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# Association between foreign agricultural investments and adoption of soil and water conservation practices in Uganda

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## Abstract

**Objectives** Recently, some developing countries are promoting foreign agricultural investments in Agriculture to exploit currently under-exploited land. Yet, the benefits to recipient countries remains less understood and inconclusive. The study sought to understand the association between proximity to a foreign agricultural investments (FAI) and adoption of soil and water conservation farming methods by smallholder farmers in Uganda.

**Methodology** We used cross-sectional data collected from a total of 1,181 smallholder respondents, sampled through a multi-stage random sampling process resulting in three independent samples from South-western, Central and Northern Uganda. Using logistic regression analysis and pooled data, we study the association between proximity to a FAI and other factors that influence the adoption of soil and water conservation farming practices by smallholder farmers in Uganda.

**Results** Descriptive results show that at the aggregate level proximity to a FAI, the education level of the farmer and ownership of information and communication assets (radio and mobile phone) are significantly different between adopter and non-adopters of soil and water conservation farming methods in the research area. The econometric findings of the study suggest that proximity to a foreign agricultural investments (FAI) has weak but significant spillovers on soil and water conservation farming practices of smallholder farmers it their vicinity with possible site specific variations that warrant more in-depth investigation. The effect of proximity to FAI on the adoption of soil and water conservation farming practices is complemented by the education level of the farmer and access to means of communication (radio, and in particular mobile phone set) indicating the importance of information and also broader socio-economic conditions.

**Recommendation** We recommend policies that enhance increased exposure of smallholder farmers to FAI especially those that help promote rural digital penetration through increased band width, FM radios and affordable data packages.

**Keywords** Foreign agricultural investments, Soil and water conservation, Spillovers, Logistic regression, Uganda

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## Introduction

Recently, some developing countries are seeking foreign investments in Agriculture to exploit surplus land currently unused or under-utilised. This has been variously called "land grabbing" [1], Foreign Agricultural Investment [2] or Resource Seeking Foreign Direct Investment [3]. Meanwhile, it is estimated that only around one quarter of Africa is cultivated [4]. One reason land is not currently being used to its full potential is that the infrastructural investments needed to bring it into production are so significant and beyond the budgetary resources of most African countries. It is hence urged that international investments might bring much needed infrastructural investments from which all can benefit.

Evidence of the impact of FAI in developing countries is currently growing, particularly as a result of research launched in the wake of the rise in land-based investments that followed from the food price hikes in 2007–2008 and again in 2011–2012. While much of this research interest has focused on land tenure and employment-related effects, evidence is also emerging with respect to technology-related spillovers that may arise with the advent of such investments into an area [5–7]. Such technology-related spillovers may occur due to local market changes, whether for inputs, outputs, labour or capital, caused by the advent of new large-scale agricultural actors into an area, as well as when new agricultural investors introduce new agricultural practices and thus act as a source of inspiration to neighbouring small-scale farmers. Only limited attention has been given to spillover effects specifically relating to soil and water conservation techniques. Common to these technology-related spillovers is that they tend to be localized in nature, implying that proximity between investments and small-scale farmers can be an important 'vehicle' for spillover effects to materialize.

Also, Deininger and Xia [5] analysed the correlation between proximity to large-scale commercial farms and the prevalence of agronomic practices such as crop rotation and intercropping and the use of inputs such as modern seeds and agrochemicals among small-scale farmers in Mozambique. They found positive, although modest and not always linear, correlation between the use of modern seeds, fertilizers and pesticides, and also agronomic practices such as crop rotation and intercropping and proximity to newly established large farms. Moreover, they conclude that the establishment of large farms seems to have no impact on smallholders if it is farther than 50 km. Adopting a similar approach, analyses have been conducted with respect to the correlation between proximity to large-scale commercial farms and small-scale farmers adoption/use of chemical fertilizers, based on data from Ethiopia and Zambia [6, 7]. From Ethiopia, [6] found modest spillover effects for neighbouring smallholders in terms of technology and access to input markets, but largely limited to maize (i.e. not for teff, wheat and sorghum that were also examined) where the technology used by large and small farms is similar, where there is a large yield gap between large and small farms and where large farm density is sufficiently high to allow interaction with small-scale farmers. Based on data from Zambia, [7] found a negative correlation between smallholder access to chemical fertilizer and proximity to newly established large-scale farms. Rather than attributing the decline in fertilizer access to the newly established large-scale farms, the authors pointed to the effects of the key role of subsidy policies which during the past decades have facilitated smallholders' fertilizer access and use as overriding the potential spillovers from large-scale farms. Thus, in addition to identifying patterns of correlation between proximity to large-scale farms and indicators of spillovers from such investments to neighbouring small-scale farmers, this illustrates the importance of a deeper analysis of the transmission channels at work [7] as well as of enabling the establishment of the magnitude of such spillover effects in order to compare their impacts to those of other investments to better integrate smallholders into value chains [6].

