Motivating Farmer Trainers. Experimental evidence from rural Uganda.*

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Abstract

Finding the most effective ways for motivating agents to volunteer for the benefit of the community is a main concern for resource-constrained organizations. This paper tests the effects of three non-monetary mechanisms in the context of a large-scale volunteer Farmer Trainer program in rural Uganda. Farmers identified by local communities were randomly selected to become Farmer Trainers in dairy farming. To encourage their volunteer activity of trainer, three non-monetary mechanisms were randomly assigned to a subset of Farmer Trainers: (i) vouchers for accessing professional Extension Agents, (ii) sign-post advertising their trainer's activity, (iii) extra training to learn to customize training sessions based on the farmers' needs. Results show that connecting Farmer Trainers to professional extension agents is the most effective way to increase their training efforts and to diffuse information to a large number of farmers even outside of their social network. This evidence speaks in favor of providing cost-effective non-monetary incentives to Farmer Trainers for the diffusion of information.

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1 Introduction

Two-thirds of the world poor live in rural areas and depend on agricultural activities. In Sub-Sahran Africa these activities are of particularly low productivity. According to the latest figures provided by FAOSTAT, Sub-Sahara African countries stand far behind the rest of developing countries in terms of harvest per hectare production, averaging roughly one thousand four hundred kilograms per hectare, that is less than half the production of South Asia and three times less than the world average.

One of the main reasons behind this low agricultural productivity is the low adoption rate of agricultural technologies, that is still much lower in Sub-Saharan Africa than in other developing countries. Cultivation of modern varieties of maize represents just 17% of the total harvested area in Sub-Saharan Africa compared to 90% in East and South East Asia and the Pacific (Jack, 2013). Fertilizer use is estimated at 10 kg/ha in Sub-Saharan Africa, as opposed to over 300 kg/ha in East Asia (FAO, 2017). In Uganda, recent estimates (Bold et al., 2017) show that only 7% of crop growing households use some sort of fertilizer and 22% plant improved seeds.

Lack of access to information is one of the main market failures behind these low rates of technology adoption (De Janvry and Sadoulet (2019); Jack (2013)). The traditional way of diffusing information through an agricultural extension system suffers from several limitations and lack of funding in developing countries. To face these issues, a farmer-to-farmer system to diffuse information has been implemented in several countries since a long time.[1] Despite the wide adoption of the "Farmer Trainers" system (FTs), few impact evaluations have been conducted to date (Takahashi et al., 2020). Existing evidence documents small impacts when FTs act as volunteers and do not receive any incentive (Kondylis et al., 2017). Whereas they are found to outperform professional Extension Agents in increasing fellow farmers' knowledge and adoption of technologies when provided with pay-for-performance incentives (BenYishay and Mobarak, 2019).

This paper investigates the impacts of non-monetary mechanisms provided to volunteer Farmer Trainers on their trainer's activities devoted to diffuse information among village farmers in rural Uganda. The analysis builds on the random assignment of three non-monetary mechanisms to a sample of Farmer Trainers, in order to encourage them to diffuse knowledge and stimulate adoption of agricultural techniques among their fellow farmers.

We focus on non-monetary mechanisms to stimulate the Farmer Trainers' activities as there are several drawbacks associated with providing monetary incentives. First, monetary incentives may crowd-out motivation of pro-social individuals (Gneezy and Rustichini (2000); Bénabou and Tirole (2006)). Community development, altruism, social status and increasing one's own knowledge are, indeed, usually reported to be the main reasons for becoming a Farmer Trainer (Simpson et al. (2015); Davis et al. (2019)). Second, it might not be a financially sustainable

[1] The system consists in training a local farmer on specific techniques to be diffused to the other fellow farmers. This farmer usually shares similar characteristics with the other farmers, but has some features that make him/her a good communicator. This system is deemed to have several advantages compared to the traditional extension services: lower financial cost, 'long term' support from the local trainer and reduced risk-aversion towards adopting new technologies by learning from a close peer.

system in the long-term, especially for resource-constrained organizations operating in rural areas of developing countries. Third, the pay-for-performance payment is subject to a significant increase in the village farmers' knowledge that is hard to measure and provide by local organizations. Fourth, FTs might act strategically and target specific farmers (e.g. focus on those sampled at baseline by researchers and exclude those lagging behind), possibly sharing with them the pay-for-performance payment. This would limit the spread of knowledge to a close group of people with the risk of reinforcing clientelism and village inequalities. The use of monetary incentives needs careful research as it might lead to cream-skimming of farmers or have other unintended consequences.

Non-financial mechanisms might be more (or as) effective, less expensive, easier to implement and more sustainable in the long term. To the best of our knowledge, the only paper experimentally testing the impact of non-monetary mechanisms on FTs' effort is the one by Shikuku et al. (2019). The authors find that incentives promoting FTs' social recognition and incentives providing a private material reward are equally effective in stimulating FTs' training activity. The issue of which non-monetary mechanisms to provide and how to motivate Farmer Trainers in a sustainable way remains open.

To the best of our knowledge, this is the first paper to test the impact of different non-monetary mechanisms to motivate Farmer Trainers to promote agricultural technologies.[2] It builds on the random assignment of three non-monetary mechanisms provided on top of a volunteer Farmer Trainer program implemented in 627 villages in rural Eastern Uganda in 2015-2017.[3] In addition to the basic treatment of training Farmer Trainers in dairy practices, three non-monetary mechanisms were randomly assigned to treated FTs to encourage their engagement. The mechanisms were: (i) vouchers to access professional Extension Agents, (ii) a metal sign-post providing publicity and social signaling, (iii) an additional training for teaching Farmer Trainers to adapt the content of training to the farmers' needs.

This paper evaluates whether and which of these mechanisms is the most effective in stimulating FTs' activity. By relying on unique panel data and attendance sheets information collected during the training sessions, we assess which non-monetary mechanisms increase FTs' training activities the most in terms of number of sessions organized and number of trainees.

Next, we study whether the mechanisms affect the composition of the group of trainees. To limit the cost of providing training, FTs might limit knowledge diffusion to a close circle of similar farmers they already know, with the risk of clientelism and elite capture (Ragasa, 2020). To explore this potential drawback of the FT system, we conduct two types of analyses. First, we look at the effect of the non-monetary mechanisms on the share of trainees belonging or not to the FT's baseline social network. Second, we rely on the sampling design by testing for any differential effects of the non-monetary mechanisms depending on whether the sample farmer was part of the FT's social network at baseline or not.

[2] The main difference with the paper by Shikuku et al. (2019) is that the authors, similarly to BenYishay and Mobarak (2019), reward FTs depending on their performance in increasing farmers' knowledge. In our study, instead, the mechanisms are provided ex-ante and are independent of any performance-based outcome, they do not require any ex-post verification, making their implementation much easier and less expensive.

[3] For the main impact evaluation results, see Behagel et al. (2020).

The main results show that providing non-monetary mechanism to encourage FT's activity is effective. FTs organize more sessions and train more farmers compared to FTs simply provided with the initial training. Facilitating access of FTs to Extension Agents seem to be particularly effective in promoting FTs' activities and in reaching out to farmers outside of the FTs' social network.

In particular, backstopping by professional Extension Agents appears to be the most effective mechanism, followed by the publicity and social signaling one. We find that FTs assigned to the first mechanism organize twice as much training sessions, train 23% more farmers and their training sessions are of higher quality according to sampled farmers.

Moreover, we find that trainees differ depending on the mechanisms provided. FTs receiving the vouchers do not limit information diffusion to a close network of peers. They reach out to farmers outside of their social network while decreasing the share of trainees from their own social network. In contrast, for FTs assigned to the sign-post publicity mechanism the share of trainees belonging to their social network is higher.

This paper stands at the crossroads between the literature on motivating agents with non-monetary mechanisms and the literature studying the patterns of information diffusion in the agricultural context. It contributes to both strands of literature by exploring how effective non-monetary mechanisms are in pushing communicators to diffuse information and to reach out to trainees that are distant from the communicator.

In fact, finding the best ways to motivate agents to voluntarily engage in collective activities is of interest beyond the diffusion of agricultural technologies. The efficacy of monetary versus non-monetary compensations depends on the motivation behind the agent's engagement, whether it is intrinsic or extrinsic. Monetary compensations can backfire when agents' intrinsic motivation dominates (Frey and Oberholzer-Gee (1997); Gneezy et al. (2011); Chetty et al. (2014)). According to Deci and Ryan (1985) "Where individuals perceive an external intervention to be controlling, their intrinsic motivation to perform the task diminishes". Designing the right mechanisms for motivating agents is also the object of the scientific literature about how to motivate workers in firms (Besley and Ghatak (2005); Besley and Ghatak (2016)) and to improve the efficacy of health-related interventions (Ashraf et al. (2014a); Ashraf et al. (2014b); Deserranno (2014)).

The second main strain of literature this papers relates to is the one about the role of farmers' social networks on the diffusion and adoption of new practices (Conley and Udry (2001); Fafchamps and Gubert (2007); Munshi (2004); Conley and Udry (2010); Vasilaky (2013)). Recent literature stresses the importance of the communicator's position in the village social network (Banerjee et al. (2013); Banerjee et al. (2014); Maertens (2017); Beaman and Dillon (2018); Banerjee et al. (2019); BenYishay and Mobarak (2019); Lee et al. (2019); Takahashi et al. (2019); Shikuku (2019)). In this paper we use social network data to identify the type of relationship linking the trainees to the Farmer Trainer in order to investigate whether the non-monetary mechanisms have any selection effect of farmers into training sessions based on their previous connection to the FT.

Finally, this paper contributes to improve the design of Farmer Trainer systems, by providing new evidence about the efficacy of different non-monetary mechanisms. Existing evidence is scarce and more work is needed to assess the impacts of the Farmer Trainer programs and improve their system design (Davis et al., 2019).

The rest of this paper proceeds as follows. Section 2 provides a theoretical framework concerning the costs and benefits encountered by Farmer Trainers in their training activities. Section 3 describes the project intervention and the non-monetary mechanisms. Section 4 presents the sample design and data. Section 5 describes the main outcomes and the empirical strategy. Sections 6 and 7 present the main findings. Section 8 discusses the robustness checks. The last section draws the main conclusions.

2 Theoretical framework

This section provides a theoretical framework concerning the utility function of Farmers Trainers for organizing training sessions and the utility function of farmers for attending training sessions. It helps us laying out the main hypotheses about the effects of the non-monetary mechanisms.

