Crony Capitalism, Collective Action, and ICT: Evidence from Kenyan Contract Farming *

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Abstract

The shift from subsistence to commercial economies creates surplus, but often induces conflict over it. Under extractive institutions and weak contract enforcement, crony capitalism may emerge and limit the benefits of modernization. We examine the relationship between a large sugar cane contract farming company and small farmers in Western Kenya, in a setting with many features of crony capitalism. We document frequent violations of the company's contractual obligations and propose a simple theory of how farmers' collective action problems may make it harder to enforce contracts. We then test the direct effects of an ICT-based intervention that reduces farmers' cost of complaining, potentially addressing company's moral hazard and farmers' free riding problems.

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1. Introduction

The shift from subsistence economy to capitalistic agriculture often involves the emergence of larger-scale production forms and of sophisticated contractual arrangements between suppliers, producers, workers, and consumers. While this process of modernization typically creates surplus, it also induces conflict over it. Under weak property rights and enforcement, *crony capitalism* can emerge (Acemoglu and Robinson, 2012): weak enforcement undermines potentially productivity-enhancing contracts; elites not only capture large shares of the surplus but also cannot credibly commit to surplus division, and politics become a struggle over rents, possibly inducing reversion to subsistence (Bauer, 2004).

We study the relationship between a large Kenyan sugar processing company and the farmers who supply sugarcane to the processing factory, within a *contract farming* scheme (Eaton and Shepherd, 2001; Bellemare and Bloem, 2018). In contract farming, at the beginning of the crop season, farmers and buyers (often large-scale processors) commit to transact with each other at harvest time and the buyer often provides farmers with inputs on credit.[1] These arrangements are common in the transition from subsistence to commercial agriculture in developing countries.

Our setting presents several features suggestive of crony capitalism: state ownerships stake, regulated prices, trade barriers, bailouts, political appointment of staff and contractors (e.g. transporters), and revolving doors between business and politics. Media have documented credible allegations of corruption among contractors of the company. We observe surplus-

[1] Scholars differ widely in their assessment of contract farming. Many observers on the left (mostly outside of economics) emphasize that these contracts exploit farmers, who become laborers with no control over productions, and that they are associated with buyer's market power, land concentration, strengthened patriarchy, and ecological degradation (Little and Watts, 1994; Oya, 2012). The traditional economics view stresses the gains from specialization, adoption of capital equipment, and increasing returns to scale, highlighting that farmers voluntarily choose to sign up and thus must get at least some gain.

destroying conflicts between farmers and the company, including contractual breaches (e.g. farmers side selling to other buyers for lower prices or even reverting to subsistence crop; company delaying input deliveries) and political violence around disputed election outcomes (more so than in the rest of the region).

In the first part of the paper, we document frequent violations of the company's contractual obligations. While many papers study farmers' contractual breaches, primarily side-selling, empirical research on buyer's contractual violations is limited[2]. We show that the company often delivers fertilizer too late or does not deliver it at all. Among other reasons, crony capitalism dynamics seem to contribute to these outcomes: inefficient contractors (weak incentives, political hiring); bribing and corruption; priority to well-connected farmers. While delays and missed deliveries hurt farmers' and company's profits, they may be consistent with managers' and workers' getting rents from transporters' contracts, shirking, and limited supervision.

Why can these inefficient outcomes persist? We emphasize the role of farmers' collective action problems (Olson, 1965). The cost of fighting the company may well be smaller than the private benefit, but the social benefits may be larger. For instance, the contractor delivers inputs to several contiguous plots at the same time. Thus, when a farmer complains about a delay, she may provide a benefit for her neighbors.[3] In the second part of the paper, we therefore propose a simple theory of how farmers' collective action problems make it harder to enforce contracts and how these problems may be exacerbated under crony capitalism patterns (e.g. managers getting rents from contractors or not having sufficient reputational incentives because of short expected tenure).

In the third part of the paper, we use a randomized controlled trial to evaluate an ICT-based

[2] Recent work on side-selling includes, among many others, Barrett et al. 2012, Deb and Suri (2013), and Casaburi and Macchiavello (2015). Ashraf et al. (2009) conduct an experiment in a setting where the buyer ultimately failed to buy from contracted farmers. See also Kranton and Swamy (2008) on hold up in agricultural exports in colonial times.

[3] Other examples of these spillovers would occur if farmers requesting the company to organize agricultural trainings or to adopt new technologies (e.g. new cane varieties).

intervention – a *farmer hotline* service – which reduced farmers' costs of reporting a complaint to the company. Farmers who are (randomly) enrolled in the hotline can file reports about delays or other issues concerning company input delivery and payments. The hotline messages reach the Zonal Managers in charge of the area of the plot, and the Fertilizer Delivery team, which supervises the contractors in charge of the deliveries of inputs. For farmers who register their phone, assignment to the treatment reduces the likelihood that a plot does not receive fertilizer by 4 percentage points (54.5% of the control average in the experimental sample) and it reduces the likelihood of a delay in fertilizer delivery by 8.8 percentage points (22% of the control group average).

Consistent with the public good nature of complaining, we find positive geographical spillovers in fertilizer deliveries across neighboring plots. While in principle providing a subset of farmers with the hotline may induce a *displacement* in input provision from control to treatment**,** we do not find evidence of such displacement. Instead, non-experimental analysis provides suggestive evidence of global positive spillovers.[4]

In spite of the arguably positive effects of the hotline intervention on farmers' and company's profits, the company did not scale up the intervention. [5] Why was this the case? It is plausible that the short-term horizon of high-level managers, subject to high turnover, may have made the investment not worthwhile for them. The unwillingness to hurt vested interests, for instance contractors' rents, may have also deterred adoption (Atkin et al., 2017). While we can obviously only speculate on these forces, the lack of scale-up provides a cautionary note on the potential in ICT under crony capitalism: adoption may require a

[4] ICT reduces the cost of reporting a complaint and is likely to generate private benefits for those who are induced to complain because of the reduction in such cost. We, however, highlight the complaints will also generate externalities, which, in general, can be positive or negative. For instance, harassment reports in the *MeToo* campaign helped identify repeated offenders, which also benefited victims who had not reported in the first instance. Displacement effects may instead arise when a complaint from one customer hurts another customer. For instance, when one customer requests an aisle sit on an airplane, she may bump out somebody else. The paper therefore also relates to the literature on externalities from crime prevention technologies (Ayres and Levitt, 1998; Gonzalez-Navarro, 2013)

[5] We do not have sufficient power to study the treatment effect of hotline access on yield. However, in a regression of yields on treatment, confidence intervals include large effects in line with the cross-sectional evidence from baseline data.