Land, water and general environmental management are the key aspects that determine the welfare of majority of populations, especially in developing countries, where farming is a main source of livelihoods. Foreign agricultural investments (FAI) can potentially impact on these resources positively or negatively. The impacts can also be intentional or inadvertent by virtue of proximity and close interaction with host communities. Proper management of these shared resources can lead to sustainable agricultural productivity and enable improved economic conditions for all. In sustainable cultivation practices, farmers must conserve the integrity of the soil while at the same time preserving water. Water is the most limiting factor for agricultural production and is one of the most important inputs, both for farming, consumption, livelihoods and nutrition [8]. That is why, for low-income farmers who depend on rainfall for agricultural production, rainfall patterns determine welfare and food security.

Soil and water conservation methods are usually grouped under sustainable land management practices and include farming methods that: (i) preserve the integrity of the soils and reduce water loss from the soils, (ii) minimize degradation of soil resources, and (iii) conserve the integrity of water resources, mostly downstream of the agricultural lands being utilized, to reduce pollution and contamination. Soil and water conservation methods focus on soil moisture retention and prevention of water runoff, as well as harvesting of the water that results from these practices. Water management also includes irrigation practices, an option that is not normally practical for resource constrained farmers. The UNCCD [9] study gives a detailed description of land management practices, including soil and water conservation technologies, while WOCAT [10] documents 28 technologies and methods used to conserve soil and water from over 20 countries globally.

Soil and water conservation technologies are advanced as one of the means that can make a significant contribution to sustainable development, and literature notes some significantly positive effects of its adoption on rehabilitation of degraded lands in some countries [11]. There are arguments that large-scale adoption (high adoption rate) of land management technologies including soil and water conservation technologies can go a long way in facilitating faster achievement of Sustainable Development Goals, especially those on hunger and environmental sustainability [9].

Adoption of soil and water conservation technologies in Uganda is context specific and farmers take up different soil and water conservation technologies depending on terrain/land conditions, perception of effectiveness and perceived need, resource availability, access to information about the conservation technologies as well as other socio-economic characteristics of the farmers, among others. In addition, influence by neighbouring farms has often been pointed out as an important influencing factor in adoption of soil and water conservation methods [12, 13]. In other words, agricultural practices on farms tend to have spill over effects through influencing adoption of the same practices on neighbouring establishments. Clearly as noted from the above discussion, firm empirical evidence on the merits and demerits of FAI in developing countries is still lacking hence the need for additional investigation. There are diverse soil and water conservation methods investigated in the present research. They include, mulching, no till/conservation farming, use of green manure crops, no burning, use of cow dung, use of grass strips, use of soil barriers, establishing terraces, and the use of chemical fertilizers. Adoption is subsequently defined as application of any one or more of these methods over the 5 year period preceding the analysis. The intensity of adoption is not examined in this study.

## Objective

The general objective of this research is to understand the spillovers on soil and water conservation farming methods from foreign agricultural investments (FAI) to smallholder farmers in their proximity. The study has the following 3 specific objectives:

(i) To examine the socioeconomic interrelationship between adopters and non-adopters of soil and water conservation practices
(ii) To empirically discern the existence of an association between adopters of soil and water conservation farming methods and foreign agricultural investments.
(iii) To examine other factors confounding the relationship between proximity to FAI and smallholder adoption of soil and water conservation practices.