To encourage volunteer participation one can either increase its benefits or decrease its costs, the aim being to decrease the cost-opportunity of the time devoted to the volunteer activity. Farmer Trainers derive an utility from organizing training sessions that can be expressed in the following way:

$$u_{FT}(N) = \alpha N - \beta N^2 - \delta max(D - N, 0) \tag{1}$$

- α measures the non-monetary rewards derived from training N farmers. It includes the FT's altruism and self-confidence in training others. The higher the number of trainees (N), the higher the satisfaction for the FT.
- β measures the cost of training. A higher number of trainees means more time dedicated to training sessions and less time allocated to other personal activities (especially taking care of his/her own land and cattle).
- δ reflects the cost of not meeting demand for training if D>N. The demand for training can be larger than what the farmer could offer. If the demand for training is high, the community could pressure the FT to conduct training. Keeping N<D can then have a social cost.

At the same time, farmers derive an utility from attending the training sessions that depends on the expected benefits (γ) and the non-monetary cost of attending the sessions (c):

$$u_{F,c} = \begin{cases} \gamma - c & \text{if attends training session} \\ 0 & \text{if does not attend training session} \end{cases}$$

Part of the benefits farmers expect to obtain from attending the training session depends also on (their perception about) how good the FT is as a trainer.

The demand for training can be expressed as $D(\gamma) = Prob(c \leq \gamma)$, which increases with γ.

Given that the farmer trainer cannot teach farmers who do not attend sessions, we have: N $\leq$ D.

If N $<$ D(γ), the first-order condition for the FT is:

$$\alpha - 2\beta N + \delta = 0 \tag{2}$$

Which implies:

$$N = \frac{\alpha + \delta}{2\beta} \tag{3}$$

The previous expression can only be true if $\frac{\alpha+\delta}{2\beta} < D(\gamma)$. Otherwise: N = D($\gamma$).

Thus, the model says that, if $\frac{\alpha+\delta}{2\beta} < D(\gamma)$, then N=$\frac{\alpha+\delta}{2\beta}$. Otherwise: N = D($\gamma$).

The description of the non-monetary mechanisms will explain how we expect these mechanisms to influence α, β, δ and γ.

3 The project intervention

The data we use were collected by a team of researchers of the Paris School of Economics working on the expansion of the East Africa Dairy Development Project (EADD) in Uganda (Behagel et al., 2020).[4] The EADD project aims at helping smallholder dairy farmers in rural areas of East African countries to increase their milk production and sales by improve their knowledge about dairy farming. For this purpose, an extension program based on a Farmer-to-Farmer model was implemented between spring 2015 and fall 2017 in rural Eastern Uganda.

3.1 Selection of Farmer Trainers and randomization design

From December 2014 to June 2015 village meetings were hold in each of the 627 sampled villages in the districts of Kamuli and Buyende in Eastern Uganda to identify eligible candidates to the training program. Village representatives were informed by the EADD staff about the project and agreed on the following criteria to select one FT per village: (i) having completed primary school, (ii) holding at least one head of cattle, (iii) not being in charge of any political role. The selection process did not involve Extension Agents nor community leaders, to avoid cherry-picking the most prominent community members while promoting a community-based and participatory process.

[4] The EADD project is a joint initiative led by Heifer International, TechnoServe, ABS, ILRI (the International Livestock Research Institute), and ICRAF (the World Agroforestry Center), financed by the Bill and Melinda Gates Foundation.

The village representatives hold then village meetings in which two to three candidates were proposed. These were then interviewed by the EADD project staff, who selected one potential Farmer Trainer (FT) per village to be part of the lotteries for the random assignment of the training program.

Two-thirds of potential FTs were randomly drawn to receive a one-week training on cattle-management techniques and feeding practices in dairy production. Seedlings and pasture seeds were also distributed for free to training participants. In addition to this basic initial training, a two-day "refresher training" took place twice a year.

In the control villages the potential FTs received training three years later. Farmer Trainers living in villages assigned to the treatment group were then expected to diffuse the practices learned to the other farmers in their villages by holding training sessions. No in-kind nor monetary remuneration was provided to the FTs for their training activities by the EADD project.

The randomization took place with public lotteries. Two series of lotteries were conducted, one to allocate villages to the treatment group and another one to assign treatment variations. The lotteries were clustered at the parish level and took place in central places to facilitate farmers' attendance. In total 11 separate public lotteries took place, 6 of which were stratified in 2 strata based on the baseline FTs' number of cows owned.

3.2 Non-monetary mechanisms

On top of the main treatment, three non-monetary mechanisms were further randomized as treatment variations with the aim of encouraging the voluntary activity of FTs. Each treatment variation was assigned independently of the others. Each FT could be assigned to zero, one, two or three variations.

Linkage variation. The first treatment variation consists in providing FTs with twelve vouchers to pay for professional extension agents (EAs) to come and visit their farm and cattle once per month. During their visits, Extension Agents can also provide technical support, additional training, help with the training sessions and monitor the training activities of the FT.

Providing vouchers is a way for making access to extension services more affordable, by relaxing the Farmer Trainer's budget constraint. This is expected to increase the quality and quantity of training sessions for several reasons. The EA may provide further information and show practical application of the techniques learned, hence improving the FT's knowledge and use of the techniques. FTs might then be able to teach a wider number of topics and to a wider spectrum of farmers. This would improve the quality of training and, possibly, the number of sessions organized and the number of trainees.

Moreover, the presence of the EA during the training sessions might have a "calling effect", increasing farmers' expected benefits of the training. Anecdotal evidence suggests, indeed, that FTs receiving regular visits by the EA are deemed more credible by the village farmers. The presence of the EA at the training sessions is, hence, likely to attract a larger number of farmers. Nevertheless, the data show that EA's participation at training sessions remains marginal in this program, as the bulk of the sessions are set up by the FTs alone.

Distributing vouchers may also free monetary resources for the Farmer Trainers to increase adoption of dairy techniques. This would make the FT familiar with a wider range of dairy techniques, possibly improving the quality of training.

All in all, the vouchers represent a non-monetary reward associated with being a Farmer Trainer (α). The monitoring of the Extension agent, may, however, increase the social cost of not meeting the demand for training (δ), even though his/her participation at the training sessions likely reduces the cost of training for the FT (β). We expect, moreover, the Linkage variation to increase the benefits farmers expect to obtain from attending the training sessions (γ).

Needs Assessment variation. The second mechanism consists in one additional day of training to teach the FTs how to adapt the training sessions to the trainees' needs and constraints. The FTs were instructed to adapt the type of techniques taught to the production profiles of their trainees and to set up a customized action plan to facilitate adoption of dairy technologies. FTs assigned to this variation received one extra day of training every 6 months to learn how to conduct needs assessment sessions.

Targeting technology adoption by addressing farmers' specific needs and constraints is expected to improve the quality of the training sessions and to encourage farmers' participation and technology adoption. This might, however, come at the expenses of setting up training sessions with small groups of farmers, possibly fairly homogeneous, limiting the diffusion of information to a wider public.

The specific training foreseen by the Needs Assessment variation might improve the FT's communication capacity, a sort of non-monetary reward for being a Farmer Trainer (α). Tailoring the training content to the farmers' needs might, however, initially require more time and effort from the FT side, raising the cost of training (β). Nevertheless, receiving a customized training session is likely to increase the benefits obtained from training expected by farmers (γ).

Sign-post variation. The third variation consists in displaying a metal signpost outside of the FT's home residency, with the picture of a healthy crossbred cow, the name of the FT and his/her phone number written on it. The FT could also add information about the training sessions, such as the number of farmers attending training in the last month, the number of sessions held or the number of feed technologies applied by the trainees and the FT.

This mechanism acts only on the supply side, without directly contributing to the quality of the training sessions. It is expected to attract a larger number of farmers and, hence, to increase training activities. Along the lines of Ashraf et al. (2014a), the signpost might be a sign of social recognition, providing a reputation effect and indirectly stimulating FTs' efforts to conduct training sessions and to improve the quality of the training delivered. Anecdotal evidence suggests, however, that the signpost might also backfire as farmers might suspect the FT to be paid for organizing training sessions.

By boosting the FT's social status, we expect the sign-post variation to increase the non-monetary reward from training (α). Such visibility might, however, come at the cost of higher social pressure raising the social cost of not meeting the demand for training (δ). The cost of training (β) might, then, increase if there is a pressing demand for training. Given that the sign-post intervention does not directly improve the quality of training, FTs assigned to this mechanism won't be more knowledgeable than those in the basic treatment group or in the other variations. So whether farmers expect higher benefits from training (γ) under this variation will mostly depend on the change in perceptions operated by the sign-post.

It is important to note that the EADD FT program represents a cost-effective model of agricultural extension. The cost of the basic treatment amounts to $110 per FT per year. [5] The linkage and signpost variation each cost $25 per village per year, less than providing monthly EA visits. The need assessment variation was the most expensive one, costing $47 per village per year. The overall cost of this program remains cheaper than a basic agricultural extension that has to pay for the transport, accommodation and salary of the EA. From a planner's perspective, analyzing the effect of this intervention can help alleviate the financial and logistical constraints that hinder the setup of policies promoting the diffusion of information.

4 Data and empirical strategy

4.1 Sample design and data

The initial sample is made of 627 villages, in which 5 farmers were surveyed at the baseline, midline and endline: the FT, 3 farmers from his/her social network and one randomly selected farmer.

The baseline survey, conducted between January and June 2015, contains information on the households composition and characteristics, livestock ownership and dairy production, land and agricultural activities and social networks. The questionnaire for the FTs contains a specific module about their village social network that was used for the sampling design. It is structured in the following way. FTs had to name a list of up to 11 farmers they know under different dimensions (close neighbors, close friends, farmers who asked advice on dairy farming, etc. see Appendix A.1 for the complete list of questions). Three "network members" were then selected as the first three dairy farmers that the FT named when asked "Is there any dairy farmer in the village who in the last 30 days has come to seek your advice on dairy farming?".[6] These sampled farmers are part of the FT's strong social ties. This sampling design was done with the purpose of maximizing the chances of sampling future trainees.

Nevertheless, these farmers are potentially very different from the average village diary farmer, hence one dairy farmer randomly picked from the whole list of village dairy farmers and

[5] Details on the cost of the program can be found in Behagel et al. (2020).
[6] If the FT named less than three farmers the rest was selected from the list of the five closest neighbors.

absent from the social network module was also surveyed.[7] The questionnaire for the sampled farmers (SFs) included a social network module pre-filled with the names of the FT, the farmers listed by the FT in the social network module and the random farmer's name.[8] The four sampled farmers were inquired about their relationship with the FT and the other farmers. In addition, they were asked to name the three most successful farmers in the village, as well as their three closest neighbors, by choosing from a list of names containing the FT and the farmers listed by the FT in the social network module. We use this information to measure the number of farmers identifying the FT as the most successful farmer in the village, as a proxy measure of the centrality of FTs in the village (Banerjee et al., 2019).

