Assessment of the Short-Run Impact of BRAC's Agriculture and Livestock Programme in Uganda

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1. Introduction

Agriculture constitutes a key sector for the Ugandan economy, as it does in many developing countries. It contributes 21 percent to Uganda's gross domestic product, 90 percent of its total export earnings, 73 percent to national employment (UNHS 2005-06), and about 50 percent to household income (UBOS, 2010; 2006). Moreover, agriculture is the major source both of food for the population and of raw materials for Uganda's industry. Despite the importance of agriculture to the economy, the sector has not performed consistently well in recent years. Agricultural sector growth declined from 7.1 percent in 2000-01 to less than one percent in 2005-06 and 2006-07, before recovering to 2.6 percent in 2008-09 (MFPED, 2010). It is important, therefore, that the agriculture sector receives special focus in order to improve its performance. Several government agencies including the Ministry of Agriculture Animal Industry and Fisheries (MAAIF) and semi-autonomous institutions (such as the Dairy Development Authority, Uganda Coffee Development Authority, National Agricultural Research Organisation (NARO) and the National Agricultural Advisory Services (NAADS)), as well as a number of national and international NGOs are working in the agricultural sector in Uganda. BRAC Uganda is a relatively new arrival, joining NGOs and bilateral agencies such as FAO, Catholic Relief Services, Self Help, Send a Cow Uganda, Kulika Charitable Trust, DENIVA, Techno Serve, and World Vision, many of which have been working in Uganda for more than 10 years (Kabbiri 2010).

Agriculture in Uganda is primarily dependent on subsistence farming. Subsistence farmers – producing mainly food crops of maize, beans, cassava, millet and sorghum – constitute 71% of the total farmers in the country. Commercial farmers, by contrast, grow coffee, tea, tobacco, fruits, flowers, and vegetables. There is a low prevalence of the usage of modern inputs in Uganda. Only six percent of farmers use improved seeds, 6.8 percent use manure (organic fertiliser), one percent use inorganic fertiliser, and 3.4 percent use pesticides, herbicides or fungicides (UBOS 2007, 2006).

The National Livestock Census conducted in February 2008 found that Uganda's cattle population grew from 6.5 million in 2006 to a promising 11.4 million in 2008. Over 90 percent of this national cattle herd is composed of indigenous cattle (Uganda Bureau of Statistics). Poultry rearing is a common income source for many poor households in the country. As of 2008, the national poultry flock was estimated to be 37.4 million, the national goat population was estimated to be 12.5 million, and the national sheep population was estimated to be 3.4 million. Although many livelihoods depend on poultry rearing, Uganda has one of the highest poultry mortality rates in the world. This means that there is significant scope to improve agricultural productivity through the reduction of poultry mortality and the adoption of improved rearing practices among Ugandan farmers. This paper explores whether BRAC's agricultural and livestock interventions have made any progress in the adoption of new technologies to enhance farm productivity. with this introduction, the following section discusses BRAC's intervention in the agricultural sector that includes female participation, and conceptual framework of programme evaluation, section three explains the methodology of the programme evaluation. Findings are presented in section four, which is split into two sections focusing on agriculture and livestock. Spillover effect of the programme is discussed in section five. Section six concludes the paper.

2. The Intervention

BRAC Uganda's Agriculture and Livestock programme was launched in August 2008 and currently covers 41 districts in 60 branch offices. Both the Agriculture and Livestock programmes were launched as a key part of BRAC's strategy to address poverty through increasing food security and improving livestock productivity. The Agriculture Programme focuses on enhancing the agricultural productivity and income of small holder farmers through training, the provision of appropriate and cost effective agro-inputs, and technical support. The Livestock Programme is focused on the prevention of Newcastle Diseases (NCD) among poultry, and improving the indigenous cattle breed through artificial insemination. Table 1 provides an overview of BRAC Uganda's Agriculture and Livestock Programmes.

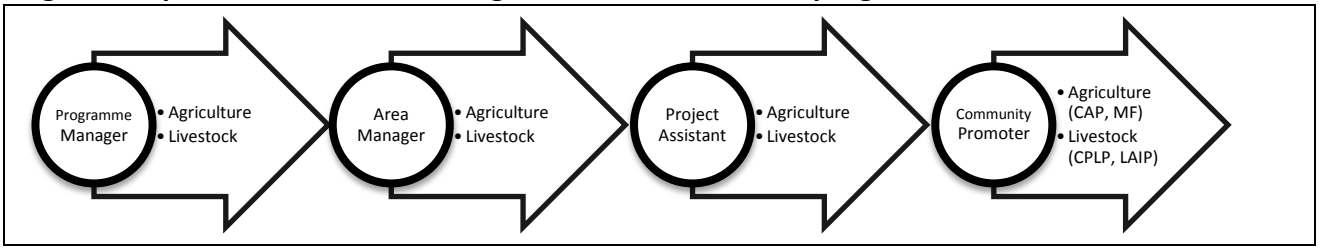
Table 1: Intervention package at a glance