"critical juncture" (Acemoglu and Robinson, 2001), where the benefits from innovative ICT solutions align with the relevant political incentives.

The remainder of the paper proceeds as it follows. Section 2 provides background on the company and the input delivery process. Section 3 presents a model of moral hazard in input provision, highlighting the role of political economy factors and farmer collective action problems. Section 4 describes the hotline experimental design. Section 5 presents the experimental results. Section 6 discusses incentives for scale-up under crony capitalism and policy implications.

2. Background

Crony Capitalism in the Kenyan Sugar Sector

We examine the relationship between a large sugar cane contract farming and its contracting farmers in Western Kenya. The Kikuyu-run Kenyan government established the company in 1973, with the support of British aid and foreign capital (Mulaa, 1981). The catchment area of the factory was mostly populated by Luhyas, a tribe with a history of fragmentation and little hierarchical structure in pre-colonial period (MacArthur, 2013) and with an economy mostly based on subsistence farming at independence.

At the time of the experiment, the contract farming scheme included about eighty thousands farmers, one of the largest in East Africa. Sugarcane was arguably the most important cash crop in the region. The contract farming scheme is based on a multi-layered organizational structure. A small number of company-based managers in the outgrower service department (around 10) relies on a larger number of field staff (100-150) to interact with small-scale farmers who supply cane.[6]

The sugarcane sector presents many features suggestive of crony capitalism. The

6 Additional details on the study setting are provided in Casaburi, Kremer, Mullainathan (2014).

government established several processing factories in the 1960s and 1970s. While most of these were privatized in the early 2000s, the government often retained majority shares. The *Sugar Directorate,* is in charge of licensing millers and the *Sugar Pricing Committee* (and previously the *Kenya Sugar Board)* regulates sugar pricing, in an attempt to ensure a fair price for farmers. Finally, the government imposes tariffs of imports of foreign sugar (though these have been decreasing recently).

The strong relationship between the industry and politics is apparent in the firm we examine. The former CEO became Nairobi County governor in 2013. Over the last few years, the company has gone through severe financial challenges and the government has provided relief funds to the company in multiple occasions. Over the years, the company has been involved in a number of corruption scandals, involving managers, workers, contractors, and farmers. Examples include farmers bribing company staff and transporters to harvest in time (Kenya Anti-Corruption Commission, 2010) and corruption in choosing contractors for input provision and transport.

Tension between the company and farmers leads to several forms of violence and destructive activities. In some instances, farmers burn their own cane to force the company to harvest their cane (this is inefficient: the mill can process burnt sugar, but obtains less sugar when doing so and pays farmers a lower price). Farmers, workers, and contractors often lead strikes that halt processing, often with the support of local politicians. Violence after the 2007 elections in the catchment area of the company was more severe than in nearby locations: arsons occurred in the company nucleus estate (i.e. a large farm around the mill that the company manages directly); attacks targeted employees and contractors coming from other regions.

Input Delivery in the Contract Farming Scheme

The company and the farmer sign a contract that typically spans for one replant cycle, made up of one planting and several ratoon harvests.[7] Each harvest cycle lasts from 18 to 22 months. Planting and harvesting occur in a staggered fashion throughout most of the year, in order to provide a constant supply of cane to the processing mill. Sugar production processing requires high coordination across harvesting, transporting, and processing. Processing needs to occur shortly after harvesting as sugar content starts declining after the cane is harvested. Plots are grouped into *fields*, sets of plots that are usually treated homogeneously for land preparation, input provision, and harvesting, in order to exploit economies of scale in these activities. Farmers' receive a fixed price per tonnage of cane harvested (set by the Kenya Sugar Board based on current sugar prices).

Input charges plus interest are deducted from the crop revenues. Limited competition among sugarcane processors and high transport costs of the raw material make it possible to enforce the repayment of these loans, though side-selling has been a growing concern in recent years. Input provision is one of the key contractual obligations of the company.

The organization of the fertilizer delivery involves several steps. Field assistants are the primary point of contact between the farmers and the company. At the time of the experiment, each of the 100-150 field assistants (the exact number varies across seasons) was dealing with hundreds of farmers. Around 50 field supervisors monitor the field assistants. Typically, a field assistant would visit the field to assess whether the plot is ready to receive fertilizer and to inform the farmers of the expected delivery. The input provision department would then authorize the delivery, after confirming the age of the plot in the company administrative data. A number of contractors would then be in charge of schedule the exact delivery date and to complete the delivery. Figure 1 summarizes the company organizational chart, highlighting the layers involved in fertilizer delivery.

Delays in Input Delivery

The agronomy department recommends that plots that receive Urea (nitrogen-release

7 Ratooning leaves the root and lower parts of the plant uncut at the time of harvesting. Yields typically fall across ratoons. A contract typically spans two or three ratoons.

fertilizer) between three and six months from the beginning of the crop cycle, but delays are very common.[8] Figure 2-Panel (a) presents the distribution of delivery dates for Urea fertilizer in the year before the study. The figure shows that, in the year preceding the intervention, 22.5% of the plots experience a delay relative to this optimal time window. In the year before the intervention, plots that receive the Urea fertilizer in the optimal time window have 2% higher yields than plots experiencing delays (p=0.016). Approximately 4.5% of the plots do not receive fertilizer at all and their yields are 36% lower than those who receive fertilizer (p<0.01). Figure 2 – Panel (c) shows the distributions of yields in the year before the study by fertilizer delivery status. The yield distribution for plots that receives fertilizer is clearly shifted to the right relative of the one for plots that did not receive fertilizer.

In addition, the current allocation of fertilizer delivers appears to be inefficient. Figure 2-Panel (b) suggests that plot yields are *increasing* in the age of fertilizer delivery in the first six months (i.e., within the optimal delivery time window), and decreasing afterwards (the slope break is significant at p=0.02). Yet, many plots receive fertilizer in the fourth or fifth month. While acknowledging that this is just correlational evidence, these patterns suggest that there may be gains from postponing fertilizer on these "early" plots by a few weeks, while ensuring no plot goes beyond the sixth month.

There are a number of ways in which moral hazard may lead to delays in input delivery. Field assistants may try to reduce the number of plots they visit in a given day, both because of the constraints and because field assistants (at least those hired on a temporary basis) must cover their own fuel expenses. Similar agency problems may concern other layers.