The main outcomes of interest are measured with the midline and endline survey data, collected, respectively, in July-September 2016 and July-September 2017. Attrition between the baseline and endline survey is limited with an overall response rate of 98.2%[9].

In addition to the survey data, we use monitoring data collected during the training sessions. FTs in the treatment group had to fill in an attendance sheet at each session reporting the date of the session, the name and surname of trainees and their signature. We use these data to measure the main outcomes of interest about the FT's training activities (see below for a detailed description of the outcomes). In addition, we match these data with the survey data by village and based on the names of the surveyed farmers and of the trainees.

4.2 Summary statistics

This section provides some descriptive statistics on socio-demographic characteristics and aspects of dairy farming measured at baseline for Farmer Trainers and sampled farmers. We also provide balance checks of observable characteristics for control and treatment groups.

The baseline sample is made of 3127 individuals, out of which 627 are Farmer Trainers and 2500 sampled farmers. Out of the 627 FTs, 216 are assigned to the control group and 411 to the treatment group. As explained above, a treated FT can be assigned to several variations. Table 1 shows that 50 FTs were assigned to the basic treatment group (training only), 162 were assigned to one variation, 146 to two variations and 53 to three variations.[10] Roughly the same amount of FTs were assigned to each variation.

i) Farmer Trainers

Table 2 presents the summary statistics of FTs' baseline characteristics and provides the balance check between the treatment and control group. The two groups are balanced in terms

[7] The list of all dairy farmers in a village was provided by the village leader and a list of random numbers was applied to select one farmer to be sampled.

[8] The questionnaire did not specify which farmer was the Farmer Trainer. Sampled farmers were simply submitted a list of dairy farmers living in the same village, among which the name of the Farmer Trainer appeared as well.

[9] The non-response rates are as following: 96.8% among control FTs (13 non respondents), and also 96.8% among treated FTs (7 non respondents), 98.3% among control farmers (28 non respondents), 99.2% among treatment farmers (7 non respondents).

[10] The study was not designed to have enough statistical power to evaluate the impact of the variations' interactions, tough we provide a robustness check of the main results controlling for the double and triple interactions.

of observable characteristics, with the exception of the share of FTs producing milk and the amount of milk produced. In the treatment group 83% of FTs produce milk for an average of 3.82 liters per day, whereas in the control group 74% of FTs produce milk for an average of 3.06 liters per day. In the Appendix we provide a robustness check of the main regression results controlling for these variables. The balance checks of comparing the basic treatment with the three variations show similar results (see Table A1). There is no significant difference for the list of observable characteristics, except for the household size and the share of farmers using a saving institution whose difference is statistically significant at the 10% level.

The figures reported in Table 2 show that most FTs' household heads are men (9 out of 10) of 42 years old who have almost all attended school, in line with the selection criteria decided by the village representatives in agreement with EADD. Yet, about 30% of FTs are already actively engaged in the community as members of a local committee, in contrast with the selection criteria and suggesting it is hard to avoid prominent community members from assuming the role of FT.[11]

The baseline knowledge level of dairy practices is fair, though self-reported adoption is fairly low. Out of 26 dairy technologies (12 practices and 14 animal feeds) FTs know on average 18 technologies, out of which 9 animal feeds. Yet, they apply very few of them: 9 technologies, out of which 5 animal feeds.

Few other characteristics are worth noting. Farmer Trainers own on average 6 heads of cattle out of which 2 are dairy cows. Accessing saving and credit services is fairly common (72% and 52%, respectively), suggesting monetary constraint should not be a main barrier to technology adoption in this context. Finally, Farmer Trainers did not have troubles in answering the social network module. They named on average 10.9 farmers out of a maximum of 11 names expected. Sampled farmers often identify the village FT as the most successful dairy farmer in the village (between 67% and 72%) and the closest neighbor (82%), suggesting this should be a good proxy measure of gossip centrality.

ii) Sampled Farmers

Table 3 shows that sampled farmers in the treatment and control groups are balanced along a set of observable characteristics. There is only one significant difference concerning school attendance, that is higher for the treatment group (87% against 84%).

The majority of the sampled farmers' household heads(9 out of 10) are men of 46 years old with basic literacy. Access to saving and credit services is quite widespread though less common than among Farmer Trainers (62% and 44% in the control group).

The dairy activity of the sampled farmers is quite similar to that of the Farmer Trainers. Sampled farmers own on average 6 heads of cattle, out of which 2 are cows. Roughly 80% of them produced some milk in the past 12 months, for an average of almost 3 liters per day. Yet only about 40% of them sold any milk in the last wet season.

[11] 90% of FTs live in households where at least one member holds a leadership position, against 39% for the sampled farmers (Behagel et al., 2020).

In contrast, knowledge and adoption of dairy technologies is slightly lower among sampled farmers than Farmer Trainers. Out of 26 dairy practices and feeds sampled farmers know on average 15 technologies, out of which half concern animal feeds, but apply only 7 of those technologies, out of which roughly 4 concern animal feeding.

iii) Farmer Trainers and Sampled Farmers

We expect significant differences between Farmer Trainers and sampled farmers given the selection process of Farmer Trainers. To compare these two groups we pool together the control and treatment groups. The tests of the differences of the means reported in Table 4 show that sampled farmers and FTs are, indeed, significantly different according to several household characteristics, milk production, knowledge and adoption of dairy technologies measured at baseline.

Before the beginning of the program, FTs had a higher knowledge and adoption level of dairy technologies, as well as a higher milk productivity than sampled farmers. For the same average number of cows, FTs report a higher average milk production per day (0.6 liters). This suggests a higher productivity of FTs, possibly related to the slightly higher knowledge and adoption of dairy practices and feeds. FTs know and use indeed on average one more feed practice and 2 more technologies than sampled farmers.

FTs seem to live in slightly a better-off conditions. Sampled farmers live in households where the household heads is older than in FTs' households and less engaged in local committees. The The literacy rate of FTs' household heads is higher by 12.4 percentage points. Almost no FTs faced a situation where they did not have enough food in the past seven days (0.01%), while 32% of the sampled farmers did. In addition, FTs are 10 percentage points more likely to access saving institutions and 7 percentage points more likely to borrow money than sampled farmers.

5 Empirical strategy

The main aim of this study is to assess the impact of non-monetary mechanisms on Farmer Trainers' training activity and on the participation of farmers from outside of the FT's network. Our main outcomes of interest focus on the training sessions, the trainees and the mechanisms triggered by the treatment variations.

5.1 Outcomes

5.1.1 FTs' training activity

The first category of outcomes concerns the training activity of the FTs. We use the information provided in the attendance sheets and the survey data reported by FTs and farmers to build a whole set of outcomes about FTs' activity.

We rely on the attendance sheets to measure the number of sessions and the number of trainees for each FT assigned to the treatment group. We measure the overall number of trainees per FT by counting the unique names/surnames listed in the attendance sheets.

Descriptive statistics reported in Table 5 show that during the two years of the program, 82% of FTs in the basic treatment group organized at least one training session. On average 5 training sessions were organized and about 22 farmers trained. These numbers are higher for FTs assigned to non-monetary mechanisms. In particular, FTs assigned to the Linkage variation are more active than FTs assigned to the two other treatment arms. They organized on average 13 sessions (against 11 in the two other groups) and trained 43 farmers (against 37 for the needs assessment and 41 for the sign-post group). Finally, training sessions appear to be slightly more crowded for FTs in the basic treatment than in villages assigned to the non-monetary mechanisms (6.4 trainees per session against about 5.8 for the variations).

FTs organized training sessions throughout the whole duration of the program, even though a higher number of sessions took place in the last trimester of 2015 and the 1st trimester of 2016. This period corresponds to the wet season when farmers have less farm work and more time to hold or attend training sessions.

To further assess the impact of the non-monetary incentives on the FTs' training activities we use information provided by the FTs themselves and the sampled farmers in the midline and endline surveys. FTs were asked in detail about their training sessions: whether they customized the information depending on the trainees' needs, the topics they covered, whether they provided practical demonstrations and whether they distributed seeds.

In addition, sampled farmers were asked to provide details about the FT's training activity, their opinion about the quality of the training, in terms of the FTs' capacities to conduct training sessions and provide useful advice, and about their interactions with the FT. We use this information to assess the impact of the non-monetary mechanisms on the quality of the training provided by the FTs and on the interactions between the FTs and the trainees.

5.1.2 Type of relationship between FTs and trainees

Given the absence of any monetary rewards and the cost associated with training fellow farmers, we might worry that FTs would limit the diffusion of information to a close circle of peers, hampering an equitable diffusion of information. To minimize the cost of training, FTs might target farmers that are similar or close to them, such as those with whom they already talk about dairy farming or their neighbors. Non-monetary mechanisms may not be sufficient to guarantee an equitable diffusion of information to a wider spectrum of farmers. We intend to explore, hence, whether non-monetary mechanisms have any effect on the type of farmers attending the training sessions, by focusing, in particular, on the pre-existing relationship between the FT and the trainees.

To determine whether trainees were already part of the FT's social network before the intervention, we match the list of names contained in the attendance sheets with the list of names declared by the FT in the social network module of the baseline questionnaire. This allows us to measure three main outcomes: (i) the share of trainees who are part of the FTs' social network, (ii) the share of trainees who do not belong to the FTs' social network (i.e. trainees not appearing in the baseline FT social network module) and (iii) the share of trainees among the sampled farmers.

Descriptive statistics reported in Table 6 show that the share of trainees that are part of the FTs' social network represent between 15-17% of all the trainees listed in the attendance sheets. The second outcome variable is the share of trainees among the sampled farmers. Slightly less than half of the sampled farmers in the treatment group participated in the training at least once (43%).

The third outcome variable is the share of trainees outside of the FTs' social network. This corresponds to the majority of the trainees (67%).[12]These figures already suggest that the diffusion of information is not restricted to a close circle of peers already known by the FT. Under the treatment variation the share of trainees from outside of the FT's social network is even larger, possibly indicating a wider diffusion especially under the Linkage variation. We tend to exclude that these figures are the result of a measurement error in our measure of social network. For each social network dimension, the FTs were asked about any additional farmers they might know, but 96.5% of them did not name anyone else. Moreover, only 3.3% of FTs named less than eleven farmers in the social network module. The list of eleven contacts seems, hence, rather exhaustive. To further corroborate the analysis based on the attendance sheets data, we will compare the survey data coming from the sampled farmers part of the FT's social network with the data of the sampled random farmers.

