.193	0.099	0.630	0.588	0.043	0.340	0.945	0.630	0.211	0.032	0.249
p-value (link = no-link) if DA tie=1	0.559	0.155	0.029	0.573	0.753	0.004	0.123	0.813	0.202	0.891	0.309	0.131
Randomization inference												
p-value (CA tie = DA tie) if link=1	*0.336*	*0.170*	*0.198*	*0.718*	*0.582*	*0.030*	*0.004*	*0.606*	*0.996*	*0.250*	*0.142*	*0.414*
p-value (CA tie = DA tie) if link=0	*0.100*	*0.508*	*0.004*	*0.002*	*0.034*	*0.006*	*0.964*	*0.168*	*0.002*	*0.056*	*0.810*	*0.022*

Notes: OLS regressions with robust standard errors clustered at the connection status*village level. P-values from randomization inference using 500 random permutations are presented in italic at the bottom of the table. "DA tie" equals 1 if the farmer knows who the DA is but does not know who the CA is. "DA-CA link" is a village-level dummy for whether the DA and the CA are linked; where "being linked" = {belonging to the same party (self-reported); belonging to the same party (based on IAT); being a friend or a family member}. All regressions control for branch fixed effects, for the walking distance to DA home, for whether the farmer is tied to both the DA and the CA ("shared tie") or tied to neither of them ("no tie") and for the interaction of the latter 2 variables with "DA-CA link". The omitted group are farmers tied only to the CA in villages in which the DA and CA have no link. "Adopted seeds from any BRAC source" equals 1 if the respondent bought seeds from either the DA, the program assistant or any other BRAC staff in the past year. "Adopted at least one technique" equals 1 if the respondent adopted properly at least one of the 4 techniques in the past year, as measured with enumerator observation. The two randomization inference p-values are estimated by comparing "DA ties" vs. "CA ties" within the sample of villages with and without a DA-CA link separately. *** p<0.01, ** p<0.05, * p<0.1.

Table A7: Coverage by delivery agent-counterfactual agent Link

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
DA-CA Link =>	**Friends or family**				**Same party (self-reported)**				**Same party (IAT)**				**Same religion**			
	DA delivery		**Adoption**		**DA delivery**		**Adoption**		**DA delivery**		**Adoption**		**DA delivery**		**Adoption**	
Dep. Var. =>	# farmers trained	# farmers DA sold seeds to	# farmers who adopted at least one techni-que	# farmers who adopted seeds from any BRAC source	# farmers trained	# farmers DA sold seeds to	# farmers who adopted at least one techni-que	# farmers who adopted seeds from any BRAC source	# farmers trained	# farmers DA sold seeds to	# farmers who adopted at least one techni-que	# farmers who adopted seeds from any BRAC source	# farmers trained	# farmers DA sold seeds to	# farmers who adopted at least one techni-que	# farmers who adopted seeds from any BRAC source
DA-CA link	-0.3844	-0.2442	1.6600	0.0694	0.1275	0.4147	1.9417*	-0.0526	-1.1386	-1.0591	0.5960	-0.0405	-0.2898	0.3043	-1.1142	-0.1645
	(0.93)	(0.96)	(2.32)	(0.28)	(0.78)	(0.78)	(0.98)	(0.21)	(0.96)	(1.02)	(1.70)	(0.32)	(0.95)	(1.04)	(1.82)	(0.32)
Number of DA Ties * DA-CA link	0.2318*	0.2321**	0.0056	0.0400	0.0872	0.1230	-0.0536	-0.0021	0.0410	0.0824	-0.0476	0.0719	0.0982	0.1473*	0.0048	0.0370
	(0.12)	(0.10)	(0.15)	(0.03)	(0.19)	(0.15)	(0.30)	(0.03)	(0.14)	(0.10)	(0.40)	(0.08)	(0.10)	(0.08)	(0.16)	(0.03)
Number of DA Ties * DA-CA no link	0.3884**	0.4028**	0.3766	0.0950	0.2926***	0.2254**	0.1242	0.0900***	0.3676**	0.3518**	0.1394	0.0422**	0.4138***	0.2767*	0.3143*	0.1154***
	(0.16)	(0.15)	(0.32)	(0.06)	(0.11)	(0.10)	(0.10)	(0.03)	(0.16)	(0.15)	(0.10)	(0.02)	(0.13)	(0.14)	(0.17)	(0.04)
Observations	55	55	55	55	53	53	53	53	47	47	47	47	53	53	53	53
R-squared	0.243	0.244	0.367	0.168	0.228	0.215	0.381	0.265	0.270	0.243	0.377	0.160	0.275	0.219	0.383	0.282
Mean Dep Var	1.550	1.367	2.617	0.250	1.550	1.367	2.617	0.250	1.550	1.367	2.617	0.250	1.550	1.367	2.617	0.250