[8] We focus on Urea deliveries. The company also provides seedcane and DAP fertilizer, typically around planting time (or at the beginning of the cycle for ratoon plots). Since most of the plots in our sample had already received these inputs by the time they entered the treatment, we do not look at the effect of the hotline on seedcane and DAP fertilizer deliveries.

For instance, field supervisors may have, at least in some cases, an incentive to underreport underperforming field assistants to higher-level managers. In turn, higher-level managers (about 7-10 *zonal* managers who are responsible for large areas of the contract farming schemes) face substantial time constraints as they deal with raw material supply, planting, harvesting, as well as with input delivery. They have limited opportunities to address systematically such delays. The relationship between the company and the contractors in charge of actual delivery is also subject to moral hazard considerations. For instance, contractors may attempt to group deliveries in a given day to plots that are close to each other, so to reduce fuel expenses. Finally, the above discussion suggests limited transparency in contractor choice and staff hiring.

Farmers would incur substantial costs in bringing up their concerns. Farmers may not find it worthwhile to travel all the way to the company main offices to resolve their issues. This is costly for the farmers but also for the managers, who often have to spend too much time to assuage farmers' feelings and to discuss issues on which they have little control (for instance that the crop is struggling because of delayed rains). Farmers may also be concerned about the company perceiving them as troublemakers, which would further decrease their incentive to complain. Free riding may also deter filing complaints. They may for instance prefer that a neighboring farmer raised the issue, hoping that the response from the company would benefit a cluster of surrounding plots, including their own one.

Qualitative discussions with the farmers, as well as the above correlational evidence, suggest that delays harm the farmers. Tensions over input delivery are just one of the source of tensions between farmers and the company. Others include delay in payments and failure to supply better varieties, for instance with a shorter maturing time. These tensions have grown in recent years (after the experiment described in this paper) as the company has faced severe financial and management challenges. An optimal contract would include penalties for input delivery delays, but such penalty is not included in the contract (and would probably be hard to enforce anyway in this setting).

3. Theory

In this section, we propose a simple model of moral hazard in input provision. Input managers choose which farmers receive inputs and they face lower costs when supplying "connected farmers," who are not necessarily those with higher returns from inputs. Farmers can complain with the company principal (e.g. the CEO) if they observe the manager shirking, but they face a collective action problem in doing so. An ICT investment (i.e. the hotline intervention) reduces the farmers' cost of complaining and, under certain assumptions, allows them to overcome the free riding problem. The company principal's rent from distorted input delivery and his discount rate affect the likelihood that the company verifies manager's effort and that invests in ICT.

3.1. Setup

Players. A principal manages a company that employs W input managers. Each manager is responsible to provide M units of fertilizer to $N \geq M$ farmers. The manager's wage, w, and the farmer's output share, $s \in [0,1]$, are exogenous.[9]

Farmers are heterogeneous along two dimensions: i) a share $\alpha < 1$ of farmers have high return (H) from one unit fertilizer, while the rest have low return (L);[10] ii) a share $\beta < 1$ of farmers are *connected* to the company. Being connected reduces the manager's cost of effort to zero and provides the principal with a rent of z per connected farmer who receives fertilizer. The two sources of heterogeneity are independent (i.e., there are $\alpha\beta$ connected farmers).

Timing.

The principal interacts with input managers and farmers over an infinite horizon of harvest cycles and has discount factor δ across harvest cycles. For simplicity, we assume that manager and farmers only live one harvest cycle.

[9] The main insights of the paper are robust to endogenizing input manager's wage or farmer's output share. We briefly discuss these extensions in Section 3.3

[10] We assume marginal returns from a second unit of fertilizer are zero.

Before the first harvest cycle, the principal decides whether to invest in ICT (hotline) or not. The investment cost is *I.* As we discuss below, the investment reduces the cost of complaining for *all* the farmers in each cycle. Each harvest cycle is then composed of four periods.

In *period 1*, each input manager receives an independent draw of his cost of effort to the $(1-\beta)N$ *unconnected* farmers. The cost of effort is equal to g_H with probability p_H and it is equal to $g_L < g_H$ with probability $p_L = 1 - p_H$. The cost of effort to provide fertilizer to connected farmers is zero. Each manager *privately* observes his cost of effort and decides whether to exert effort (on all the *N* plots under his responsibility), $e = \{0,1\}$.[11] The manager's choice under different states of the world determines the ex-ante likelihood of shirking, which we denote with *p.*

In *period 2*, each farmer observes the manager's effort on her plot and decides whether to complain or not. Farmers have heterogeneous costs of complaining. Without loss of generality we index farmers as *i=1,2,..M.* Farmer *i's cost of complaining is* $c^I + \epsilon * i$ if the company had invested in ICT in period 1, and to $c^{NI} + \epsilon * i > c^I + \epsilon * i$ otherwise. In other words, ICT reduces the cost of effort equally for all farmers, without altering the ranking in the cost of complaining cross farmers. In addition, *j* of the $\alpha(1-\beta)N$ high-return non-connected farmers draw a large benefit from complaining and therefore do so, *even if the input manager has exerted effort*.[12] The number of farmers who report such uninformative complaints is drawn from a uniform distribution over support $[0, J]$, independent across managers, with probability mass function $\frac{1}{J+1}$. The remaining

[11] We assume that, when exerting effort, the manager's participation constraint is satisfied even when the cost of effort is high, $w \geq g_H$.

[12] In our setting, farmers may have several reasons to complain even if the manager delivered inputs. First, they may try to obtain more inputs to use them on other crops. Second, they may try to get more fertilizer if their crop is not growing properly. Third, they may resent the company for other reasons (e.g. payment delays) and thus may over-report misbehavior of its employees.

the $\alpha(1-\beta)N-j$ high-return non-connected farmers observe the number of unjustified complaints *j* and then decide whether to complain or not. Let us denote with *k* the (endogenous) number of genuine complaints from these farmers. Therefore, if the manager exerts effort, the total number of complaints is *l=j;* if the manager shirks, *l=k+j*.

In *period 3*, the principal observes the number of complaints *l* and cannot discern informative and uninformative without verifying effort. The company then decides whether to verify manager's effort or not. The company's cost of verification for each input manager is *V*. If the principal detects that the manager is shirking, it can induce him to exert effort and charge him a fine, *f*.[13]

In *period 4*, farmers harvest their plot. With fertilizer, expected output is *y+H* for high-return farmers and y+L for low-return farmers. Without fertilizer, it is *y* for all farmers.[14] Therefore, in the efficient allocation of fertilizer, a manager would first deliver fertilizer to all high-return farmers.