Components/inputs / Agents	Gender	Receiving Training[1]	Receiving Refresher[2]	Receiving Revolving Fund	Receiving Free inputs[3]	Agricultural tools	Receiving equipments	Providing veterinary services	Providing Extension Services
CAP: Community Agriculture Promoter	F	Yes	Yes	Yes	-	-	-	-	Yes
MF: Model Farmer	F	Yes	Yes	-	Yes	Yes	-	-	Yes
GF: General Farmer	F	Yes	-	-	Yes	-	-	-	-
CPLP: Community Livestock Promoter	F	Yes	Yes	-	-	-	Yes	Yes	Yes
LAIP: Artificial Inseminator Promoter	M	Yes	Yes	-	-	-	Yes	Yes	Yes

[1]Twelve hour, twenty hour, twenty four hour, forty eight hour, and eighty four hour training for GF, MF, CAP, CPLP and LAIP respectively (on a four hour per day training basis).
[2]Monthly refresher for CAP, CPLP and bimonthly and half yearly refresher for MF, LAIP respectively
[3]MF receives in every season-10Kg and GF receives 5Kg free on a one-time basis.

The Agriculture Programme covers at least 41,200 farmers in several layers. This includes: 800 model farmers (20 per branch), 40,000 general farmers (1,000 per branch), and 400 horticulture nursery farmers (10 per branch). The farmers that are selected under the programmes are all poor marginalised women in villages. There are several components of the Agriculture Programme, including extension, experimentation (technology development and transfer including seed trials) and seed production. In addition, the Livestock Programme has 800 Community Poultry Livestock Promoters (20 per branch), and 70 Livestock Artificial Insemination Promoters (LAIP). These positions of Model Farmer (MF), Community Agriculture Promoter (CAP) and Community Poultry and Livestock Promoter (CPLP) are selected from BRAC Microfinance Groups. The operational structure is visually illustrated in Figure 1.

Figure 1. Operational structure of Agriculture and Livestock programme of BRAC



BRAC trains selected Model Farmers (MFs) in areas of crop production and technology. This training focuses on the best crop production techniques for farmers, the benefits of using new crop varieties, and how to identify and prevent common crop pests and diseases. This training lasts six days for the MFs (on the basis of four hour per day) and three days for General Farmers (GF).

The training of MFs is done by the Project Assistant (PA). After their training is completed, MFs are expected to train 50 GFs within their area. PAs are not themselves directly involved in the training of GFs, but do make farm visits to them. Refresher courses are held on a regular basis to reorient the MFs with

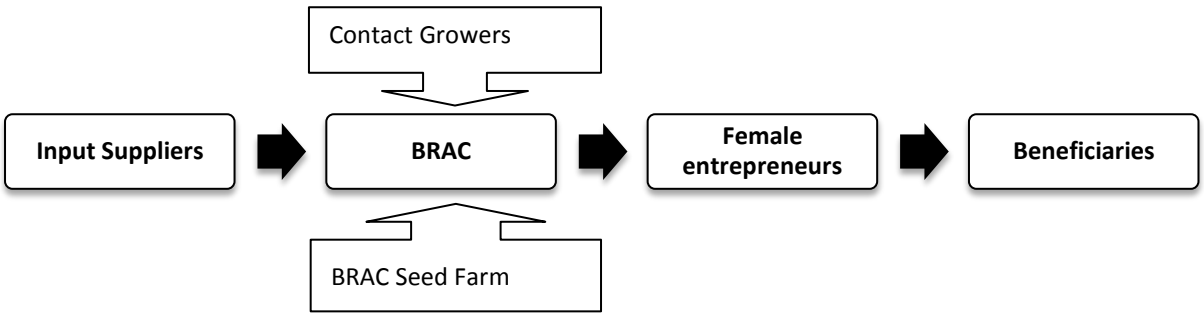
their training techniques. Some of the selected MFs are chosen to become Community Agriculture Promoters (CAP), whose role is to provide general farmers and their local communities with farm inputs at a reasonable price. These inputs include seeds (such as high yielding varieties of maize, rice, beans, groundnuts, cabbage, tomatoes, and eggplants), tools (such as hoes and *pangas*), and inorganic fertilisers.

Community Poultry & Livestock Promoters (CPLP) constitute an important segment of BRAC's female entrepreneurs. They deliver critical productivity-enhancing services in the Poultry & Livestock sector. The CPLPs are identified from the pool of BRAC borrowers within each branch. After selection, they are trained by project assistants with the support of project officers. Another group of 'franchised' entrepreneurs in the Poultry & Livestock sector are the Livestock Artificial Insemination Promoters (LAIP). About 90 percent of cattle breeds in Uganda are indigenous. This means that most cattle rearers in the country are affected by low levels of milk and meat production. The role of LAIPs is to improve Uganda's cattle breeds through the provision of high quality artificial insemination (AI) services at an affordable price. CPLPs and LAIPs receive 12 days and 21 days of comprehensive technical skill training, respectively, in vaccination, disease control and cattle breeding. LAIPs receive their training from the National Animal Genetic Resource Centre (NAGRC). Both the CPLPs and LAIPs are provided with necessary equipment for their trade, such as a flux and AI tool kit for delivering vaccinations and AI services to their respective communities.