## Materials and methods

### Conceptual framework

Foreign agricultural investments or farms may benefit neighbouring smallholder farmers through access to improved techniques, factor and output markets, and technology. If transport or other transaction costs are high, smallholders may be rationed out of input and output markets [14] as quantities involved may be too small to defray these costs even without credit constraints. To the extent that they use these inputs, foreign agricultural investments can provide them to neighbouring smallholders, potentially on implicit credit. Foreign agricultural investments tend to employ casual workers on an irregular basis, allowing them to pick up simple techniques such as crop rotation and many others and try them out on their farms. According to Zaehringer et al. [15], foreign agricultural investments can influence small-scale farmers' land management practices directly, for example via technology transfer or by improving access to agricultural inputs. The changes occurring on small-scale farmers' land also have impacts on ecosystem services. We thus observe that a conducive agricultural and rural development policy is necessary for FAIs to have an impact on smallholder farmers of host countries. In addition to making it possible for these FAIs, a conducive rural development policy also allows smallholder farmers easy access to capital, inputs, markets, extension services and improved land tenure security. The entry of foreign agricultural investments tends to complement these and other services for the benefit of smallholders. With a conducive policy environment, we envisage that proximity to FAIs would then expose smallholder farmers to soil and water conservation technologies among other agricultural technologies. The policy benefits noted above coupled with exposure and availability of both input and product markets would then enhance adoption of soil and water conservation technologies with the resultant benefits of improved agricultural productivity, food security and enhancement of ecosystem services.

### Analytical model

When introduced to new technologies such as soil and water conservation farming methods farmers either decide to adopt or decline, given differing resource endowments, education level, information, aims and objectives including their utility preferences. Hence positive decisions take a positive value whereas negative decisions take a zero value. Qualitative response models such as Probit, Logit and Linear Probability Models are the gold standard when analysing such a dichotomous dependent variable [16, 17]. In the present analysis we use the **Logit model** to understand the association between proximity to a FAI and adoption of soil and water conservation farming methods. The Logit model transforms the population regression model $\left(y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + \varepsilon_i\right)$ by plugging it into the logistic function as presented in equation one.

$$f\left(y\right) = \frac{e^y}{e^y + 1} = \frac{1}{1 + e^{-y}} \quad (1)$$

where $y$ is defined as the population regression model resulting in equation two and $\varepsilon_i$ the random error term.

$$f(w) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + \varepsilon_i)}} \quad (2)$$

The Logit regression function in equation two improves on Ordinary Least Squares (OLS) because even though $y$ can take on any values from $-\infty$ to $\infty$, $f\left(y\right)$ is constrained to fall between 0 and 1. The logit formulation hence solves the problem associated with OLS predicting values below 0 and above 1 for dependent variables that never actually take on such values.

### Empirical model

Hence, the empirical Logit model to be estimated based on equation two is presented in equation three.

$$y_i = \beta_0 + \beta_1 d_i + \sum\nolimits_{k=2}^{9} x_{k,i}\beta_k + \varepsilon_i, y_i = 1\left(y_i > 0\right).\mathrm{i} = 1, \ldots, \mathrm{n} \quad (3)$$

$\mathrm{y_i}$ (the dependent variable) = 1 if a household used at least one soil and water conservation method, 0 otherwise.$d_i$ = distance from farmer's residence to a foreign agricultural investment (FAI) (km).$x_{2,i}$ = Age of farmer (years).$x_{3,i}$ = Gender of farmer (dummy) (Male = 1 and 0 = female).$x_{4,i}$ = Family labor (Household members 18 years and above).$x_{5,i}$ = Formal schooling of farmer (number of years).$x_{6,i}$ = Total size of land holding (acres).$x_{7,i}$ = Tenure documentation of primary plot of land (dummy) (documented = 1 and 0 = undocumented).$x_{8,i}$ = Farmer or household owns a radio (dummy) (1 = Yes and 0 = No).$x_{9,i}$ = Farmer or household owns a mobile phone (dummy) (1 = Yes and 0 = No).

### Data and sources

We used data from 1181 respondents and on 1706 plots of land obtained from three independent random samples of respondents drawn from research locations in Northern, Central and Western Uganda. Based on literature review, we undertook an extensive mapping of Danish Agricultural Investments in Uganda. The selection criteria included investments that (i) involve Danish Capital, (ii) entailed acquisition of land rights and (iii) engaged in primary production. We then selected three Danish agricultural investments in Uganda ensuring that the investments were mutually different with respect to agro-ecological conditions, agrarian structure, crop type, type of management and nature of financing. These three Danish investments guided the geographical location of the study.