Assumptions on Parameters. To avoid presenting a taxonomy of cases, we make a number of assumptions that simplify exposition:

1. $max\{\alpha N, \beta N\} \leq M < \left(\alpha+\beta(1-\alpha)\right)N.$
2. $p_H * \Delta\pi_C < V$
3. $c^I \leq \mathrm{s} * \Delta \mathrm{Y} < c^{NI}$

In Assumption 1, the first inequality states that each manager has enough fertilizer unites to serve all connected farmers or all high-return farmer. The second inequality states that, when the manager exerts effort and serves high-return farmers, some of the low-return connected farmers will not receive fertilizer. Assumption 1 implies that when the input

[13] The fine could represent a social punishment or a reduced likelihood of promotion, as well as a monetary cost.

[14] We assume that there is some large enough source of noise (e.g. rain, pests) that the company cannot infer manager's effort from the final output. Modeling this noise would complicate the algebra without giving additional insights.

manager delivers fertilizer efficiently, the increase in output per manager is $\Delta Y \equiv N\alpha(1-\beta)H - ((1-\alpha)\beta N - (M-\alpha N)L$ and the increase in company's profits per manager is $\Delta\pi_C \equiv (1-s)\Delta Y + f - ((1-\alpha)\beta N - (M-\alpha N) * z)$.

Assumption 2 ensures that the company does not find it optimal to verify effort if the manager only shirks when his cost of effort is high and the company's information is simply the prior probability of this state of the world. Assumption 3, as we discuss below, ensures that, under shirking, a sufficient number of farmers reports a complaint with ICT, but not without it.

3.2. Equilibrium

We now solve the game. We characterize a pure-strategy subgame perfect equilibrium where farmers coordinate on efficient complaining, solving by backward induction.

The company's choice to verify effort (period 3). The principal observes the number of complaints *(l)*. In addition, it infers the number of complaints farmers would report under manager's shirking *(k)* and the probability that the manager shirks *(p)* on the equilibrium path. The company chooses to verify effort if $Prob(e=0|l) * \Delta\pi_C \geq V$. The company's posterior that the manager is shirking when it observes *k* complaints is $Prob(e=0|l\} = \frac{p*Prob(l|e=0)}{p*Prob(l|e=0)+(1-p)*Prob(l|e=1)}$.

The farmers' choice to complain when observing shirking (period 3). For given number of unjustified complaints, *j*, $\alpha(1-\beta)N - j$ high-return non-connected farmers may complain when the manager shirks. We assume that, conditional on a number of complaints, farmers can coordinate on the equilibrium where the lower-cost farmers complain, but we abstract from ϵ-differences in costs in deriving the conditions below.

In the efficient equilibrium, farmers agree on the minimum number of complaints they must report to induce the company to verify the manager's effort, which we denote with $\hat{l}$. In turn, the number of *genuine* complaints will be $\hat{k} = max\{0, \hat{l} - j\}$. When the company observes l complaints, it could be for two reasons: the manager exerted effort and $j = l$ farmers reported *unjustified* complaints *or* the manager shirked and a sufficient number of farmers reported genuine constraints. The company will verify effort if $Prob(e = 0|l) * \Delta\pi_C > V,$ where

$$Prob(e = 0|l) = \frac{p * Prob(l|e = 0)}{p * Prob(l|e = 0) + (1 - p) * Prob(l|e = 1)}$$

$$= \frac{p}{p + (1 - p)\frac{J + 1 - l}{J + 1}}$$

Therefore, $\hat{l}$ is the total number of complaints s.t. $\frac{p}{p+(1-p)\frac{J+1-l}{J+1}} * \Delta\pi_C = V$ (we ignore integer problems). Farmers who have not received fertilizer and have not reported an unjustified complaint observe *j* and set $\hat{k} = max\{0, \hat{l} - j\}$.

To ensure this is an equilibrium, we also need to verify that the individual rationality constraint holds for each farmer *i* who is scheduled to report a complaint for a given number of unjustified complaints *j*. We observe that in this equilibrium every farmer is marginal: if she deviates and does not complain, the number of complaints will be too low and the company will not respond. Therefore, in spite of the public good nature of complaining, in this equilibrium the farmer's individual rationality constraint is satisfied if her *private* benefit from manager's effort ($s * \Delta Y$) is larger than her cost of complaining. Under assumption 2, this is the case when the company invests in ICT but not without it.

The manager's choice to exert effort (period 2). Under ICT, the manager exerts effort regardless of he effort cost. Without ICT, the manager only exerts effort under low cost of effort.[15]

[15] A strategy where the manager never exerts effort is not an equilibrium since the company would always verify effort. We do not consider mixed strategies where the managerw randomizes whether to shirk or not for a given cost of effort.

The company's choice to invest in ICTeffic. The investment in ICT raises company revenues in the states of the world where the manager's cost of effort is high (p_h) and the number of unjustified complaints alone is not sufficient to induce the company to verify effort (i.e. $j \leq \frac{\hat{l}}{J+1}$). Therefore the expected increase in revenues in each harvest cycle is equal to $Wp_H \frac{\hat{l}}{J+1} \Delta\pi_C$. The company will invest in ICT if $\frac{Wp_H \frac{\hat{l}}{J+1} \Delta\pi_C}{1-\delta} \geq I$. Intuitively, this condition is less likely to hold if the principal's rent when connected farmers receive fertilizer (*z*) is high and when his discount rate (δ) is high In the experiment, researchers covered a large portion of the set up costs and maintenance cost, and the company provided some of its staff to manage the hotline. Therefore, we can think of the experiment as inducing a large enough reduction *I* to induce the company to adopt the ICT platform.

To summarize, the model derives conditions under which a reduction in the cost of complaints, induced by ICT, solves farmers' collective action problem.

3.3. Discussion and Extensions

The above framework describes how the hotline could address moral hazard concerns among company managers. The framework captures essential features of our setting. We however discuss two important departures. First, managers are disciplined by the *threat* of farmers' complaints. Informative complaints are off the equilibrium path. The hotline data however do include complaints about fertilizer delivery delays (most of which were then verified to be correct). It is straightforward to enrich the model to feature informative complaints in the equilibrium under ICT. For instance, managers may be uncertain about farmers' cost of complaining and, under certain realizations of their effort cost, they would take the risk of shirking and being punished in some states of the world.[16]

[16] Similarly, we could allow for some informative complaining in equilibrium even without ICT.