5.2 Main specification

The present analysis assesses the intention-to-treat effect of being assigned to one of the three treatment variations compared to being assigned to the basic treatment. The sample is, hence, limited to FTs (and farmers) assigned to the treatment group.

We compare the effect of the three treatment variations pooled together against the basic treatment group, by estimating the following linear regression:

$$Y_{ijs} = \alpha + \beta Variation_{ijs} + \lambda_s + \epsilon_{ijs} \quad (4)$$

With Y_{ijs} is the outcome for the individual i in village j in the lottery stratum s. The lottery strata fixed effects are captured by λ_s. Lotteries were stratified at the parish level in order to have the control group and the four treatment groups within the same parish. The error terms (ϵ_{ijs}) are clustered at the village level and are robust to heteroskedasticity.

We further distinguish the effect of each single treatment variation and compare it to the

[12] Note that Table 6 includes FTs that never trained (30), this is why the sum of the share of trainees part of the SN and the share of trainees from outside of the social network does not equal 1. If we limit to FTs that trained at least once, the sum of the two outcomes is 1 as shown in A2.

omitted category of the basic treatment:

$$Y_{ijs} = \alpha + \beta_1 Linkage_{ijs} + \beta_2 NeedAssessment_{ijs} + \beta_3 Signpost_{ijs} + \lambda_s + \epsilon_{ijs} \quad (5)$$

$Linkage_{ijs}$, $NeedAssessment_{ijs}$ and $Signpost_{ijs}$ are dummy variables equal to 1 if the FT of the village is assigned to the named variation and 0 otherwise. We provide robustness checks of the main results by controlling for the interactions of the treatment variations.

6 Results on the Farmer Trainer's side

6.1 FTs' training activities

The first set of results concerns the training activities conducted by the Farmer Trainers. The outcomes are measured using attendance sheets filled by the FT at each training session, limiting the analysis to the treatment group only.

Results reported in Panel A of Table 7 show that the non-monetary mechanisms are effective in motivating FTs to train fellow farmers. They increase the likelihood for FTs to hold at least one training session by 13 percentage points more compared to simply providing FTs with an initial training. This means that 95% of the FTs assigned to the treatment variations organized at least one training session, compared to 82% in the basic treatment group.

Columns 2 and 3 show that FTs organized on average 6.5 more training sessions and they trained on average 18.9 more trainees than FTs assigned to the basic treatment group. These are large effects that correspond to more than the double of sessions and almost the double of trainees than in the basic treatment group. Importantly, training sessions did not get more crowded, as showed by the negative and non-significant coefficient in column 4.

Panel B of Table 7 provides detailed results by treatment variation. The Linkage variation appears to be the most effective non-monetary mechanism in stimulating FTs' training efforts. Under this variation, the likelihood of organizing at least one training session increases by 10.8 percentage points, on average 5 more sessions are organized and 12.2 more farmers are trained compared to FTs in the basic treatment group. These effects are large compared to the sample means for the basic treatment group, representing the double number of sessions, and corresponding to a 55.4% increase in the number of trainees.

In turn, FTs assigned to the needs assessment or sign-post variation are not more likely than FTs in the basic treatment group to organize a training session (column 1), even though they set up almost 2 additional sessions (column 2). Not surprisingly, the needs assessment variation does not increase the number of trainees (column 3). Training customization might, in fact, require FTs to train the same farmers over multiple sessions and/or to organize smaller group sessions. The signpost variation, in turn, made FTs training on average 8.7 more farmers than FTs in the basic treatment group. Finally, column 4 shows that training sessions do not appear to be more crowded under any treatment variation.

Interestingly, the increase in the number of trainees and sessions associated with the Signpost intervention gives an idea of the demand for training. As explained above, this intervention did not (directly) improve the quality of training, but simply advertised the activity of the Farmer Trainer. By simply putting up a Signpost outside of the FT's residence, demand increases by 39.3% compared to the basic treatment group. We cannot say, however, whether the increase in the number of sessions is a consequence of an increase in demand or if the Farmer Trainer feels compelled to organize more sessions because of the Signpost advertisement, making then the number of trainees increase.

Overall, facilitating access to Extension Agents appears to be the most effective way to promote FT's activity. Two main mechanisms can explain this result. First, we can think of a supply side effect. The participation of an Extension Agent to the training session decreases the cost of training and this pushes the FTs to organize more training sessions. In terms of our theoretical framework, this corresponds to a decrease of β. Second, there can be a demand-side effect, whereby the expected benefits of attending a training session (γ) at which an Extension Agent will be present, or organized by a FT who is known to be backstopped by an Extension Agent, increase.

Looking at those FTs receiving multiple treatment variations gives further insights about the mechanisms at play. Results reported in Table A3 show that the Signpost and Needs Assessment variations do not add anything more to the effects of the Linkage variation on FTs' training activities (see the p-values at the bottom of the Table). In turn, for those FTs having a Signpost, being assigned in addition to the Linkage variation significantly increased the likelihood of organizing at least one training session and the number of sessions organized. This suggests that the visit of the Extension Agent pushed the FT to organize training sessions. In turn, it did not attract more trainees than the Signpost already did. In other words, the "calling effect" of the Extension Agent does not seem to be larger than the Signpost advertisement mechanism for encouraging farmers' participation. For those displaying a Signpost, the Linkage variation stimulated the offer of training but not the demand for training.

6.2 Accessing extension services

The core component of the Linkage variation is to provide vouchers to FTs to access professional extension services to visit his/her cattle and to help with the training sessions by providing technical support or additional information. Note that the FTs do not have to organize training sessions in order to obtain the vouchers. In principle, the FT can use the voucher to pay for the Extension Agent even without setting up a training session.

Table 8 provides descriptive statistics about the visits of the extension agents. In the basic treatment group, 35% of FTs were visited by an Extension Agent (EA) at least once since the start of the program. This share is much higher when FTs are provided with non-monetary mechanisms. In particular, it more than doubles for the Linkage group (88%). In this group FTs benefited on average from 8 visits, ten times more than in the basic treatment group (0.84) and about 38% more than in the two other treatment variations.

Moreover, extension agents participated more often in training sessions organized by FTs in the linkage variation: 39% of FTs had an EA leading the session compared to 11% in the treatment group and 26-27% in the two other treatment variations. It is interesting to notice that access to extension agents increased also for FTs under the two other treatment variations, even though less than in the Linkage group.[13] This suggests that the monetary constraint relaxed by the voucher is not the only and main reason for the pre-existing lack of access to extension services.

These descriptive statistics already suggest that the Linkage intervention was successful in making extension agents' backstopping FTs. The regression results reported in Table 9 show indeed that FTs in the Linkage variation are 48ppts (+137%) more likely to receive an EA visit in the past 12 months compared to the basic treatment group (column 1). They receive on average 6.8 more visits.

This means, however, that FTs redeemed only a third of the twelve vouchers provided. They organized a slightly more training sessions than the number of EA visits received. Results in Table 7 report indeed that FTs in the Linkage variation organized on average 11 training sessions, which is about 3 more session than the number of visits received by EAs.

Nevertheless, FTs in the Linkage variation are 25ppts more likely to have an EA helping out with the training session (column 3). This likely decreases the cost of training for the FTs, by sharing the managing of the session with the EA.

Importantly, the EAs did not only visit the FTs they already knew among the ones assigned to the Linkage variation. Interacting the assignment to the Linkage variation with baseline information about being visited by an EA at baseline does not show any significant results (Table 9, columns 4-6). This goes against any possible suspicion of clientelism between FTs and EAs and, moreover, it corroborates the fact that FTs were not cherry-picked by the EAs, but rather identified by the village communities.

In line with these results, FTs in the linkage variation are the ones appreciating the most the EA's visits. They report the double of advantages than FTs in the basic treatment group (Table 10, Panel A, column 1). They consider, in particular, the EAs to be useful in helping with training fellow farmers (+12ppts column 4), to increase FTs' knowledge (+47ppts, column 5), to make the FT accountable and to monitor his/her work (+5ppts, column 6).

Interestingly, they are not more likely than the other treated FTs to declare that the main advantage of the EA is to check the FT's animals. This means that the EAs helped FTs conducting their volunteer training activity and did not (just) contribute to the private benefit of the FT by checking the animals' health.

Also the sampled farmers were asked about the main advantages of EAs visiting Farmer Trainers. Results in Panel B of Table 10 show that, in line with the results concerning the FTs, farmers in the linkage variation are 6 percentage points more likely than those in the basic

[13] Each FT in the Linkage variation was put in contact with a specific EA operating in the geographic area. Extension Agents were not forbidden to visit FTs assigned to other treatment variations or to the control group.

treatment group (mean of 0.18) to report at least one advantage regarding the attendance of an EA at the training sessions. In particular, they are 2 percentage points more likely to report that the main advantage is to make the FT accountable and monitor his/her work (column 6).

Overall, these results suggest that facilitating access to extension services promoted FTs' activity and stimulated the demand for training. FTs in the Linkage variation benefited from on average 4 EA visits, but organized several training sessions even in the absence of the EA. Moreover, the presence of an EA during the training session appears to be appreciated by farmers, by making the FT more accountable. This is in line with a complementarity between FTs and EAs. The latter have a higher status and are the appropriate entry points to disseminate new information. The former are more similar to village farmers and are, hence, able to persuade potential adopters of the merits of innovation (Fisher et al., 2018). A similar positive dynamic might be at play here, stimulating FT's activity and attracting more trainees.

6.3 Type of relationship between FTs and trainees

A technology diffusion program, such as the Farmer Trainer program, is usually considered successful if it manages to significantly increase farmers' knowledge and adoption. Yet, the pattern of information diffusion within a village may face a trade-off between equity and efficacy.

It might, in fact, be easier for FTs to limit knowledge diffusion to a close circle of similar farmers they already know. The Farmer-to-Farmer system has, indeed, sometimes been criticized for the selection of prominent community members at times linked to clientelism and elite capture (Ragasa, 2020). Diffusing information to a close group of peers has the advantage of making the group homogenous in terms of needs and capacities, which can limit the cost of training[14] and increase the benefits of volunteering by reinforcing social connections (Conley and Udry (2001); Munshi (2004); Fafchamps and Gubert (2007); Conley and Udry (2010)).

As a result, inequalities in accessing information might increase if FTs restrain knowledge diffusion to their close peers.[15] Accessing information becomes then even harder for marginal farmers, while it becomes easier for farmers closer to the FT.

To explore this potential drawback of the FT system, we conduct two types of analyses. First, we look at the effect of the non-monetary mechanisms on the share of trainees belonging or not to the FT's baseline social network. Second, we rely on the sampling design by testing for any differential effects of the non-monetary mechanisms depending on whether sample farmers were part of the FT'social network at baseline or not.