2.1. Female entrepreneurs in the agricultural input market

BRAC utilises female entrepreneurs, called Community Agriculture Promoters (CAPs), to take extension services and technologies to rural villages in Uganda by supplying improved varieties of various seeds to their respective communities. BRAC acts as a bridge between input suppliers and primary users, using these female entrepreneurs as intermediaries. Currently BRAC can purchase bulk quantities of good quality seeds and fertilisers at a wholesale price, which the CAP then sells to communities at this comparatively low price. In addition, BRAC has planned to collect certified seeds from model farmers (who will be working as contact growers) and its own seed production farm, selling these too among smallholder general farmers through CAP (Fig. 2). Thus, BRAC contributes both to extending the seed supply chain at reasonable prices, as well as to developing female entrepreneurship.

Figure 2: Supply chain of modern agricultural inputs



2.2. Conceptual framework for programme evaluation

BRAC Uganda's agriculture and livestock programme has two-fold objectives, namely i) capacity building and adoption of new technology by beneficiaries in the short-term and ii) improving farm productivity, livestock productivity in the long-term.

In order to ensure effective evaluation of the agriculture and livestock programme, the BRAC Uganda Research and Evaluation Unit carried out a baseline survey immediately after setting up BRAC offices with the agriculture and livestock programmes. This baseline study – known as the Microfinance Multiplied study – captured information on agriculture and livestock-rearing activities that households utilised. It should be mentioned here that although there are two farming seasons in Uganda (from March to July and Aug to Nov), it was apparent during the survey that farmers had difficulty recalling information from both seasons: only the seasons just prior to the survey were easily recalled. Subsequently, six months after the

initial baseline study, the Research and Evaluation Unit conducted a mid-term survey between May and June 2010. The aim of this study was to investigate the programme's short-run success in improving input usage and cropping techniques in intervention areas. The analysis focused on, therefore, indicators that revealed the extent of the penetration of extension services, the adoption of new technology, and changes in production and income that may be influenced by the agriculture and livestock programme.

3. Data and methodology

Evaluation of any intervention or social programme is primarily dependent upon obtaining a credible estimate of the counterfactual, that is, what would have happened to programme participants if they had not participated? One feasible solution to this problem is to estimate the counterfactual based on a group of nonparticipants, and to calculate the impact of the intervention as the difference in mean outcomes between these groups. This approach, however, is only valid under a very precise condition: the comparison group must be statistically equivalent to the treated group. In other words, the groups must be identical except for the fact that one of them received the treatment. The main concern of such evaluations, therefore, is how to find a proper comparison group. We used propensity score matching (PSM) for constructing a comparison group. Through comparisons with experimental estimators, Heckman, Ichimura, and Todd (1997, 1998), and Heckman et al. (1998) show that PSM provides reliable, low-bias estimates of programme impact provided that i) the same data source is used for participants and nonparticipants, ii) participants and nonparticipants have access to the same markets, and iii) the data include meaningful explanatory variables capable of identifying programme participation. The evaluation has been designed to fulfill these requirements for PSM. The following section describes how PSM constructs a counterfactual comparison group for the evaluation problem, following Heckman, Ichimura, and Todd (1997) and Smith and Todd (2001, 2005).

3.1 Data

Between June and November 2009, BRAC Uganda Research and Evaluation Unit carried out a baseline survey to evaluate its "Microfinance Multiplied" (MFM) approach. This survey included modules on agricultural activities. It was, therefore, able to serve as a baseline for the mid-term agriculture evaluation. The baseline survey was conducted in 33 counties, with 17 LC1s[1] (12 treatments and 5 controls) selected from each county for the survey. Within each of these LC1s, 25 households were randomly selected for interviews. This amounted to a total sample size of 14,025 potential respondent households.

A complete follow-up survey is planned by 2011 to assess the impacts of the MFM approach. This mid-term survey, however, was conducted in August-October 2010 to collect some basic information on farm practices with a few self-reported measures of change. Out of the 33 counties in the baseline survey, 13 counties were selected for the follow-up. Within each of these counties, six LC1s were randomly selected from 12 treatment LC1s, and three LC1s were randomly selected from the five control LC1s in the midterm survey. Thus, nine LC1s were randomly picked from each county. More specifically, nine LC1s in ten counties and eight LC1s in three counties were selected as survey locations. In each LC1, 25 households were interviewed, resulting in a total of 2,854 households in the mid-term. Out of this sample, we used a panel of 2,231 households for PSM analysis.