We selected a small-scale coffee production investment in Kyeshero, Kanungu district Southwestern Uganda, a large-scale cereals production investment in Nwoya Northern Uganda, and a medium-scale farm run in partnership between Ugandan and Danish investors with maize as the primary crop in Nakasongola, Central Uganda. We then delimited/identified six research locations based on an area spanning a radius of 25 km with the investment as the centre.[1] This meant that we inevitably cut across a number of sub-counties and parishes. We proceeded to align the research locations with existing administrative boundaries by including all administrative units whose boundaries were fully or partly contained in the 25 km radius circle. In Kyeshero, Uganda, we used the sub-county (instead of parish) administrative boundaries because of the small geographical size of the parishes at this location. Furthermore, wards/parishes which had less than 10 percent of their area within the 25 km research location were excluded from the research area. Inclusion/exclusion of parishes in urban areas (falling within the 25 km radius) was based on information from key informant interviews on their levels of interaction with the agricultural investments of interest.

A multistage random sampling procedure was then followed to select a sample of 400 respondents per research location. In the first stage, we drew a random sample of 20 communities from each research location. We used probability proportionate to the total population of the research location to arrive at the number

[1] With the exception of Nwoya in Northern Uganda where a radius of 50 km was adopted (see Munk et al., 2020 [18]).

**Table 1** Characteristics of adopters and non-Adopters of Soil and Water Conservation (SWC) farming methods in Uganda

| Use of Soil and Water conservation farming methods (19% yes) | Mean | | *T*-test |
|---|---|---|---|
| | Non Adopters ($n = 871$) | Adopters ($n = 209$) | |
| Distance from farmer to FAI (km) | 15.052 | 11.608 | 4.751*** |
| Age of farmer (years) | 39.682 | 38.416 | 1.018 |
| Family labour (number of family members) | 4.887 | 5.192 | -1.368 |
| Total size of land holding (acres) | 12.175 | 7.749 | 1.130 |
| | Percent | | $Chi^2$ |
| Gender of farmer (dummy) (% male) | 50.8 | 49.28 | 0.156 |
| Education (respondent completed secondary school or higher) | 18.34 | 32.02 | 16.567*** |
| Documentation status of most important land parcel (dummy) | 12.96 | 16.27 | 1.571 |
| Farmer/household owns a radio | 56.65 | 76.56 | 27.948*** |
| Farmer/ household owns a mobile phone | 62.96 | 87.08 | 44.808*** |

***$P < 0.01$, **$p < 0.05$, *$p < 0.1$

of communities to be selected from each parish. The desired/computed number of communities were then randomly selected from the sampling frame of communities for each parish. In the second stage, we computed the number of individuals/ respondents to be selected from each of the randomly selected communities using probability proportional to size (PPS). In other words, we used the relative share which the population of the community constitute of the total population of all the selected communities from that parish. In the third stage, we randomly selected the actual individuals/respondents to be interviewed. In order to draw a random sample of individuals 18 years and above, a comprehensive list of all individuals aged 18 years and above (sampling frame) living in the selected communities was generated with the help of local community leaders. Each entry in the sampling frame was numbered and using the random number generator in Excel the desired number (as determined in stage 2) of respondents plus a small allowance for possible replacements was selected.

The research tools were pre-tested for completeness and appropriateness in one of the local communities and revised following the pretest. In Uganda, field interviews were conducted by a team of trained enumerators with a total of 1181 respondents and on 1706 plots of land. In Nakasongola field work was conducted from 30th March to 13th April 2019. In Nwoya field work was conducted from 01st April to 18th April 2019 whereas the period for Kanungu (Kyeshero)was from March 27-April to 10th 2019. The names of selected individuals were pseudonymised using a 6 digit code to ensure anonymity and confidentiality. Further details on sampling strategy are available from [18] available at www.diis.dk.

### Data analysis

The quantitative data from the household questionnaire were analysed using STATA Econometrics program to generate descriptive statistics and estimate the logit regression model. The test for the null hypothesis ($H_o : \beta = 0$) on whether there are significant positive spillovers from large scale agricultural investment on usage of soil and water conservation farming technologies to smallholder farmers in its proximity focuses on the **coefficient (marginal effects)** on the variable **distance (km) of farm from FAI**. Rejecting the null hypothesis (that is, if the coefficient on distance is statistically distinguishable from zero), in favour of the alternative hypothesis ($H_A : \beta \neq 0$), implies that the FAI is significantly influencing the usage of soil and water conservation farming practices by smallholder farmers in its proximity.