Second, and relatedly, our model assumes that managers have complete information about farmers' complaining costs (i.e., on whether farmers have access to the hotline or not). In our setting, input managers may however have incomplete information about such costs. For instance, they may get aware that some farmers have access to the hotline but they may not know the individual treatment status for each farmer. Again, our model can easily accommodate this extension. In this case, the disciplining effect of hotline would arise both from an increase in the manager's perceived probability that farmers have low cost of complaining (i.e., a pre-emptive disciplining role) and by some actual complaining in equilibrium.

Finally, we discuss possible extensions of the model. Farmers' output shares (i.e., sugarcane prices) and managers' wages are essentially fixed over the course of the experiment and thus we treat them as exogenous in the model. However, the model can allow for endogenous output shares and wages. With homogeneous farmers, ICT would allow the company to reduce farmers' output share, while keeping them on their participation constraints. With heterogeneity in farmers' outside option, ICT would allow the company to recruit more farmers in its scheme. Introducing the ICT platform, thus increasing managers' expected effort, may require the company to raise the wage to keep the managers on their participation constraint. We also consider a setting where the company and the farmers interact over many harvests (i.e. over an infinite horizon) under *imperfect contract enforcement*. In this scenario, the company may default on farmers and decide not to pay them at harvest if the benefit of doing so is larger than the continuation value of the relationship with the farmers. By raising expected output, and thus company profits, the hotline would increase the rent from the relationship. This may be particularly beneficial for companies with "intermediate" discount rates, which would be credible only with the additional rent induced by the ICT.

4. Experimental Design

The farmer hotline enabled farmers to report delays or other problems concerning input delivery and other tasks (e.g. payments). The hotline service included two main components. First, farmers had the opportunity to make calls to a dedicated number during office hours. Second, farmers received periodic calls (approximately every two months) from the hotline operators in which they were explicitly asked to report any query they may have about the company services. Recorded queries reached the relevant company departments. For instance, queries about fertilizer deliveries reached both to the Zonal Manager, in charge of the section of the contract farming scheme where the plot is located, and to the Fertilizer Delivery team, which supervises the contractors in charge of the deliveries of inputs.[17]

The intervention took place from late 2012 to mid-2014.[18] Randomization occurred at the field level (1,089 fields) and was split across three (approximately) monthly waves. In the first two, roughly half of the fields were each allocated to a hotline and to a control group. For these waves, farmers had to pay the cost of the call when contacting the operator. In wave 3, a free hotline was added as third treatment. In the analysis presented in this paper, we bundle the two hotline treatments.[19]

Within each wave, stratification occurred by harvest cycle type (ratoon number), two geographic zones, and a variable capturing the field-level average response rate to a phone survey done before the intervention.. During the recruitment for the intervention, which the company conducted before the randomization, 3,768 (out of 8,081 belonging to the study fields), recorded their cell phone number and qualified as eligible for the hotline service in the case their field was randomized in the treatment group.

Table 1 confirms that the randomization achieved substantial balance across several plot-

[17] Other work looking at the impact of ICT on firms' organization and productivity includes Baker and Hubbard (2003, 2004), Bloom et al. (2014), Akerman et al. (2015), and Hjort andPoulsen (2019).. Trucco (2017) and Sharan and Kumar (2019) are two recent papers on the impact of citizens' complaints.

[18] It was cross-cut with one wave of another experiment in which we the company sent farmers SMS on agricultural practices (Casaburi et al., 2019).

19 We do not have sufficient power to distinguish outcomes of the free and for-payment hotline.

level variables measured in the company administrative data. However, baseline yields for plots without a registered phone number are slightly higher in treatment fields than in control fields (p=0.08). [20]

5. Results

Based on company records, about 13% of the enrolled farmers in treatment fields reported a complaint through the hotline. In turn, 70% of the treatment fields had at least an entry logged in the system. About 38% of the reported issues concerned fertilizer deliveries, followed by queries on payments and harvesting. About 91% of the complaints were marked as resolved by the hotline operators.

Conversations with the staff in charge of the project suggest that access to the hotline enabled farmers to bypass multiple layers in the company hierarchy, represented in Figure 1. Specifically, through their complaints, farmers were able to communicate much faster with the high level managers of the outgrower service department and with the coordinators of fertilizer deliveries, instead of relying on (sporadic) interactions with lower level field assistants and with representatives of the input delivery contracting firms. Furthermore, discussions with company managers further suggested that the hotline put more pressure on the company field staff. The hotline increased their accountability. Unsolved queries escalated within a few weeks. In turn, managers were thus better able to identify field staff and contractors who were systematically responsible for unsolved farmer complaints.

This section presents the treatment effect of the hotline on fertilizer delivery first in those plots who registered for the service and then in plots located in treatment fields but not registered. Finally, it discusses the impact of the intervention on plot yields.

5.1 *Impact on Fertilizer Delivery: Direct Effects.*

20 Baseline yield data are available for 82.5% of the plots targeted by the study.

The analysis focuses on two main outcomes we measure in the company administrative data: i) whether that a plot does not receive the Urea fertilizer during the cycle; ii) whether the plot receives fertilizer with a delay relative to the recommended time window (3-6 months).

Table 2 presents treatment effects for the plots with a registered phone number (i.e., the plots whose farmers recorded their phone numbers with the company before the randomization occurred). Column (1) shows that the likelihood that a plot does not receive fertilizer decreases by 4 percentage points among plots with a registered phone in the treatment fields (compared to similar plots in control fields), significant at 5%. This is equivalent to 54% of the control group mean. The coefficient is stable when we add the plot-level controls (Column 2). Column (3) of Table 2 focuses on the likelihood that the Urea fertilizer is not received within the optimal time window. The treatment group average is 8.8 percentage points lower than the control one, a 23% reduction. Again, the coefficient is stable when adding plot-level controls (column 4).

5.2 *Impact on Fertilizer Delivery: Spillovers*

The experiment could induce positive or negative effects for farmers who did not enroll in the program. First, as discussed in Section 2, input delivery is highly clustered by field: in a given day, contractor trucks typically deliver fertilizer to most plots of a given field. This may induce positive geographic externalities: a query reported by one farmer in one field will likely affect the relevant input delivery outcomes for other farmers in the same field. Second, a more timely input delivery in the treatment fields may lead an increase in the delays in other fields, either in the control group or outside of the study sample. Third, the hotline could help the company managers to identify and address problems with specific field assistants or contractors, thus generating further positive spillover for non-treatment fields.