3.2 Propensity Score Matching

The basic idea of propensity score matching is to identify observations from non-participants who are very similar to participants in terms of a variety of observable characteristics. This is done by regressing participation with the observable characteristics: $p(x)=pr(D=1|X)$. This gives a predicted probability of participation for each observation. Observations with very close (or identical) probabilities are considered comparable. After identifying one (or several) 'comparable non-participant(s)' for each participant, their differences in the outcome variables are estimated. The average effect of programme participation is the

[1] In Uganda, LC1(Local Council-1) is the smallest administrative unit at village level. Usually each village has one LC1 but there may be more than one depending on the size of the village.

mean of these differences. This is clearly not a foolproof method since the differences in unobservables (individual knowledge, skill, performance etc.) cannot be accounted for in predicting the probability of participation, but it does have the advantage of yielding low-bias estimates of impacts. Validity of the PSM approach rests, in part, on two assumptions:

Assumption 1: there is a set X of covariates to be observed so that after controlling for these covariates, the potential outcomes for nonparticipants are identical to outcomes of participants if they had not received the programme. This property is also known as *unconfoundedness.*

Assumption 2: for each value of X, there is a positive probability of being both treated and untreated: $0<P(D=1|X)<1$. The major advantage realised from this is the reduction of dimensionality, as it allows for matching on a single variable (the propensity score) instead of on the entire set of covariates.

3.3. Determinants of participation

The first step in PSM analysis is to estimate the propensity score. The participation model must be characterised and the probability of participation predicted. A key objective of this step is to include variables that are likely to affect both the participation and the outcome of interest. These covariates are used to estimate the propensity score with logit model, given that the treatment is typically dichotomous (i.e. D=1, BRAC participants who received training; and D= 0, Otherwise). Propensity scores have been calculated separately for participating in agriculture and livestock programme using the logit model. Receiving training on agriculture has been used as a participation variable for agriculture. Similarly, training on livestock has been used as a participation variable for livestock programme. The strength of the predictors of participation is reflected in the reasonably high pseudo-R^2. This gives confidence on the estimated probability of participation (i.e. propensity scores).

The propensity score is estimated using various socio-demographic characteristics of sampled households, namely: number of household members, gender of household head, housing materials, water source for drinking, access to different utilities, village dummy, microfinance membership, existing cultivation practices and technology usage. Looking at the p-values, it is seen that participation is clearly related to household membership with LC1, intercropping and increased profit from agriculture having a higher probability of participation in agriculture programme. On the other hand, those households with poor lighting devices (such as *todobas*) are less likely to participate in agriculture programme. Commercial farm households who sell agricultural produce are less likely to join the programme. The richer households with mobile phones are less likely to participate. Demographic characteristics (such as household size) indicate households to be controlled. BRAC membership, housing materials, utilities, and presence of other extension service providers (such as NAADS) indicators do not have any predictive power. Based on these coefficients, the propensity score has been estimated for the observations. The balancing property was met (i.e. there was no significant difference in any of the characteristics between participants and non-participants within specific score ranges or blocks). Figure A1a gives the distribution of propensity scores (i.e. predicted probabilities of participation) for the two groups. As expected, participants have higher scores than non-participants.

Similarly, the propensity score is estimated for livestock programme participation using a logit model. Households rearing cattle and poultry are more likely to participate in the livestock programme. The presence of BRAC's community poultry and livestock promoter at the community level significantly increases participation. The indicators namely: demographic characteristics, housing materials, utilities, BRAC microfinance membership, LC1 membership of any household member, and presence of other extension service providers (such as NAADS and other NGOs) do not have any predictive power. The propensity score has been estimated for the observations basing on those coefficients. Figure A1b gives the distribution of propensity scores for the two groups.

For matching purposes, the nearest neighbourhood method was applied, which performs relatively better for smaller samples (Smith and Todd, 2005). Common support was applied to drop observations with no comparable non-participant household. Since this is a relatively small sample and the distribution of propensity shows that there are few non-participants with high propensity score, replacement in matching (i.e. using the same non-participant for comparing with multiple participants) was allowed.

After propensity scores have been estimated and a matching algorithm has been chosen, the impact of the programme is calculated by averaging the differences in outcomes between each treated unit and its neighbour (or neighbours). Stata statistical software was used to perform the matching and to generate estimates of the impact of the intervention. A programme developed by Leuven and Sianesi (2003), 'psmatch2', was used for this purpose.

The estimated impacts of programme participation with the assumption of "unconfoundedness" in PSM (i.e. conditional on the observables included in the regression of participation, the two groups are similar) are presented below.

4. Findings

The key objective of the agriculture midterm survey was to look at the penetration of BRAC extension services, and to have subsequent early feedback from the beneficiaries. We use participation in training as the indicator of programme participation. However, many of the other components of the interventions are at the community level, and farmers not participating in training sessions may also use those services. There is also a possibility of spillover effects if the farmers interact and share their knowledge. These can bias the impact estimates downwards. It is, therefore, critical to look into the correlation between attending training sessions and other services. Table 2 provides a comparison of the extent of availing key services between the intervention and comparison groups. Knowledge sharing amongst farmers was captured by a proxy question of how many farmers they talk to about cultivation. We do not observe any significant difference in farmers' interactions between the two groups. On average, each respondent reported talking to two farmers who they know received training from BRAC. While this raises the concern of spillover through knowledge sharing, such spillover might be very small as we find remarkable difference in the extent of buying seeds from BRAC. Only six percent of the matched controls households reported buying seeds from BRAC while this figure is 61 percent for the intervention group. Therefore, the PSM impact estimate suggests a significant increase of 55 percentage points for the participants in terms of 'purchasing improved seeds'.