As explained above, we use the attendance sheets data merged with the FTs' social network module collected at baseline to identify whether the trainees were already known by the FT at baseline. We match the two data sources based on farmers' names and village of residence. Three categories of trainees can hence be identified:

[14] A vast literature studies the role of social networks and, in particular, of homophily in explaining the diffusion pattern of agricultural technology information, see, for instance, Munshi (2004), Golub and Jackson (2012), Beaman and Dillon (2018).

[15] Similarly to BenYishay and Mobarak (2019), also in this study we find small but significant differences between the FTs and the sampled farmers (Table 4).

- Those named by the FT in the social network module
- Those named by the FT in the social network module and surveyed
- The remaining trainees, which we consider to be outside of the FT's social network

As explained above, the farmers surveyed in a given village were identified via the social network module. These correspond to the ones named by the FT as seeking advice from him/her about dairy farming in the past thirty days. If they were less then three, the first ones among the five closest neighbors were surveyed. Given the special link between the FT and the surveyed farmer, we consider their relationship as a "strong" tie.

Results reported in Panel A of Table 11 show that the non-monetary mechanisms increase the share of trainees holding strong ties with the FT at baseline by 14.2 percentage points (column 2), but also the share of trainees outside of the FT's social network by 11.2 percentage points (column 3). This apparently contradictory result is clarified by the results reported in Panel 2. FTs in the Signpost and Needs Assessment variations tend to train a larger share of trainees belonging to their social network (column 2) by, respectively, 7 and 6 percentage points. In turn, FTs in the Linkage variation train a larger share of trainees outside of their own social network by 11.6 percentage points compared to the basic treatment group, that corresponds to 17.3% of the sample mean (67%).

These results point towards a different pattern of information diffusion produced by the three non-monetary mechanisms. FTs diffusion information more towards a close circle of farmers when (i) he/she has to customize information to the trainees' needs and constraints (Needs Assessment) or (ii) the advertisement device is visible to close neighbors or to farmers already used to visit the FT (Signpost). Customizing information likely increases the cost of training, so FTs compensate it with targeting farmers more similar to themselves. The sign-post is a pure supply-side mechanism visible to farmers geographically and socially close to the FT. In both cases the diffusion of information is rather directed towards a restrained group of farmers, leaving marginal farmers (in geographic and social terms) apart.

The Linkage variation, in turn, seems to facilitate the diffusion of information to farmers previously unknown to the FT (column 3). We can think of at least two main reasons. First, the larger number of training sessions organized by FTs assigned to this variation, as shown in Table 7, makes it easier for other farmers to attend at least one session. Second, as shown above (Table 10 and **??**), farmers value the presence of an Extension Agent during the training session and this may further attract farmers without any previous link to the FT. Both reasons can of course coexist and are not exclusive of each other. We try to explore these in Section 7 by using the data collected from the midline and endline surveys.

Interestingly, results reported in Table A4 (column 3) show that the Linkage variation increased the share of trainees outside of FT's social network even when combined with either or both of the two other variations. In turn, FTs in the Needs Assessment variation mostly focused on farmers with whom they shared strong ties (sampled farmers) and the combination with either variations did not make any significant difference. Finally, the Signpost variation attracted more sampled farmers especially when combined with one of the two other variations.

Overall, these results show that FTs in the Linkage variation trained more farmers and that, under this variation, the share of farmers unknown to the FT is relatively more important than in the two other variations. In turn, the sign-post variation did not attract more farmers from outside of the FTs' social network, possibly because the advertisement mechanism works mostly for geographically and socially close farmers rather than distant ones. Finally, the result about the needs assessment variation is in line with a taste for homophily, as customizing information and following up with farmers over time might be easier with close people living nearby with whom the FT is already used to discuss about dairy farming.

7 Results on the farmers' side

7.1 Farmers' interaction with the Farmer Trainer

In addition to the attendance sheets, we dispose of data collected by the midline and endline surveys about farmers' participation at the training sessions and their interactions with the local FT beyond the training sessions. These data allow us to explore further the demand-side effect of the non-monetary mechanisms.

We conduct the analysis separately for sampled farmers belonging to the FT's social network at baseline and for sampled farmers randomly picked in the village. This allows us to explore further the above results testing whether the non-monetary mechanisms, in particular the Linkage one, are effective in reaching out to trainees that do not belong to the FT's social network.

We not find some significant effect of the non-monetary mechanisms on the participation of farmers already known by the FT and their interactions outside of the training sessions (Table 12, Panel A).

Both for the Need Assessment and Signpost variation (Panel B), there is an increase of farmers' participation by respectively 7 and 9 percentage points. Concerning interaction outside of the training sessions, the Signpost variation is the one with the most significant results with an increases of 7 percentage points for both being visited by the FT to talk about dairy farming and asking for advice to the FT . This is likely explained by the fact that the Signpost was mostly visible to farmers close to the FTs. Results reported in Table 11 show indeed that the Signpost attracted more farmers who were already seeking the advice of the FT about dairy farming at baseline. In turn, the Linkage mechanism does not increase the participation of farmers already known by the FT. This might be due to the fact that the Linkage mechanism increased more the participation of farmers from outside of the FT's social network, as shown above. However, there is an increase of 6 percentage point for asking for advice to the FT.

The analysis about sampled farmers outside of FTs' social network provides a different picture. Results reported in Table 13 show that the non-monetary mechanisms significantly increase the likelihood of these farmers to attend a training session and make them on average attend 2.8 sessions more than in the basic treatment group (Panel A, columns 1 and 2).However,the likelihood of interacting with the FT outside of the training sessions does not significantly increase (columns 3 and 4).

We detect a slight differential effect of the mechanisms on training participation in favor of the linkage variation (Panel B, 2). Moreover, sampled farmers unknown to the FT at baseline appear to interact slightly more with the FT in villages assigned to the Linkage variation. This is in line with the main results showing that FTs in the Linkage variation reached out to a wider public. The size of the effects is fairly large, corresponding to an increase of 52% compared to the mean for the basic treatment group. This confirms that the Linkage variation helped diffusing information outside of the FTs' social network and improved informal interactions between more distant farmers and the FT.

7.2 Quality of training

It is unclear ex-ante whether the three non-monetary mechanisms presented in this analysis would improve the quality of training. A larger number of sessions, as it is the case for FTs in the Linkage variation, might come at the expenses of lower quality (FT's fatigue, same topics). On the other hand, FTs might acquire more self-confidence and better training skills over time, increasing quality of training. It might, in fact, be less costly to always illustrate the same limited set of techniques session after session. Quality of training might also be hampered if a larger number of trainees means a higher variance of needs and constraints, making it harder for the FT to provide helpful advice to everyone.

A way to evaluate the quality of training is to look at the effect on trainees' knowledge and adoption. Behagel et al. (2020) find no effect of the specific treatment variations on farmers' knowledge and adoption.[16] Yet, according to the authors, farmers' milk production and profits significantly increase in villages assigned to the Linkage variation. This might be explained by an increase in farmers' productivity, without any change in their production function of milk production. Technology does not change, but farmers change the way in which they rear animals and produce milk. Attending training sessions might, hence, make salient (or refresh) information about techniques already known and (so far inefficiently) adopted by farmers.

We would expect, then, the increase in farmers' productivity to be reflected in a higher farmers' satisfaction for the training received. To test for this hypothesis, we use the information reported by farmers about the training activities organized by the FT of their village, about their own participation in the program and the quality of the training received. We rely on this data to build an index of the quality of training to explore whether the non-monetary mechanisms increased only quantity of training or also the quality of the information transmitted.[17]

[16] Note that the overall treatment does significantly increase farmers' rate of adoption, but not knowledge.

[17] The index is based on the sum of positive answers to seven items ('FT's advice is appropriate for fellow farmers', 'FT's advice is useful to me', 'FT customizes information', 'FT distributes seeds', 'FT is knowledgeable about feeding practices' and 'Number of topics discussed at training') standardized with respect to the mean and standard deviations of the basic treatment group.

Results show that sampled farmers in villages assigned to the non-monetary mechanisms appreciate more the quality of the training activity than farmers in the basic treatment group (column 8 of Panel A of Table 14). This result is explained by farmers living in villages assigned to the Linkage and to the Signpost variation. The main dimensions farmers are satisfied with concern the distribution of seeds by FTs (column 4) and, though marginally significant, providing helpful advice to the farmer themselves (column 2) and demonstrating practices (column 5).

These results suggest that FTs in the Linkage variation increased the quantity of training, but also the quality of it, as reported by farmers. Facilitating access to inputs by distributing seeds appear to be particularly appreciated by farmers, even though this variation did not increase farmers' adoption of feedings (Behagel et al., 2020).

8 Robustness checks

We perform four robustness checks. The first one controls for the double and triple interactions of the non-monetary mechanisms. The second on adjusts the p-values for multiple hypothesis testing using the Romano-Wolf stepdown p-values. The third one runs the main estimation controlling for a vector of FT's observable characteristics using the Lasso procedure. The fourth one controls for the unbalanced covariates between treated and control groups.

First, we replicate the main analysis by controlling for the double and triple interactions of the three non-monetary mechanisms. Results reported in Tables A3 and A4 confirm the main ones and show that, in fact, the size of the effect for each single mechanism alone is even larger.

Table A5 reports for each treatment variation the model p-values and the Romano-wolf p-values estimated for the regressions on the FT's training activities. All results are confirmed. Similarly, Table A6 reports the results for the robustness check conducted on the outcomes related to farmers' training participation and their interaction with the FT. Also in this case all results are confirmed.

Table A7 reports the main results of the Lasso procedure. We run the specification including the three treatment variations and controlling for a set of observable FTs' characteristics. We limit the analysis to the main outcomes of interest concerning FT's training activities. We take into account a list of 22 binary and categorical variables concerning household characteristics and dairy production. Given the large number of potential control variables, we apply a Lasso procedure. The main results are confirmed.

Finally, results reported in Tables A8 and A9 confirm the main results when controlling for the covariables that were found to be significantly different from zero between the control and treatment group of FTs.

Conclusion

The Farmer-to-Farmer system has been applied in a vast majority of developing countries to facilitate access to information about agricultural practices and technologies. Farmer Trainers are often volunteers receiving a technical training and acting as communicators to diffuse information in their village. How to best design this system by providing the right incentives to motivate Farmer Trainers to conduct training activities while avoiding clientelism and elite capture is still an open question.