Our design enables us to test experimentally for the first channel (i.e. within-field spillovers). Table 3 reports the treatment effect for plots without a phone number (i.e., comparing non-phone plots in treatment fields with non-phone plots in control fields). Columns (1) and (2) show that there is no significant impact on the likelihood that a plot does not receive fertilizer. However, in columns (3) and (4), we observe that plots without a registered phone number in treatment fields experience a reduction of 7.9 percentage points in the fertilizer delivery delays (20% of the average for plots without a phone in control fields), significant at 5%. The coefficient is robust when adding plot-level controls.

We cannot test experimentally for the second and third channel (i.e. cross-field and company-level spillovers). An ideal experimental design to test for cross-field spillovers would vary treatment intensity across larger clusters that are independent from each other in terms of input provision. However, such a design was not feasible in our setting: the contractors that deliver fertilizer cover large areas (in some instances, the whole catchment scheme). In addition, the coverage area changes over time and overlaps across contractors.

However, we can use non-experimental time variation in the intensity of the program. More specifically, we test whether a higher share of treatment fields scheduled to receive fertilizer in a given month (as a share of the total number of fields in the scheme) increases delays in non-treatment (i.e., control or non-study) fields. We use Urea delivery data from January 2011 to December 2013. For each of these 36 months, we compute the number of treatment plots and of non-treatment plots that are at the end of the optimal input delivery window. We then identify two key variables: the proportion of non-treatment plots that receive fertilizer after the optimal time window and the number of treatment plots, as determined by the timing of the randomization waves and by the variation in the age at which treatment fields entered the intervention (typically, between the first and the third month of the harvest cycle).

Table 4 presents the results of the analysis of these variables on the sample of 36 months available in the data. Column 1 presents the results of a bivariate regression where the dependent variable is the percentage of plots that do not receive fertilizer within the optimal time window and the independent variable is the number of treatment plots. The coefficient of interest is small and non-significant. Adding calendar month fixed effects leaves the results unchanged (column 2). Column 3 adds trends by month (starting from January 2011). In this specification, the coefficient on the number of treatment plots become larger (in absolute value) and it is now significant at 5%: an extra treatment plot reduces the fraction of non-treatment plots in the contract farming scheme that experience a delay in receiving Urea fertilizer by 0.1 percentage points. These results are unchanged when we add year fixed effects (column 4).

These results mitigate the concerns that our treatment effects come from a transfer of resources from other fields to the treatment fields. Obviously, they must be interpreted cautiously because they are based on a small sample size (36 months) and because they identify the coefficient of interest from non-random variation in the number of treatment fields across months.

The evidence that the experiment did not increase delays in control and non-study fields is consistent with Figure 1. As discussed in Section 2, there was room to reduce the prevalence of deliveries out of the optimal time window (in the treatment group) by slightly delaying the delivery in other plots, while still keeping deliveries for these plots within the six-month window.

5.3 Impact on Plot Yields

Table 5 presents results on the impact of the hotline treatment on yields. About 22% of the plots ended up not completing the cane cycle targeted by the experiment. We do not have yield data for these plots. A plot may fail to complete the cycle if the farmer uproots the crop (for instance to plant maize), if it side-sells to different buyer or if the company ends the contract (for instance because of poor plot management). In the Appendix, we show that there is no significant impact of treatment on the likelihood of completing the cycle.[21]

[21] In addition, there is no significant treatment effect on the likelihood that a plot is still in the contract farming scheme in the harvest cycle that follows the one targeted by the experiment.

We cannot reject either no impact on yield or impact consistent with expected given cross-section relationship. A treatment-on-treated regression of yields on timely-delivery, instrumented with the hotline assignment, gives a confidence interval that includes the coefficient from the cross-sectional regression reported in Section 2 (1.83). For plots with no phone number is larger, we observe a marginally significant difference in yields between treatment and control, which however disappears once including baseline yields (as discussed in Section 4, baseline yields were slightly unbalanced for this group of plots).

6. Conclusion

We study the relationship between a large Kenyan agri-business and the farmers supplying raw materials. In a setting featuring many aspects of crony capitalism, we document frequent violations of the company's contractual obligation to provide inputs to farmers. A simple model illustrates how managers' moral hazard and farmers' collective action problems can lead to the persistence of these inefficient outcomes. An ICT-based intervention –mostly funded through research money – lowered the farmers' cost to report a complaint and reduced inefficiencies in input delivery.

In spite of these benefits, the company did not scale up the ICT intervention. Given the high manager turnover and their short-time horizon, company managers may have not found the investment worthwhile. In addition, the intervention may have reduced managers' rents, thus further decreasing the incentives to adopt. These dynamics suggest that efficiency returns from ICT innovations may not be enough for adoption if and that one also needs alignment of other political economy incentives (Acemoglu, 2010).

Thee results suggest that individual companies may not have incentives to institute complaint platforms, even if these could increase efficiency. Thus, these findings also provide a rationale for the institution of *independent* complaint platforms. Consumer protection agencies around the world provide opportunities to report complaints toward large companies. In addition, large non-profits organization, like *Better Business Bureau,* provide third-party dispute resolution procedures. Understanding the impact of such institutions in developing countries is a promising avenue for future research.