Table 2: Correlation of training with usage of other services

Outcome Variables	Treated	Controls	Difference	t-stat	n
Agriculture					
No. of farmers interacted at community	13.45	12.50	0.95	0.58	2,166
No. of farmers received BRAC training	2.19	2.53	-0.33	0.75	2,081
Purchases any seeds from BRAC	0.61	0.06	0.55	19.39***	1,110
Livestock					
No. of farmers interacted at community	7.21	3.62	3.58	3.76***	1,882
Buys any vaccine from BRAC	0.28	0.04	0.24	8.49***	2,047
Buys Artificial Insemination service	0.11	0.02	0.08	4.20***	2,047

Source: Agriculture Midterm Survey 2010

Similarly, a proxy question was also used to estimate the social network and number of farmers amongst smallholder livestock rearers at the community level. Interactions between smallholder livestock rearers appear to be higher among participants in comparison with matched controls. This means that social mobilisation, as well as information dissemination, was higher among participants.

Overall, 57% of households reported rearing poultry. Twenty eight percent of participants reported buying vaccines from BRAC which was higher than that of matched controls. Consequently, the PSM impact estimate suggests a significant increase of 24 percentage points for the participants with "buying vaccine". Overall, 46% of households reported rearing cattle while 10% of the participants reported purchasing artificial insemination services from BRAC: this was much higher than matched controls. Thus, the PSM impact estimate suggests a significant increase of 8 percentage points for participants in terms of 'taking up of AI services'. These results indicate that training is a useful entry point in delivering other agriculture services. Since usage of inputs from BRAC is strongly associated with the extent of receiving training, our estimates are likely to capture the impact of the full intervention (instead of only the training component).

4.1. Agriculture

Impact on adoption of improved technology

This section examines whether the skills development training has had an impact on the adoption of modern cultivation methods and inputs among participants. In these terms, the influence of BRAC programmes may be revealed in the adoption of any new technology by participants. To capture such information the respondents were asked: "which new cultivation methods or inputs did you apply during the first cropping season in 2010"? Table 3 shows that participant households frequently reported the adoption of new inputs in comparison with matched controls. New technologies were primarily observed in the usage of improved seed and agronomic practices. Seventy five percent of participant households used improved seeds, while this figure is 48 percent for matched controls households. Therefore, the PSM impact estimate suggests an increase of 27 percentage points for programme participants in terms of using improved seeds. Sixty one percent of participants who used improved seeds reported buying seeds from BRAC, while this figure is only six percent for nonparticipants (Table 2). We do not observe any significant impact on the usage of fertilisers and pesticides. The adoption of new cultivation methods was also found to be encouraging among participants, especially with regards to line sowing techniques that are being promoted by BRAC. Impact estimates suggest a significant increase of six percentage points for participants reporting "line sowing" techniques.

Table 3: Impact estimates for using new technology

Outcome variables	Treated	Controls	Difference	t-stat	n
Inputs					
Uses improved seed	0.75	0.48	0.27	9.17***	2,201
Uses fertilisers	0.13	0.14	-0.01	-0.28	2,201
Uses pesticides/herbicides	0.18	0.17	0.01	0.42	2,201
Methods					
Uses mixed cropping	0.54	0.64	-0.10	-3.18***	2,201
Uses line sowing	0.46	0.40	0.06	1.93*	2,201
Uses weeding	0.53	0.54	-0.01	-0.32	2,201
Uses zero tillage	0.06	0.05	0.01	0.55	2,201

BRAC does not promote the use of mixed-cropping, whereby farmers cultivate more than one crop in one plot. Instead, BRAC promotes the cultivation of mono-crops. This allows farmers to cultivate different crops in different plots, and separating their cultivation results in a better harvest. Thus, PSM impact estimates suggest a significant reduction of 10 percentage points for participants with 'mixed-cropping practice'. There was no impact observed regarding 'weeding' and 'zero tillage' (planting without any tillage).

Impact on adopting improved seeds of different crops

Here we look into the adoption of improved seeds by crop variety. Those seeds that were most commonly bought by the participants from BRAC were reported to be beans followed by maize, groundnuts, tomatoes, cabbage, and rice, as illustrated in Table 4. The PSM impact estimates suggest significant increase of 37, 22, and 11 percentage points for participants in using 'beans', 'maize', 'groundnuts' seeds

respectively compared to matched controls. While we observe relatively lower impacts on purchasing 'tomatoes', 'eggplant', 'cabbage' and 'rice' seeds. These vegetables seeds are relatively expensive what could be one of the possible reasons for this lower up-take. On the other hand, rice is more labour intensive and is not feasible for all regions in Uganda. Those who had purchased seeds from BRAC expressed their satisfaction with the germination rate. It is notable that the satisfaction score was found to be significantly higher among participants compared to controls. This might be due to lack of supervision by model farmers beyond their commanding areas.