## Results

### Descriptive results

The descriptive statistics of the variables used in modelling spillovers of soil and water conservation farming practices are presented in Table 1. For continuous variables we used the t-test statistic to assess if users of soil and water conservation methods were significantly different from non-users. The $Chi^2$ test was applied on the categorical variables. The results show that distance from the FAI, level of education, access to a radio and access to mobile phone (communication) facilities are significantly different between adopters and non-adopters of soil and water conservation farming practices. However, both adopters and non-adopters of soil and water conservation (SWC) practices are nearly homogeneous across the other socioeconomic variables considered.

**Table 2** Marginal effects of Logistic regression of factors associated with adoption of soil and water conservation technologies among smallholder farmers in the vicinity of FAI in Uganda

| Dependent variable: Farmer carried out soil and water conservation technologies on the main parcel in the previous 5 years | Logistic regression results marginal effects *(dy/dx)* | P-value |
|---|---|---|
| Distance of household from FAI (km) | – 0.004 | 0.007*** |
| Age of farmer (years) | – 0.001 | 0.335 |
| Gender of farmer (1 = female, 0 = otherwise) | – 0.038 | 0.120 |
| Family labour (number of family members) | – 0.001 | 0.883 |
| Formal schooling of farmer (years) | 0.069 | 0.009*** |
| Total size of land holding (acres) | – 0.003 | 0.758 |
| Tenure documentation (1 = formal title, 0 = otherwise) | 0.014 | 0.699 |
| Farmer/household owns a radio | 0.096 | 0.000*** |
| Farmer/ household owns a mobile phone | 0.169 | 0.000*** |
| Number of Observations | 903 | |
| Wald chi2 (9) | 60.29 | |
| Prob > chi2 | 0.000 | |
| Log pseudo likelihood | – 133.195 | |

***$p<0.01$, **$p<0.05$, *$p<0.1$; Dependent variable is whether farmer implemented soil and water conservation technologies on the main parcel in the previous 5 years

### Regression results

Because the estimated slope coefficients indicating the log-odds ratio lack a simple intuitive economic meaning [17], they were converted into estimated marginal effects (dy/dx) that are presented in Table 2 and discussed in what follows.

From Table 2, the results reveal that holding all other variables constant, farmers in close proximity with the FAI are significantly ($P<0.01$) more likely than those further away from the FAI to use soil and water conservation practices with a probability of 0.4 percent. This result is complemented by formal schooling and radio and phone ownership that enhance access to information. All other variables held constant, farmers with more education (in terms of years of schooling) are significantly ($P<0.01$) more likely than those with lesser education to use soil and water conservation practices with a probability of 6.9 percent. Likewise, holding all other variables constant, farmers who own a radio and a mobile phone are significantly more likely than those that do not to use water and soil conservation farming methods. The probability is much higher at 16.9 percent for a mobile phone than it is for owning a radio at 9.6 percent. All other hypothesised factors including age of farmer, gender of farmer, family labor, size of land holding, and land tenure documentation had the hypothesised sign expectations but were not significant.

## Discussion

The pooled descriptive results suggest that adopters of soil and water conservation methods are significantly closer to foreign agricultural investments than the non-adopters with possible site specific variations. These results also suggest that users have a lower proportion of educated farmers compared to no-users of soil and water conservation practices. This may be attributed to the higher probability of less educated farmers in the proximity of FAI to seek casual employment with those farms compared to their more educated counterparts. More adopters of soil and water conservation practices owned a radio and or a mobile phone compared to non-adopters highlighting the importance of access to ICT (radio and mobile phone) as complementary assets to aid agricultural technology adoption.

As earlier stated, the test for whether there are significant positive spillovers from foreign agricultural investments on usage of soil and water conservation farming methods to smallholder farmers in its proximity focuses on the **coefficient** on the variable **distance (km) of farm from FAI** as a measure of proximity to the source of soil and water conservation innovations. The regression results in Table two suggest that the coefficient (and by implication the marginal effects) on the distance variable is statistically and significantly distinguishable from zero meaning that we reject the null hypothesis in favour of the alternative. This means that the results suggest that foreign agricultural investments have positive and significant spillovers on the usage of soil and water conservation farming methods by smallholder farmers in their proximity. The closer the farmer is to a FAI the higher the chances of exposure resulting in the shortening of the learning curve. This finding is consistent with [19] who found that increased proximity to commercial farms had positive spillovers on fertilizer use, crop yields and to a lesser extent on improved maize seed in Ethiopia. The same study established that spillover effects were almost exclusively limited to the 0–25 km range. A study in Mozambique [5] also observed that the spillover effects were more pronounced within the 25 km radius. We find the mean radius for users in this study to be 17 kms which is consistent with the two studies just cited above. We note that not many studies have investigated spillovers pertaining to soil and water conservation farming practices from foreign agricultural investments in smallholder dominated farm settings.