This paper investigates the effects of three non-monetary mechanisms randomly assigned to local Farmer Trainers on their efforts to diffuse information about agricultural technologies in rural Uganda. We explore, in particular, whether farmer trainers reach out to farmers outside of their own social network or not depending on the type of non-monetary incentives received.

We show that non-monetary mechanisms effectively stimulate Farmer Trainers' activities. Facilitating access to technical information provided by professional Extension Agents appears to be the most effective way to engage Farmer Trainers. They organize more sessions and train more farmers compared to those Farmer Trainers only receiving the initial training. Importantly, Farmer Trainers assigned to this mechanism successfully attract trainees from outside of their own social network and do not limit the diffusion of information only to a close circle of peers.

These results show that a relatively cheap intervention ($25 per village per year) is effective in stimulating Farmer Trainer's activity and in diffusing information to a wider range of farmers, without the need to design a pay-for-performance monetary incentive. This type of non-monetary mechanism is economically sustainable, easily implementable and adaptable to different types of contexts. Our results are encouraging for the design of the Farmer-to-Farmer system and for development actors working to facilitate farmers' access to information.

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Tables

Table 1: Sample size

Group	Farmer Trainers	Sampled Farmers
Control	216	859
Basic treatment	50	198
One variation	162	644
Two variations	146	583
Three variations	53	211
Linkage	206	821
Need Assessment	203	808
Signpost	204	814

Table 2: Descriptive Statistics and Balance Checks for Farmer Trainers

	Control		Treatment		
	Mean	Sd	Mean	Sd	Diff
Male Household head	0.96	0.19	0.94	0.23	-0.02
Household head age	42.54	11.53	42.23	12.09	-0.31
Household head attended school	0.99	0.10	0.98	0.12	-0.01
Household head had off farm activity	0.70	0.46	0.67	0.47	-0.03
Household size	8.22	3.79	7.98	4.07	-0.25
N.children in the household	5.14	3.07	5.02	3.55	-0.12
Household head part of a local committee	0.32	0.47	0.29	0.45	-0.03
Has completed high school	0.34	0.48	0.33	0.47	-0.01
Use a saving institution	0.72	0.45	0.73	0.44	0.01
Borrowed money in an institution	0.52	0.50	0.51	0.50	-0.01
N.cows	2.14	4.63	2.25	2.91	0.10
N. heads of cattle	5.85	10.64	6.40	8.38	0.55
Share of FTs producing milk	0.74	0.44	0.83	0.38	0.09**
Average milk production per day	3.06	4.55	3.82	5.22	0.77*
Share of farmers selling milk	0.39	0.49	0.45	0.50	0.06
N. feeds known	8.85	2.08	8.82	2.15	-0.03
N. feeds used	4.98	1.57	4.79	1.53	-0.18
N.technologies known	17.70	3.20	17.59	3.18	-0.11
N.technologies used	8.82	2.69	8.64	2.63	-0.18
Land size in acre	7.92	14.12	9.22	15.62	1.31
Size of the social network	10.90	0.64	10.91	0.63	0.01
N. sampled farmers considering FT most successful	0.67	0.86	0.72	0.94	0.06
N. sampled farmers considering FT closest	0.84	0.82	0.83	0.83	-0.01

Table shows averages for baseline. The Diff column is the coefficient of a simple regression of treatment status on the variable, with clustered standard errors at the village level. Stars indicate whether this difference is significant.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: Descriptive Statistics and Balance for Sampled Farmers

	Control		Treatment		
	Mean	Sd	Mean	Sd	Diff
Male Household head	0.90	0.30	0.90	0.30	-0.00
Household head age	46.12	14.29	46.59	13.78	0.48
Household head attended school	0.84	0.36	0.87	0.33	0.03*
Household head had off farm activity	0.50	0.50	0.47	0.50	-0.04
Household size	8.71	4.49	8.73	4.11	0.02
N.children in the household	5.28	3.88	5.48	3.78	0.20
Household head part of a local committee	0.18	0.38	0.18	0.39	0.00
Use a saving institution	0.62	0.49	0.63	0.48	0.01
Borrowed money in an institution	0.44	0.50	0.44	0.50	0.00
N.cows	2.49	4.80	2.30	3.56	-0.19
N. heads of cattle	6.78	11.41	6.35	8.22	-0.43
Produces milk	0.80	0.40	0.83	0.38	0.02
Average milk production per day	2.82	3.93	2.95	4.48	0.13
Share of farmers selling milk	0.39	0.49	0.42	0.49	0.04
N. feeds known	7.70	2.03	7.75	2.09	0.04
N. feeds used	3.86	1.77	3.66	1.86	-0.19
N.technologies known	15.34	3.21	15.19	3.24	-0.15
N.technologies used	7.01	2.79	6.67	2.93	-0.33
Land size in acre	7.57	12.03	8.37	13.86	0.80
Considers FT most successful farmer	0.17	0.38	0.18	0.39	0.01
Considers FT closest farmer	0.21	0.41	0.21	0.41	-0.01

Table shows averages for baseline. The Diff column is the coefficient of a simple regression of treatment status on the variable, with clustered standard errors at the village level. Stars indicate whether this difference is significant.
* p < 0.10, ** p < 0.05, *** p < 0.01.

Table 4: Descriptive Statistics and Balance for Sampled Farmers and Farmer Trainers

	Sampled Farmers		Farmer Trainers		
	Mean	Sd	Mean	Sd	Diff
Male Household head	0.90	0.30	0.95	0.22	0.05***
Household head age	46.43	13.96	42.33	11.89	-4.09***
Household size	8.73	4.24	8.06	3.97	-0.66***
Household head attended school	0.86	0.34	0.99	0.11	0.12***
Household head had off farm activity	0.48	0.50	0.68	0.47	0.20***
Household head part of a local committee	0.18	0.39	0.30	0.46	0.12***
Use a saving institution	0.62	0.48	0.73	0.45	0.10***
Borrowed money in an institution	0.44	0.50	0.52	0.50	0.08**
N.cows	2.36	4.03	2.21	3.60	-0.15
N. heads of cattle	6.50	9.45	6.21	9.22	-0.29
Produces milk	0.82	0.39	0.79	0.40	-0.02
Average milk production per day	2.91	4.29	3.56	5.01	0.65***
Share of farmers selling milk	0.41	0.49	0.43	0.49	0.02
N. feeds known	7.73	2.07	8.83	2.12	1.10***
N. feeds used	3.73	1.83	4.86	1.54	1.13***
N.technologies known	15.24	3.23	17.63	3.18	2.39***
N.technologies used	6.79	2.89	8.70	2.65	1.91***
Land size in acre	8.09	13.26	8.77	15.12	0.68

Table shows averages for baseline. The Diff column is the coefficient of a simple regression of treatment status on the variable, with clustered standard errors at the village level. Stars indicate whether this difference is significant.
* p < 0.10, ** p < 0.05, *** p < 0.01.

Table 5: Number of training sessions and number of trainees

	Basic	Linkage	Need Assessment	Signpost
	Mean	Mean	Mean	Mean
At least one session	0.82	0.98	0.94	0.94
	(0.39)	(0.12)	(0.23)	(0.24)
N. of sessions	5.05	13.31	11.68	11.43
	(5.45)	(8.66)	(9.22)	(9.01)
N. of trainees	22.11	43.07	37.04	41.16
	(20.23)	(34.41)	(33.45)	(39.50)
N. of trainees per session	6.46	5.95	5.68	5.85
	(6.11)	(3.73)	(3.42)	(3.71)
Observations	44	199	198	199

Table 6: Type of relationship between FTs and trainees

	Basic	Linkage	Need Assessment	Signpost
	Mean	Mean	Mean	Mean
Share of trainees part of SN	0.15	0.16	0.17	0.17
	(0.14)	(0.12)	(0.13)	(0.15)
Share of trainees among sampled farmers	0.43	0.57	0.58	0.59
	(0.31)	(0.31)	(0.29)	(0.29)
Share of trainees outside of SN	0.67	0.82	0.77	0.77
	(0.34)	(0.15)	(0.23)	(0.24)
Observations	44	199	198	199

Table 8: Receiving visit of an EA : Descriptive Statistics

	Basic	Linkage	Need Assessment	Signpost
	Mean	Mean	Mean	Mean
EA visit	0.35	0.88	0.66	0.67
	(0.48)	(0.33)	(0.47)	(0.47)
N.EA visits	0.84	7.97	4.91	4.71
	(1.45)	(6.31)	(5.59)	(6.12)
EA led training	0.11	0.39	0.27	0.26
	(0.32)	(0.49)	(0.45)	(0.44)
Observations	44	199	198	199

Table 7: FTs' training activities

	(1) **FT held at least one session**	(2) **N.sessions**	(3) **N. trainees**	(4) **N. trainees per session**
Panel A : Basic treament VS Variation				
Variation	0.129**	6.545***	18.872***	-0.409
	(0.06)	(1.01)	(4.06)	(0.95)
Constant	0.817***	1.864	8.370	5.971***
	(0.08)	(1.68)	(6.57)	(1.34)
Panel B : Variations				
Linkage	0.108***	5.072***	12.241***	0.082
	(0.03)	(0.81)	(3.21)	(0.42)
Need Assessment	0.022	1.726**	-0.633	-0.490
	(0.03)	(0.83)	(3.26)	(0.43)
Signpost	0.027	1.850**	8.695***	-0.261
	(0.03)	(0.83)	(3.34)	(0.43)
Constant	0.860***	3.554**	16.252**	6.035***
	(0.07)	(1.49)	(6.34)	(1.07)
Observations	395	395	395	395
Mean for basic treatment group	0.82	5.05	22.11	6.46
P-values				
Linkage = Need Assessment	0.011	0.005	0.002	0.339
Linkage = Signpost	0.007	0.006	0.439	0.561
Need Assessment= Signpost	0.895	0.911	0.035	0.646

Variation : dummy variable equal to 0 if FT received the basic treatment and to 1 if FT received at least one variation of the treatment
Standard errors in parentheses
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 9: Receiving visit of an EA

	(1) EA visit	(2) N.EA visits	(3) EA led training	(4) EA visit	(5) N.EA visits	(6) EA led training
Linkage	0.480***	6.807***	0.256***	0.418***	6.493***	0.236***
	(0.04)	(0.49)	(0.04)	(0.07)	(0.86)	(0.06)
Need Assessment	0.008	0.124	-0.002			
	(0.04)	(0.49)	(0.04)			
Signpost	0.087**	0.625	0.000			
	(0.04)	(0.49)	(0.04)			
Had a contact with an EA at baseline				-0.004	-0.293	0.066
				(0.07)	(0.46)	(0.05)
Contact with an EA at baseline x Linkage				0.094	0.458	0.037
				(0.09)	(1.06)	(0.08)
Constant	0.299**	2.273	0.264**	0.368***	2.844	0.255**
	(0.12)	(1.79)	(0.12)	(0.11)	(1.74)	(0.11)
Observations	391	391	395	391	391	395
Mean for basic treatment group	0.35	0.84	0.11	0.35	0.84	0.11
P-values						
Linkage = Need Assessment	0.000	0.000	0.000			
Linkage = Signpost	0.000	0.000	0.000			
Need Assessment= Signpost	0.159	0.461	0.966			