Table 4: PSM estimates for adopting improved seed by crop variety

Outcome variables	Treated	Controls	Difference	t-stat	n
Maize	0.24	0.02	0.22	10.95***	2,201
Rice	0.03	0.01	0.02	2.86**	2,201
Beans	0.40	0.02	0.38	16.12***	2,201
Groundnuts	0.12	0.00	0.12	8.10***	2,201
Cabbage	0.04	0.01	0.03	3.74***	2,201
Tomatoes	0.06	0.00	0.06	5.44***	2,201
Eggplant	0.03	0.00	0.03	4.06***	2,201

Source: Agriculture Midterm Survey 2010

Impact on market orientation

The crop types produced and sold by households are categorised into seven groups. As Table 5 illustrates, households are mostly involved in selling cereals and staples, alongside nuts and beans, roots and tubers, cash crops, and fruits. In comparison with matched controls, participant households were more likely to sell agricultural products. The PSM impact estimate suggests a significant increase of five percentage points for participants in terms of 'selling cash crops'. Some crops are predominantly sold by the households (such as cereals, roots and tubers and beans). It should be mentioned here that cereals are mostly dominated by maize. The participant households appear to be more market oriented in selling cash crops compared to matched controls.

Table 5: Impact estimates for selling of agricultural produce by categories, 2010

Outcome variables	Treated	Controls	Difference	t-stat	n
Cereals and staple	0.63	0.63	-0.00	-0.26	2,201
Nuts and beans	0.65	0.64	0.01	0.07	2,201
Cash crop	0.18	0.14	0.05	1.91*	2,201
Vegetables	0.21	0.22	-0.01	-0.23	2,201
Peas	0.07	0.07	0.00	0.13	2,201
Roots and tubers	0.60	0.60	0.00	0.06	2,201
Fruits	0.39	0.38	0.01	0.26	2,201

Source: Agriculture Midterm Survey 2010

Impact on value of production

Table 6 summarises the total costs incurred for agricultural inputs, the total value of production of selected crops, and the total profit from agricultural produces across participants and matched controls. The amount of land allocated for cultivation seemed to be significantly higher for participant households in comparison with matched controls. The logarithmic scales reduce wide-ranging quantities into smaller scopes. So, all of the monetary values have been converted into logarithmic scale to facilitate a smooth analysis. However, the number of crop types produced was higher for participants in comparison with matched controls, incurring significantly higher input costs. Participants may grow diversified crops to minimise risk of crop failure. Profits earned from agriculture produces were found to be slightly higher for

the participants insignificant though. There is no significant difference in total value of selected crops except groundnut and finger millet. The total input cost is relatively higher for participant households. That participant households brought more land under cultivation might incur these additional costs.

Table 6: Impact estimates of cost, revenue and profit from agriculture

Outcome variables	Treated	Controls	Difference	t-stat	n
Usage of farm land (acre)	5.03	4.27	0.76	2.54**	1,028
No. of crop type produced	3.15	3.13	0.02	0.12	2,201
No. of crop type sold	2.41	2.36	0.05	0.49	2,201
Total input cost	11.45	11.28	0.16	2.45**	1,974
Total value of production of selected crops (log value)					
Maize	12.45	12.47	-0.02	-0.17	1,488
Groundnut	12.91	12.73	0.18	1.80*	959
Beans	12.27	12.41	-0.14	-0.91	1,177
Rice	13.97	14.23	-0.26	-0.63	104
Tomato	13.03	12.90	0.13	1.20	1,065
Banana (Food)	12.81	12.79	0.02	0.18	1,115
Finger millet	12.31	13.18	-0.86	-3.29**	279
Total profit from agriculture	12.23	12.06	0.17	1.41	1,062

Source: Agriculture Midterm Survey 2010

However, the profit is not significantly different between participants and non-participants, meaning that participant households have yet reached a commercial level of operation. In other words, it might take some time to transform from subsistence farming to commercial farming.

4.2. Livestock

Impact on awareness about disease

Community Poultry Livestock Promoters are identified from the pool of BRAC borrowers in every branch. After selection, they are trained by project assistants with the support of the project officers. They are the key door-to-door outreach agents who deliver vital services to their respective communities. These services include poultry vaccination, educating poultry farmers on housing, feeding, water management and disease prevention, and also livestock-related services such as de-worming, best practices for housing and feeding of livestock, cattle breed selection and milking of livestock.

Table 7: Impact estimates on knowledge and awareness

Outcome variables	Treated	Controls	Difference	t-stat	n
Knows prevention of Newcastle diseases	0.25	0.23	0.03	0.59	1,150
Knows prevention of Gumboro disease	0.26	0.16	0.10	2.36**	1,149
Knows prevention of Fowl Pox diseases	0.14	0.05	0.09	2.96***	1,148

Source: Agriculture Midterm Survey 2010

Around half of households were rearing poultry: their knowledge and awareness about poultry disease was low. However, as Table 7 reveals, around three quarters of small holder poultry rearers do not know about the preventive measures of Newcastle Disease, while the figures were even higher for Gumboro. This means there are significant opportunities to improve productivity through reducing poultry mortality and improve rearing practices among farmers. Raising awareness at the community level, therefore, will be critical in order to protect poultry from diseases. We do not observe any significant impact on knowledge of preventive measures against Newcastle Disease. This lack of awareness may be one driver of Uganda's huge poultry mortality rates.