Notes: OLS regressions with robust standard errors in parenthesis. P-values from randomization inference using 500 random permutations are presented in italic at the bottom of the table. "DA-CA link" is a village-level dummy for whether the DA and the CA are linked; where "being linked" = {belonging to the same party (self-reported); belonging to the same party (based on IAT); being a friend or a family member}.. All regressions control for the number of exclusive ties (DA ties+CA ties) interacted with "DA-CA link", for the # sampled farmers in the village, for branch fixed effects. # farmers trained (sold seeds to) equals the sum of the sample farmers who report being trained by (sold seeds by) the DA. # farmers who adopted at least one technique is based on enumerators observations. # farmers who adopted seeds is the sum of farmers who report getting seeds from the DA or other BRAC sources. The number of DA ties is the sum of sample farmers who know the DA. The two randomization inference p-values are estimated by identifying the effect of an extra DA tie within the sample of villages with and without a DA-CA link separately.
*** p<0.01, ** p<0.05, * p<0.1.

Table A8: The Extension Program and Village-Level Inequality

	(1)	(2)
	Gini Coefficient	
	Profits = Rev - Exp	Total Consumption
Agriculture Extension Program	0.0461**	0.0626**
	(0.02)	(0.02)
Observations (villages)	119	119
R-squared	0.074	0.057
Mean in control	0.236	0.387

Notes: ANCOVA regressions with robust standard errors. All regressions control for the four stratification variables (branch fixed effects, above median market distance, above median village size, above median proportion of farmers). For Profits, the Gini coefficient has been calculated by setting the minimum of the variable, in absolute value, to 0. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A9: Balance Checks on the Agriculture Extension Program

	Control villages	Treated villages: Agri Extension Program	p-value [Control=Treated]
Age	42.311	41.176	*0.036*
	(16.08)	(17.70)	
Completed primary school (=1 if yes)	0.431	0.459	*0.287*
	(0.50)	(0.50)	
Acres of land cultivated	1.091	1.210	*0.062*
	(0.96)	(1.02)	
Number of marketable crops grown	1.247	1.236	*0.646*
	(0.90)	(0.89)	
Output value	363.747	368.668	*0.681*
	(583.57)	(541.47)	
Involved in commercial farming	0.548	0.57	0.108
	(0.50)	(0.49)	
Profits (revenues-expenditures)	74.402	82.891	*0.310*
	(313.88)	(304.10)	
Consumption per adult equivalent	167.412	168.698	*0.473*
	(357.96)	(312.28)	

Notes: P-values are obtained from regressing each of the reported baseline variable on the dummy for "treatment" with robust standard errors clustered at the village level, and controlling for the four stratification variables (branch fixed effects, above median market distance, above median village size, above median proportion of farmers). *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Marketable crops include all crops except cereals and staple food. "Output value" is the total agriculture production (in thousand of UGX) in the last season. "Involved in commercial farming" equals 1 if the farmer's revenues from selling agriculture output are positive. "Profits" are equal to total revenues from selling agriculture output minus expenditures in the last season (in thousand of UGX). "Consumption per adult equivalent" equals the household's monthly per capita consumption of food, non-durables and semi-durables (children below 18 are given a weight of 0.5 and adults a weight of 1) in thousand of UGX. All monetary values are truncated above and below two standard deviations from the mean.

Table A10: Balance Checks on the Agriculture Extension Program

Dependent variable =1 if respondent was not surveyed at endline (attrition)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VAR =>	-	Acres of land cultivated	Number of market-able crops grown	Output value	Involved in commercial farming	Profits (revenues - expenditur es)	Total consumpti on per adult equivalent
Agri Extension Program	0.0174	0.0150	0.0029	0.0099	0.0043	0.0132	0.0194
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)
VAR		-0.0011	-0.0111*	-0.0000	-0.0140	-0.0000	0.0000
		(0.01)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)
Agri Extension Program* VAR		0.0016	0.0119	0.0000	0.0215	0.0000	-0.0000
		(0.01)	(0.01)	(0.00)	(0.02)	(0.00)	(0.00)
Observations	4,741	4,530	4,741	4,633	4,668	4,437	4,723
R-squared	0.016	0.013	0.017	0.016	0.016	0.012	0.016
Mean in Control	0.0590	0.0590	0.0590	0.0590	0.0590	0.0590	0.0590

Notes: P-values are obtained from regressing each of the reported baseline variable on the dummy for "treatment" with robust standard errors clustered at the village level, and controlling for the four stratification variables (branch fixed effects, above median market distance, above median village size, above median proportion of farmers). *** p<0.01, ** p<0.05, * p<0.1. Marketable crops include all crops except cereals and staple food. "Output value" is the total agriculture production (in thousand of UGX) in the last season. "Involved in commercial farming" equals 1 if the farmer's revenues from selling agriculture output are positive. "Profits" are equal to total revenues from selling agriculture output minus expenditures in the last season (in thousand of UGX). "Consumption per adult equivalent" equals the household's monthly per capita consumption of food, non-durables and semi-durables (children below 18 are given a weight of 0.5 and adults a weight of 1) in thousand of UGX. All monetary values are truncated above and below two standard deviations from the mean.