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Advantage of receiving an EA

	(1) N. advantages	(2) At least one	(3) Shows importance of FT task	(4) Helps FT with training	(5) Increases knowledge of FT	(6) Accountability and monitoring work of FT	(7) Check FT's animals
Panel A : Farmer Trainers							
Linkage	0.689***	0.016*	0.043	0.124***	0.468***	0.050*	0.008
	(0.06)	(0.01)	(0.03)	(0.03)	(0.04)	(0.03)	(0.01)
Need Assessment	-0.018	0.003	-0.044	0.025	0.006	0.006	-0.007
	(0.06)	(0.01)	(0.03)	(0.03)	(0.04)	(0.03)	(0.01)
Signpost	0.139**	0.006	0.019	0.054*	0.056	-0.011	0.015
	(0.06)	(0.01)	(0.03)	(0.03)	(0.04)	(0.03)	(0.01)
Constant	0.383**	0.988***	0.063	-0.102***	0.322***	0.042	0.055
	(0.17)	(0.01)	(0.06)	(0.04)	(0.12)	(0.07)	(0.06)
Observations	395	395	395	395	395	395	395
Mean for basic treatment group	0.36	0.98	0.04	0.02	0.23	0.06	0.00
P-values							
Linkage = Need Assessment	0.000	0.279	0.041	0.024	0.000	0.212	0.465
Linkage = Signpost	0.000	0.309	0.575	0.100	0.000	0.076	0.677
Need Assessment= Signpost	0.054	0.859	0.104	0.500	0.398	0.635	0.130
Panel B : Sampled Farmers							
Linkage	0.059**	-0.008	-0.002	0.013	0.030	0.021**	0.001
	(0.03)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.00)
Need Assessment	0.010	0.003	-0.010	0.005	0.006	0.009	0.001
	(0.03)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.00)
Signpost	0.042	-0.012**	0.010	0.007	0.020	0.008	-0.002
	(0.03)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.00)
Constant	0.254***	0.994***	0.076***	0.046*	0.119**	0.009	-0.001
	(0.08)	(0.02)	(0.03)	(0.03)	(0.05)	(0.02)	(0.00)
Observations	1596	1596	1596	1596	1596	1596	1596
Mean for basic treatment group	0.18	1.00	0.02	0.02	0.12	0.02	0.00
P-values							
Linkage = Need Assessment	0.221	0.152	0.621	0.595	0.411	0.255	0.970
Linkage = Signpost	0.655	0.465	0.443	0.690	0.713	0.216	0.461
Need Assessment= Signpost	0.407	0.016	0.239	0.905	0.610	0.967	0.234

Standard errors in parentheses

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 11: Share of trainees part of the FT's social network

	(1) **Share of trainees part of SN**	(2) **Share of trainees among sampled farmers**	(3) **Share of trainees outside of SN**
Panel A : Basic treament VS Variation			
Variation	0.017	0.142***	0.112**
	(0.02)	(0.05)	(0.05)
Constant	0.171***	0.367***	0.646***
	(0.04)	(0.08)	(0.08)
Panel B : Variations			
Linkage	-0.008	0.034	0.116***
	(0.01)	(0.03)	(0.02)
Need Assessment	0.014	0.059*	0.008
	(0.01)	(0.03)	(0.02)
Signpost	0.011	0.072**	0.016
	(0.01)	(0.03)	(0.02)
Constant	0.174***	0.404***	0.686***
	(0.04)	(0.07)	(0.07)
Observations	395	395	395
Mean for basic treatment group	0.15	0.43	0.67
P-values			
Linkage = Need Assessment	0.281	0.609	0.001
Linkage = Signpost	0.327	0.377	0.001
Need Assessment= Signpost	0.894	0.736	0.831

Variation : dummy variable equal to 0 if FT received the basic treatment and to 1 if FT received at least one variation of the treatment
Standard errors in parentheses
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 12: Self-reported farmers' interaction with Farmer Trainer : Farmers in SN

	(1) **Farmer attends training**	(2) **N. sessions attended**	(3) **Visited by FT to talk about dairy farming**	(4) **Asked for advice to FT**
Panel A : Basic treament VS Variation				
Variation	0.094*	1.129*	0.054	0.052
	(0.05)	(0.64)	(0.05)	(0.05)
Constant	0.418***	2.069*	0.597***	0.353***
	(0.08)	(1.25)	(0.07)	(0.08)
Panel B : Variations				
Linkage	0.008	0.089	0.003	0.064**
	(0.03)	(0.41)	(0.03)	(0.03)
Need Assessment	0.069**	0.251	-0.004	-0.017
	(0.03)	(0.40)	(0.03)	(0.03)
Signpost	0.094***	0.277	0.075**	0.073**
	(0.03)	(0.40)	(0.03)	(0.03)
Constant	0.397***	2.763**	0.604***	0.338***
	(0.07)	(1.19)	(0.06)	(0.08)
Observations	1377	1377	1350	1377
Mean for basic treatment group	0.56	2.48	0.60	0.46
P-values				
Linkage = Need Assessment	0.208	0.798	0.874	0.065
Linkage = Signpost	0.053	0.713	0.076	0.814
Need Assessment= Signpost	0.559	0.965	0.059	0.026

Variation : dummy variable equal to 0 if FT received the basic treatment and to 1 if FT received at least one variation of the treatment

Table 13: Self-reported farmers' interaction with Farmer Trainer : Farmers out of SN

	(1)	(2)	(3)	(4)
	Farmer attends training	**N. sessions attended**	**Visited by FT to talk about dairy farming**	**Asked for advice to FT**
Panel A : Basic treament VS Variation				
Variation	0.258**	2.870**	0.050	0.132
	(0.11)	(1.26)	(0.11)	(0.10)
Constant	0.468**	2.217	0.655***	0.081
	(0.18)	(3.20)	(0.19)	(0.19)
Panel B : Variations				
Linkage	0.095	2.566*	0.109	0.166**
	(0.07)	(1.43)	(0.07)	(0.07)
Need Assessment	-0.003	1.938	-0.030	-0.030
	(0.07)	(1.94)	(0.07)	(0.07)
Signpost	-0.015	-1.011	-0.072	-0.064
	(0.07)	(1.64)	(0.07)	(0.07)
Constant	0.669***	3.403	0.697***	0.171
	(0.17)	(3.18)	(0.18)	(0.16)
Observations	219	219	211	219
Mean for basic treatment group	0.36	1.11	0.54	0.32
P-values				
Linkage = Need Assessment	0.325	0.642	0.201	0.074
Linkage = Signpost	0.270	0.193	0.064	0.018
Need Assessment= Signpost	0.901	0.350	0.695	0.747

Variation : dummy variable equal to 0 if FT received the basic treatment and to 1 if FT received at least one variation of the treatment

Standard errors in parentheses

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 14: Farmers' opinions about FT

	(1) FT's advice is appropriate	(2) FT's advice is helpful	(3) FT custumizes information	(4) FT distributes seeds	(5) FT demonstrates practices	(6) FT knowledgeable in feeding practices	(7) N. topics discussed during visits	(8) Index quality trainings and advice	(9) est9
Panel A : Basic treament VS Variation									
Variation	0.040	0.068*	0.048	0.089***	0.067	-0.014	0.050	0.050	0.122**
	(0.03)	(0.04)	(0.05)	(0.03)	(0.06)	(0.02)	(0.03)	(0.03)	(0.05)
Constant	0.842***	0.621***	0.327***	0.034	0.457***	0.058*	0.206***	0.206***	-0.115
	(0.05)	(0.08)	(0.08)	(0.05)	(0.11)	(0.03)	(0.06)	(0.06)	(0.10)
Panel B : Variations									
Linkage	0.021	0.045*	0.026	0.056**	0.060*	-0.002	0.026	0.026	0.077**
	(0.02)	(0.03)	(0.03)	(0.02)	(0.03)	(0.01)	(0.02)	(0.02)	(0.03)
Need Assessment	-0.005	0.008	-0.017	0.022	0.035	-0.001	0.027	0.027	0.022
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.01)	(0.02)	(0.02)	(0.03)
Signpost	0.029*	0.028	0.026	0.041*	0.016	-0.004	0.031	0.031	0.064*
	(0.02)	(0.03)	(0.03)	(0.02)	(0.03)	(0.01)	(0.02)	(0.02)	(0.03)
Constant	0.856***	0.644***	0.357***	0.054	0.458***	0.049*	0.205***	0.205***	-0.088
	(0.05)	(0.08)	(0.07)	(0.05)	(0.09)	(0.03)	(0.05)	(0.05)	(0.09)
Observations	1596	1596	1561	1561	1094	1596	1596	1596	1596
Mean for basic treatment group	0.87	0.66	0.40	0.09	0.51	0.05	0.23	0.23	-0.02
P-values									
Linkage = Need Assessment	0.219	0.337	0.298	0.411	0.607	0.933	0.964	0.964	0.243
Linkage = Signpost	0.723	0.653	0.997	0.661	0.354	0.871	0.835	0.835	0.755
Need Assessment= Signpost	0.133	0.580	0.258	0.578	0.688	0.775	0.880	0.880	0.345

Variation : dummy variable equal to 0 if FT received the basic treatment and to 1 if FT received at least one variation of the treatment

A Appendix

A.1 FT network module, baseline questionnaire

Each FT was asked to provide the following list of people. For each person we collected the name, surname, gender and distance from the FT's home.
"Is there any dairy farmer in the village.. "

1. .. who in the last 30 days has come to seek your advice on dairy farming? [*Ask for 5. If many, ask for those who have asked most frequently*]
2. .. who in the past year has come to seek your advice on dairy farming? [*Ask for 5. If many, ask for those who have asked most frequently*]
3. .. to whom in the last 30 days you have asked advice on dairy farming? Max 2 names
4. .. from whom you think you could learn anything new in dairy farming? Max 2 names
5. .. who could learn anything new from you in dairy farming? Max 2 names
6. .. whom you could borrow money from in case of abrupt need? Max 2 names
7. .. who could borrow money from you in case of abrupt need? Max 2 names
8. .. to whom you talk at church/mosque? Max 2 names
9. Who are the dairy farmers who live closest to you? Max 5 names