Impact on the use of vaccination services

Those who bought vaccines frequently reported buying Newcastle disease, which is a widely promoted preventive measure for controlling deadly diseases of poultry birds alongside Gumboro and Fowl Pox (Table 8). PSM impact estimates suggest a significant increase of 22, 18, and 18 percentage points for participants in purchasing 'NCD vaccine', 'Gumboro vaccine' and 'Fowl Pox vaccine' respectively. BRAC participants were more likely to report that vaccination had reduced the mortality rate of their poultry.

Table 8: Impact estimates of vaccination services

Outcome variables	Treated	Controls	Difference	t-stat	n
Buys NCD vaccine	0.25	0.03	0.22	8.01***	2,047
Buys Gumboro vaccine	0.19	0.01	0.18	7.49***	2,047
Buys Fowl Pox vaccine	0.20	0.02	0.18	7.17***	2,047
Noticed reduces mortality	0.40	0.27	0.13	3.43***	2,047

Source: Agriculture Midterm Survey 2010

Impact on market orientation

Table 9 provides an overview of household activities related to livestock rearing. Overall, 44 percent of households reported producing/rearing any livestock products. Fifty percent of households, however, reported selling any livestock or livestock products, indicating that the additional houses here are involved in trading these products or livestock. A large portion of households are engaged in both producing and selling. Around 74 percent of households reported selling livestock products that are also involved in production. A significantly higher proportion of households among participants were engaged in selling livestock products in comparison with matched controls. This indicates that participant households rearing livestock are more market-oriented.

Table 9: Impact estimates of production and selling livestock product

Outcome variables	Treated	Controls	Difference	t-stat	n
Produces any livestock product	0.55	0.44	0.11	2.56**	2,043
Sells any livestock product	0.62	0.46	0.16	3.93***	2,046
Sells who produces	0.86	0.75	0.12	2.69**	890
Trades (buy and sell)	0.34	0.28	0.06	1.06	1,156

Source: Agriculture Midterm Survey 2010

As a result, PSM impact estimate suggests an increase of 16 percentage points for those participants with "market orientation". Around one third of households were involved only in the trading of livestock products, as shown in Table 9. The most common livestock products for selling were live poultry birds, other live animals, milk, and eggs.

Impact on profitability

Regarding the total input cost and total revenue from sale, there is significant difference between participants and matched controls, as Table 10 shows. The number of items that were being sold was found to be more than the number of items produced. This is not surprising, however, since a group of households engaged only trading. Sales revenue was found to be less than half of input cost, meaning a bulk of the volume produced might be consumed at home or given away (as is customary practice in Uganda). There is also the possibility of practicing barter economy in rural areas. There was no significant impact on profit from livestock rearing.

Table 10: Impact estimates of cost, revenue and profit from livestock

Outcome variables	Treated	Controls	Difference	t-stat	n
Total input cost	10.68	10.10	0.61	4.97***	1,605
Total value of livestock products	11.02	10.33	0.69	3.22***	828
Total revenue from sale	11.86	11.53	0.33	2.21**	1,014
Total profit from livestock	11.32	10.69	0.63	2.74**	669

Source: Agriculture Midterm Survey 2010

Table 11: Impact estimates on self-reported welfare

Outcome Variables	Treated	Controls	Difference	t-stat	n
Economic situation compared to last 12 month [5=improved much…1=worsened much]	3.42	3.37	0.04	0.86	2,197
Economic situation in next 12 month [5=will improve much…1=will worsen much]	3.60	3.61	-0.01	-0.16	2,190
Economic situation compared to most neighbours [5=much better-off…1=much worse-off]	3.18	3.17	0.01	0.26	2,194
Log of monthly food expenditure	11.00	11.20	-0.20	-2.71**	2,201

Source: Agriculture Midterm Survey 2010

Table 11 examines the welfare impact for participants based on their self-reported poverty indicators. We do not observe any impact on self-reported poverty indicators. There is a marginal difference between the two groups regarding current and future economic status. This difference is insignificant, though. The expenditure on food seems to be higher for matched controls compared to participants. Thus, PSM impact estimate suggests a significant reduction of over UGX11,000 (0.20 in logarithmic scale) on expenditure of monthly food consumption for participants. This implies that participant households have smaller out-of-pocket expenditure than nonparticipants.