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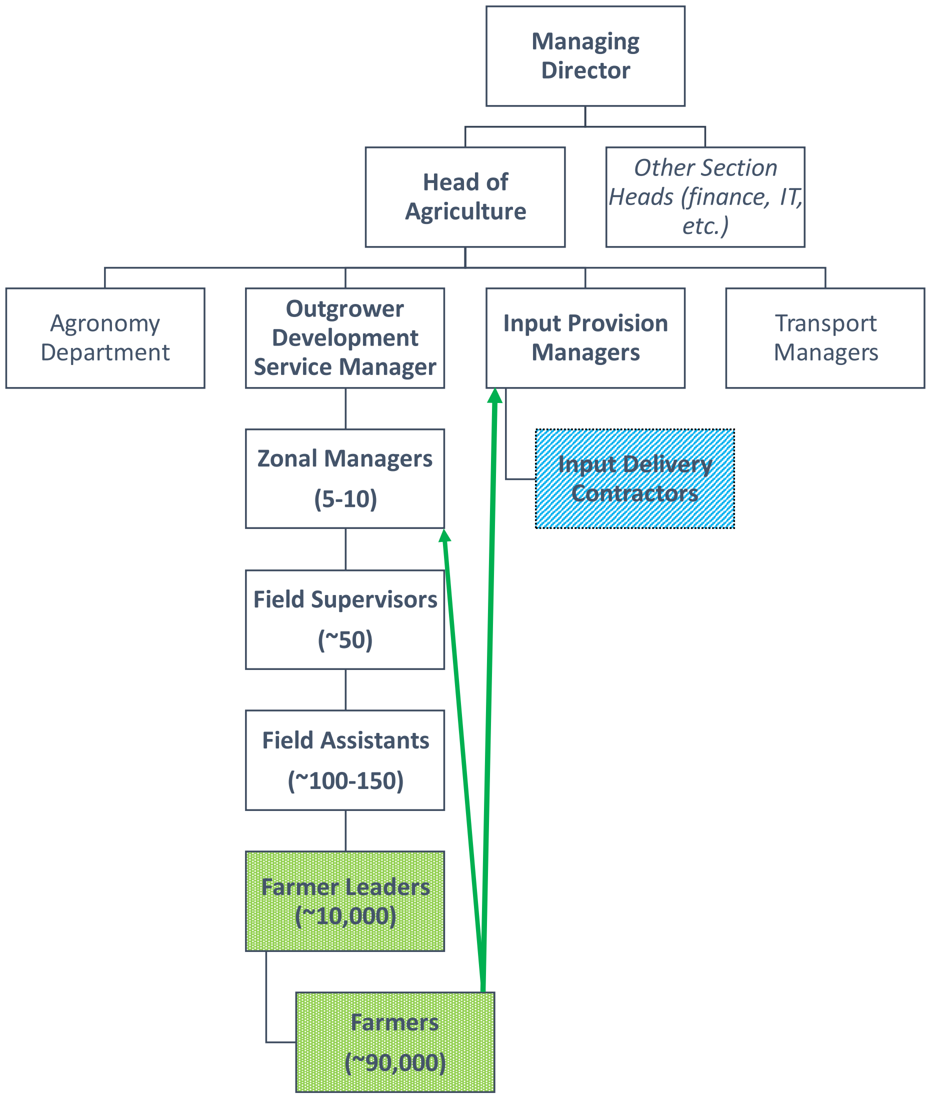
Figures

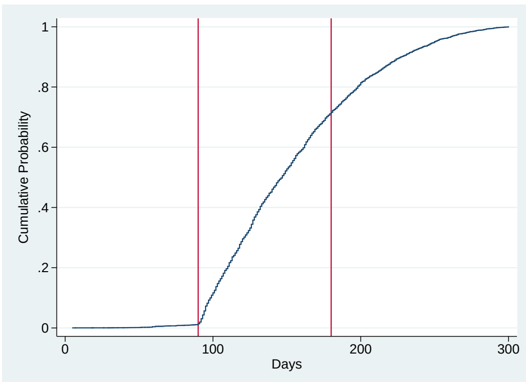
Figure 1: Company Organizational Chart and Hotline Intervention



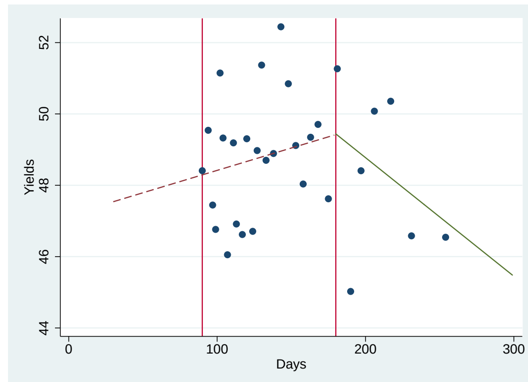
Notes: The chart describes the organization of the company and the multiple layers of interaction among company staff, contractors and farmers. The arrows identify the lines of communication the hotline enabled.

Figure 2: Urea Delivery and Productivity: Correlational Evidence

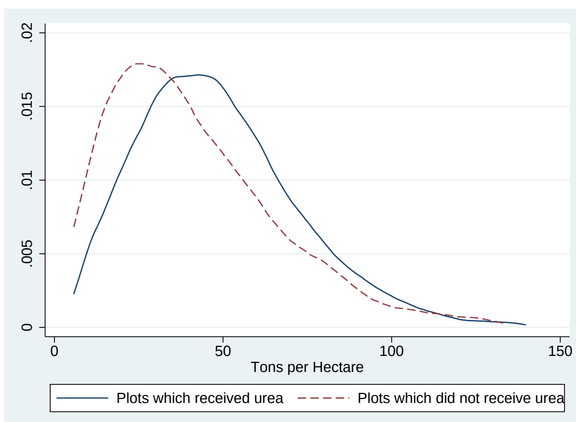
(a) Cane Age at Urea Delivery



(b) Yields and Urea Delivery Date



(c) Yield Distribution by Urea Delivery Status



Notes: The graphs use administrative data on fertilizer delivery and plot yields in the year before the experiment. **Panel (a)** plots the distribution of the age of cane (in days) at the time of urea delivery. We drop from the figure plots that receiver fertilizer after 300 days ($< 0.5\%$). The two vertical red lines represent the optimal time window identified by the agronomy department for urea delivery (90-180 days).

Panel (b) presents the correlation between cane age at Urea delivery and yields (tons of cane per hectare). The two vertical red lines represent the optimal time window identified by the agronomy department for urea delivery (90-180 days). Each dot of the scatter represents median age and average yield in each of 30 quantiles. The dashed line plots a linear fit for plots that receive fertilizer by the end of the optimal time window. The continuous line plots a linear fit for plots that receive fertilizer after the end of the optimal time window. The difference in slopes is significant with p-value=0.02.

Panel (c) presents the kernel density of yields for plots that received fertilizer (continuous) and for plots that did not receive it (dashed).