A.2 Appendix Tables

Table A2: Type of relationship between FTs and trainees

	Basic	**Linkage**	**Need Assessment**	**Signpost**
	Mean	Mean	Mean	Mean
Share of trainees part of SN	0.18	0.16	0.18	0.18
	(0.14)	(0.11)	(0.13)	(0.14)
Share of trainees among sampled farmers	0.47	0.57	0.59	0.60
	(0.29)	(0.31)	(0.29)	(0.28)
Share of trainees outside of SN	0.82	0.84	0.82	0.82
	(0.14)	(0.11)	(0.13)	(0.14)
Observations	36	196	187	187

Table A1: Descriptive statistics and balance checks for Farmer Trainers in the basic treatment versus those in the three treatment variations

	Basic Treatment		Variation		
	Mean	Sd	Mean	Sd	Diff
Male Household head	0.93	0.26	0.91	0.29	-0.02
Household head age	45.22	13.65	45.79	13.57	0.57
Household head attended school	0.91	0.29	0.89	0.31	-0.01
Household head had off farm activity	0.52	0.50	0.51	0.50	-0.01
Household size	9.10	4.46	8.52	4.06	-0.59*
N.children in the household	5.76	4.07	5.34	3.70	-0.42
Household head part of a local committee	0.20	0.40	0.20	0.40	0.01
Has completed high school	0.30	0.46	0.34	0.47	0.04
Use a saving institution	0.58	0.49	0.66	0.47	0.07*
Borrowed money in an institution	0.40	0.49	0.46	0.50	0.06
N.cows	2.47	3.79	2.27	3.39	-0.20
N. heads of cattle	7.10	10.27	6.26	7.96	-0.83
Share of FTs producing milk	0.84	0.37	0.82	0.38	-0.01
Average milk production per day	3.33	5.31	3.10	4.56	-0.23
Share of farmers selling milk	0.43	0.50	0.43	0.49	0.00
N. feeds known	8.17	1.98	7.93	2.17	-0.23
N. feeds used	3.66	1.94	3.91	1.84	0.25
N.technologies known	16.08	3.08	15.61	3.40	-0.47
N.technologies used	7.05	3.29	7.07	2.94	0.02
Land size in acre	8.54	12.01	8.54	14.49	0.00
Size of the social network	10.98	0.15	10.90	0.67	-0.08
N. sampled farmers considering FT most successful	0.79	0.96	0.73	0.95	-0.07
N. sampled farmers considering FT closest	0.69	0.75	0.85	0.83	0.16

Table shows averages for baseline. The Diff column is the coefficient of a simple regression of treatment status on the variable, with clustered standard errors at the village level. Stars indicate whether this difference is significant.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A3: Robustness check controlling for treatments interactions on FTs' training activities

	(1) **FT held at least one session**	(2) **N.sessions**	(3) **N. trainees**	(4) **N. trainees per session**
	b/se	b/se	b/se	b/se
Linkage	.173***	7.57***	25.4***	.699
	(.058)	(1.5)	(5.3)	(1.2)
Need Assessment	.0503	3.82**	7.64	-.976
	(.077)	(1.6)	(4.8)	(1.1)
Signpost	.0681	4.15***	16.3**	-.586
	(.069)	(1.3)	(6.5)	(1.1)
Linkage x Need Assessment	-.0488	-3.41	-17**	-.35
	(.08)	(2.3)	(7.2)	(1.3)
Linkage x Signpost	-.0762	-4.29**	-16.9*	-.64
	(.074)	(2)	(8.8)	(1.4)
Need Assessment x Signpost	.000111	-3.36	-6.35	1.69
	(.097)	(2.3)	(8.9)	(1.4)
Linkage x Need Assessment x Signpost	-.131	-5.31*	-24.4**	.0431
	(.13)	(3)	(12)	(2.2)
Constant	.82***	1.99	8.8	5.9***
	(.082)	(1.6)	(6.5)	(1.4)
Control for interaction	Yes	Yes	Yes	Yes
Observations	395	395	395	395
Mean for basic treatment group	0.82	5.05	22.11	6.46
P-values				
Linkage = Need Assessment	0.017	0.025	0.000	0.068
Linkage = Signpost	0.010	0.030	0.179	0.162
Need Assessment= Signpost	0.782	0.834	0.163	0.613
Linkage = Linkage x Need Assessment	0.087	0.002	0.000	0.669
Linkage= Linkage x Signpost	0.047	0.000	0.001	0.594
Need Assessment = Need Assessment x Linkage	0.525	0.043	0.026	0.785
Need Assessment= Need Assessment x Signpost	0.761	0.044	0.252	0.253
Signpost = Signpost x Linkage	0.307	0.006	0.021	0.982
Signpost= Signpost x Need Assessment	0.660	0.023	0.119	0.333

Standard errors in parentheses

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table A4: Robustness check controlling for treatments interactions on the type of trainees

	(1) **Share of trainees part of SN** b/se	(2) **Share of trainees among sampled farmers** b/se	(3) **Share of trainees outside of SN** b/se
Linkage	-.00063	.0873	.173***
	(.028)	(.07)	(.054)
Need Assessment	.025	.144**	.0253
	(.032)	(.063)	(.069)
Signpost	.0266	.0964*	.0414
	(.032)	(.058)	(.064)
Linkage x Need Assessment	-.0122	-.105	-.0366
	(.038)	(.09)	(.073)
Linkage x Signpost	-.0247	.0252	-.0516
	(.039)	(.091)	(.071)
Need Assessment x Signpost	-.0328	-.0429	.0329
	(.044)	(.086)	(.088)
Linkage x Need Assessment x Signpost	-.0218	-.168	-.109
	(.061)	(.13)	(.12)
Constant	.168***	.364***	.652***
	(.045)	(.079)	(.082)
Control for interaction	Yes	Yes	Yes
Observations	395	395	395
Mean for basic treatment group	0.15	0.43	0.67
P-values			
Linkage = Need Assessment	0.364	0.416	0.002
Linkage = Signpost	0.327	0.887	0.002
Need Assessment= Signpost	0.959	0.400	0.785
Linkage = Linkage x Need Assessment	0.849	0.204	0.079
Linkage= Linkage x Signpost	0.696	0.683	0.056
Need Assessment = Need Assessment x Linkage	0.580	0.078	0.657
Need Assessment= Need Assessment x Signpost	0.415	0.180	0.959
Signpost = Signpost x Linkage	0.452	0.599	0.481
Signpost= Signpost x Need Assessment	0.401	0.290	0.952

Standard errors in parentheses

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table A5: Robustness check for multiple hypothesis testing on FTs' training activities. Romano-Wolf p-values.

	Model p-values			RW p-values			
	Linkage	Signpost	Needs A.	Linkage	Signpost	Needs A.	Obs.
FT held at least one session	0.00	0.29	0.38	0.00	0.48	0.74	395
N. sessions	0.00	0.03	0.04	0.00	0.08	0.11	395
Number of trainees	0.00	0.02	0.83	0.00	0.07	0.84	395
N. trainees per session	0.92	0.77	0.46	0.93	0.79	0.74	395

Robust standard errors clustered at the FT level.

Table A6: Robustness check for multiple hypothesis testing on farmers' participation in training sessions. Romano-Wolf p-values.

	Model p-values			RW p-values			
	Linkage	Signpost	Needs A.	Linkage	Signpost	Needs A.	Obs
Farmer attends training	0.52	0.01	0.05	0.61	0.01	0.05	1596
N.sessions attended	0.28	0.74	0.39	0.48	0.68	0.56	1596
Visited by FT	0.46	0.04	0.78	0.61	0.04	0.93	1561
Asked for advice to FT	0.27	0.04	0.79	0.48	0.04	0.93	1596

Robust standard errors clustered at the FT level.

Table A7: Robustness check. Lasso specification to control for FT's characteristics and interaction terms.

	(1) **FT held at least one session**	(2) **N. of sessions**	(3) **N. of trainees**	(4) **N. of trainees per session**
Linkage	0.109***	5.186***	15.016***	-0.062
	(0.03)	(0.84)	(3.40)	(0.40)
Need Assessment	0.019	1.774**	1.267	-0.266
	(0.03)	(0.84)	(3.51)	(0.42)
Signpost	0.028	1.711**	7.890**	-0.154
	(0.03)	(0.86)	(3.60)	(0.41)
Lasso controls	Yes	Yes	Yes	Yes
Observations	380	380	380	380
Mean for basic treatment group	0.82	5.05	22.84	6.28
P-values:				
Linkage = Need Assessment	0.009	0.005	0.003	0.695
Linkage = Signpost	0.008	0.004	0.144	0.857
Need Assessment= Signpost	0.816	0.956	0.166	0.828

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A8: Robustness check controlling for unbalanced covariates on FTs' training activities

	(1) **FT held at least one session**	(2) **N.sessions**	(3) **N. trainees**	(4) **N. trainees per session**
Linkage	0.110***	5.089***	12.255***	0.077
	(0.03)	(0.81)	(3.22)	(0.42)
Need Assessment	0.025	1.745**	-0.607	-0.499
	(0.03)	(0.83)	(3.25)	(0.43)
Signpost	0.027	1.860**	8.692***	-0.261
	(0.03)	(0.84)	(3.34)	(0.43)
Constant	0.836***	3.756**	16.012**	6.074***
	(0.08)	(1.82)	(7.51)	(1.23)
Covariate controls	Yes	Yes	Yes	Yes
Observations	395	395	395	395
Mean for basic treatment group	0.82	5.05	22.11	6.46
P-values				
Linkage = Need Assessment	0.011	0.005	0.002	0.337
Linkage = Signpost	0.006	0.006	0.439	0.569
Need Assessment= Signpost	0.963	0.918	0.035	0.636

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A9: Robustness check controlling for unbalanced covariates on the type of trainees

	(1) **Share of trainees part of SN**	(2) **Share of trainees among sampled farmers**	(3) **Share of trainees outside of SN**
Linkage	-0.007	0.035	0.117***
	(0.01)	(0.03)	(0.02)
Need Assessment	0.015	0.060*	0.010
	(0.01)	(0.03)	(0.02)
Signpost	0.010	0.073**	0.016
	(0.01)	(0.03)	(0.02)
Constant	0.148***	0.421***	0.689***
	(0.05)	(0.08)	(0.08)
Covariate controls	Yes	Yes	Yes
Observations	395	395	395
Mean for basic treatment group	0.15	0.43	0.67
P-values			
Linkage = Need Assessment	0.259	0.609	0.001
Linkage = Signpost	0.361	0.381	0.001
Need Assessment= Signpost	0.816	0.743	0.855

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$