5. Spillover effect

In each programme, intervention has direct and indirect effect on participants and nonparticipants respectively. The indirect effect on nonparticipants is called the 'spillover effect'. In some cases, spillover effects are intended. For example, agricultural extension programmes encourage participants to adopt a certain technology and hope that this will induce further adoption within the community or in neighbouring communities. Whether intentionally or not, nonparticipants can be affected by programmes, and these spillover effects should be taken into account when conducting an impact evaluation. Therefore, our evaluation design was also interested whether spillovers are present. In the non-experimental evaluation design, spillover effect is useful measure to know the effectiveness of programme intervention on nonparticipants and thus, helps in redesigning the programme in future. In our setting, we estimated intention to treat (ITT) comparing those who were supposed to participate in the programme (E=1) in the treatment areas (T=1) with those in comparison areas (T=0). We also estimated the spillover effect (SO) comparing those who did not participate in the programme (not received training, E=0) living in the treatment areas (T=1) with those in comparison areas (T=0). Difference-in-difference (DiD) was applied for measuring ITT and spillover effect.

We observed positive spillover effects (indirect effect) on the usage of improved seeds meaning that those who did not receive training from BRAC were also using improved seeds, and this was significantly higher than that of the comparison group.

Table 12: Impact estimates for using new technology (agriculture)

Outcome variables	Intent to treat effect	Spillover effect
Inputs		
Uses improved seed	0.13 (4.91)***	0.09 (2.99)**
Uses fertilisers	-0.00 (0.01)	0.00 (0.17)
Uses pesticides/herbicides	0.02 (1.26)	0.01 (0.31)
Agronomic practices		
Uses mixed cropping	-0.04 (1.21)	0.01 (0.41)
Uses line sowing	0.09 (3.09)***	0.08 (2.35)**
Uses weeding	0.09 (2.88)**	0.08 (2.43)**
Uses zero tillage	-0.00 (0.22)	-0.00 (0.35)

t-statistics in the parenthesis, *, **, *** signifies at 10%, 5%, and 1% level

However, the evidence shows that the direct effect of programme intervention was found to be more than the indirect effect (Table 12). Using improved seeds is one way of increasing productivity while new cultivation methods could also increase farm productivity. We observe positive spillover effects on following new cultivation methods such as line sowing and proper weeding.

Table 13: Impact estimates for using new technology (livestock)

Outcome variables	Intent to treat effect	Spillover effect
Buys vaccine from any source	0.00 (0.01)	0.01 (0.58)
Buys medicine from any source	0.01 (0.78)	0.01 (0.70)
Buys artificial insemination service from any source	0.01 (1.34)	0.01 (1.13)
Buys treatment services from any source	-0.01 (0.70)	-0.00 (0.32)

t-statistics in the parenthesis

We do not observe any significant spillover effect on livestock extension services such as buying vaccine, medicine, artificial insemination services and treatment (Table 13). It should be mentioned here that BRAC provides training to the Poultry & Livestock Promoters who usually buy vaccine and medicine from BRAC and resell them in their respective communities. So, an increased number of promoters buying vaccines indicates a widening of vaccination services over time.

6. Conclusions

The aim of this paper was to investigate the short-term impact of BRAC-Uganda's agriculture extension programme in promoting the adoption of modern technology among participants. We find impact on certain farming practices, which are the immediate domains in the chain of effects from the intervention to farm productivity and farmers welfare. The duration of programme exposure – one year – was too short to observe impacts on secondary dimensions. On the basis of this analysis, we also sought to recommend approaches for improving the programme. The survey found areas that BRAC could further explore for extending services. About 66 percent of participants who did not buy seeds from BRAC reported that they had not been approached or offered this service. A smaller proportion of participants (14 percent) were price sensitive, while another group of participants (seven percent) was found to be quality sensitive

regarding purchasing seeds from BRAC. About 13 percent of participants who did not buy seed reported unavailability of preferred varieties of seeds that were not promoted by BRAC.

The survey has shown that there has been progress in the adoption of modern technology and modern cultivation methods, and that this could be further improved by widened and deepened training in skills development to more beneficiaries and existing beneficiaries respectively. The most frequently recalled training was on planting methods (68 percent), followed by disease and pest management (56 percent), and weed management (53 percent). This reflects BRAC's emphasis on labour intensive cultivation practices (such as line sowing) rather than the purchase of expensive complementary inputs such as fertiliser, pesticides, and herbicides. This could eventually save the production costs. On the other hand, training on harvesting (11 percent), post-harvest handling (12 percent), marketing (10 percent), and seed preservation (23 percent) were less likely to be recalled by trainees, although these techniques are equally important for increasing the value of agricultural produce. It was observed that training on modern cultivation methods brought change in the farming practices adopted among participants.

Similarly, there is also an unserved market in the poultry and livestock sector although the uptake of vaccination services was found to be progressing. For example, 14 percent and 27 percent of participants did not use vaccination and artificial insemination services respectively due to unavailability of those services. Impact estimates reveal a significant positive impact for participants utilising vaccination services. Low uptake does not only reflect a lack of access: a group of poultry rearers (13 percent) and cattle rearers (four percent) were discouraged from using these services because they did not understand their importance. A strong educational campaign on these services may be necessary to increase demand on these products. The participants were also price sensitive regarding purchase of vaccine (28 percent) and artificial insemination services (29 percent).

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