Tables

Table 1: Baseline Balance

	Eigible Plots				Non-Eigible Plots			
	Control	Hotline	p-value	N	Control	Hotline	p-value	N
Plot Size (ha.)	0.44	0.43	0.45	3768	0.44	0.44	0.81	4313
	(0.32)	(0.29)			(0.31)	(0.31)		
Ratoon 1	0.25	0.27	0.42	3768	0.26	0.29	0.19	4313
	(0.43)	(0.45)			(0.44)	(0.45)		
Ratoon 2	0.24	0.30	0.33	3768	0.25	0.33	0.30	4313
	(0.43)	(0.46)			(0.43)	(0.47)		
Ratoon 3	0.10	0.09	0.78	3768	0.09	0.07	0.66	4313
	(0.30)	(0.28)			(0.28)	(0.26)		
Zone 1	0.12	0.11	0.15	3768	0.09	0.08	0.14	4313
	(0.32)	(0.32)			(0.28)	(0.27)		
Zone 2	0.28	0.24	0.91	3768	0.30	0.25	0.28	4313
	(0.45)	(0.42)			(0.46)	(0.44)		
Zone 3	0.26	0.27	0.32	3768	0.27	0.27	0.35	4313
	(0.44)	(0.44)			(0.45)	(0.45)		
Zone 4	0.18	0.19	0.92	3768	0.15	0.19	0.35	4313
	(0.38)	(0.39)			(0.36)	(0.40)		
Zone 5	0.17	0.19	0.92	3768	0.18	0.20	0.20	4313
	(0.37)	(0.39)			(0.39)	(0.40)		
Baseline Harvest Yield	56.30	58.39	0.99	3141	51.40	55.52	0.08*	3533
	(28.94)	(27.21)			(27.29)	(31.49)		
Baseline Harvest: UREA Delivered	0.87	0.88	0.93	3141	0.87	0.90	0.81	3533
	(0.34)	(0.33)			(0.34)	(0.30)		
Baseline Harvest: UREA Delivered by 6 months	0.58	0.61	0.29	3141	0.63	0.64	0.53	3533
	(0.49)	(0.49)			(0.48)	(0.48)		

Notes: The table reports baseline balancing for variables from the company administrative data. P-values are from regressions that include field-level stratification dummies. The regression was statified by harvest cycle (ratoon number), by zone and by the field-level average response rate to a phone survey done before the intervention. Standard errors are clustered at the field level. *p<0.1, **p<0.05, ***p<0.01.

Table 2: Treatment Effect on Fertilizer Delivery for Eligible Plots

	Urea Not Delivered		Urea Not Delivered in Time	
	(1)	(2)	(3)	(4)
Hotline	-0.038**	-0.041***	-0.085***	-0.085***
	[0.015]	[0.015]	[0.028]	[0.028]
Mean Y Control	0.104	0.104	0.393	0.393
Controls	N	Y	N	Y
Observations	3768	3768	3768	3768

Notes: The sample includes "eligible" plots whose farmers registered a phone number before the intervetion. *Urea Not Delivered* is a dummy equal to one if the plot did not receive urea fertilizer in the harvest cycle targeted by the experiment. *Urea Not Delivered in Time* is a dummy equal to one if the plot did not receive urea fertilzier within the optimal time window recommended by the company agronomy department (i.e. within at most six months from the start of the harvest cycle). All the columns include stratification dummies. Columns (2) and (4) also include baseline controls from Table 1. Standard errors are clustered at the field level. * p<0.1, **p<0.05, ***p<0.01.

Table 3: Treatment Effect on Fertilizer Delivery for Non-Eligible Plots

	Urea Not Delivered		Urea Not Delivered in Time	
	(1)	(2)	(3)	(4)
Hotline	-0.010	-0.013	-0.075**	-0.074**
	[0.016]	[0.016]	[0.032]	[0.032]
Mean Y Control	0.097	0.097	0.378	0.378
Controls	N	Y	N	Y
Observations	4313	4313	4313	4313

Notes: The sample includes "non-eligible" plots whose farmers did not register a phone number before the intervetion. *Urea Not Delivered* is a dummy equal to one if the plot did not receive urea fertilizer in the harvest cycle targeted by the experiment. *Urea Not Delivered in Time* is a dummy equal to one if the plot did not receive urea fertilzier within the optimal time window recommended by the company agronomy department (i.e. within at most six months from the start of the harvest cycle). All the columns include stratification dummies. Columns (2) and (4) also include baseline controls from Table 1. Standard errors are clustered at the field level. * p<0.1, **p<0.05, ***p<0.01.

Table 4: Fertilizer Deliveries in Non-Treatment Plots

	(1)	(2)	(3)	(4)
N. treatment plots	0.001	-0.011	-0.092**	-0.098**
	[0.040]	[0.035]	[0.035]	[0.035]
Mean Y Control	39.247	39.247	39.247	39.247
Calendar Month FE	N	Y	Y	Y
Time (year-month) Trend	N	N	Y	Y
Year FE	N	N	N	Y
Observations	36	36	36	36

Notes: The unit of observation is the month (January 2011 to December 2013). The dependent variable is the percentage of non-treatment plots (i.e. study control plots and non-study plots) that experience a delay in Urea delivery relative to the optimal window out of the total number of non-treatment plots that finish the optimal time window in that month. The regressor is the number of treatment plots that finish the optimal delivery time window (i.e. they complete the sixth month in the cycle) in each month. * p<0.1, **p<0.05, ***p<0.01.

Table 5: Treatment Effect on Yields

	Eligible		Non-Eligible	
	(1)	(2)	(3)	(4)
Hotline	-0.394	0.571	2.194	2.043*
	[1.379]	[1.181]	[1.466]	[1.158]
Mean Y Control	56.662	56.662	53.195	53.195
Controls	N	Y	N	Y
Observations	2819	2819	3178	3178

Notes: The outcome variable is measured in tons of sugarcane per hectare. The sample in Columns (1) and (2) includes "eligible" plots whose farmers registered a phone number before the intervetion. The sample in Columns (3) and (4) includes "non-eligible" plots whose farmers did not register a phone number before the intervetion. All the columns include stratification dummies. Columns (2) and (4) also include baseline controls from Table 1. Standard errors are clustered at the field level. * p<0.1, **p<0.05, ***p<0.01.

A Appendix Tables

Table A.1: Treatment Effect on the Probability of Completing the Harvest Cycle

	Eligible		Non-Eligible	
	(1)	(2)	(3)	(4)
Hotline	0.025	0.027	0.015	0.010
	[0.020]	[0.019]	[0.022]	[0.021]
Mean Y Control	0.730	0.730	0.722	0.722
Controls	N	Y	N	Y
Observations	3768	3768	4313	4313

Notes: The outcome variable is a dummy equal to one if the plot completed the harvest cycle and sold cane to the company. The sample in Columns (1) and (2) includes "eligible" plots whose farmers registered a phone number before the intervetion. The sample in Columns (3) and (4) includes "non-eligible" plots whose farmers did not register a phone number before the intervetion. All the columns include stratification dummies. Columns (2) and (4) also include baseline controls from Table 1. Standard errors are clustered at the field level. * p<0.1, **p<0.05, ***p<0.01.. *p<0.1, **p<0.05, ***p<0.01.