The other three significant confounding factors, namely education level of the farmer, ownership of radio and mobile phone have to do with the household head's capacity to learn new methods and **access to information** which we find to be increasingly important in the diffusion of agricultural technology even among the remotest parts of the globe. On the importance of education, the results of this study are consistent with Diro et al. [20] who fund a positive and significant relationship between the education of the household head and adoption of minimum tillage. The strong formal schooling findings in this study are also consistent with Ketema and Bauer [21], Prakash et al. [22] and Grabowiski et al. [23] who found a positive and significant relationship between the education of the household head and the adoption of minimum tillage. On access to information, the findings of this research are consistent with [20] who posits that radio ownership by the household head affects the adoption of minimum tillage positively and significantly as information from the radio enhances the adoption of improved technologies. Furthermore, the results corroborate with [24] who while focusing on tissue culture banana technology among a sample of Kenyan farmers, separately examined awareness exposure (having heard of the technology) and knowledge exposure (understanding the attributes of the technology). Their results show that the parameters differ considerably compared to those from a classical adoption model when accounting for heterogeneous knowledge exposure. These authors underscore the importance of their results for other technologies that are knowledge-intensive and require considerable adjustment in traditional practices. This is indeed the case with soil and water conservation farming methods that can be said to be knowledge intensive as a farmer would need a thorough understanding and appreciation of the benefits before undertaking the necessary adjustment in the deployment of scarce productive resources, most especially land and labour, required for utilisation of these technologies. The education level of the farmer leverages information transmitted through radio and mobile phone to complement exposure to foreign agricultural investments as the source of knowledge and awareness of soil and water conservation farming methods.

Our results also contribute to a better understanding of the importance of neighbours (versus traditional agricultural extension services) in the process of technology adoption among smallholder rural based farmers. This study brings to the fore the importance of information communication technology (ICT) as an important complementary element of technology adoption in agriculture. Basing on the magnitude of the marginal effects, our results suggest ICT as a stronger complementary force compared to the other variables. The results of this study are also consistent with the findings of [13] who found evidence of social learning (from neighbours) as a more powerful and more persistent force for adopting new agricultural technologies than learning from extension services alone. While the results of the present study are consistent with [20, 21] and [22] who found that the age of the household head affects the adoption of minimum tillage negatively, they are contrary to [23] who found a positive and significant relationship between age of the household head and the use of manure on farmlands as use of green manure and farm yard manure were some of the Soil and Water conservation technologies investigated in this study. The results are also contrary to Ketema and Bauer [25] and Tao et al.[26] who found a positive relationship between family size and manure application. This study actually found a negative (not significant) relationship between adoption of soil and water conservation technologies and number of family members.

## Conclusion

This research contributes to the literature on the hotly debated topic of the nature and magnitude of (positive or negative) spillovers from foreign agricultural investments to neighbouring host communities in sub-Saharan Africa. We use regression approaches and cross sectional data to assess whether proximity to foreign agricultural investments leads to positive spillovers on soil and water conservation farming methods. Soil and water conservation farming methods are gaining importance, especially in sub-Saharan Africa as mitigation measures against the devastating effects of climate change through changes in rainfall intensity and patterns.

The results of the present analysis confirm that, in general, proximity to foreign agricultural investments is associated with positive but rather marginal spillovers on soil and water conservation farming methods among farmers in host communities. The results also underscore the importance of confounding factors as complementary elements in the utilisation of soil and water conservation farming methods. It turns out that social learning and access to information communication technology combined form a very powerful catalyst for change among smallholder farmers in Uganda.

We advocate for policies that increase smallholder farmers' exposure to foreign agricultural investments while at the same time promoting ICT or digital penetration with cheaper bandwidth and affordable data bundles. To succeed as catalysts for agricultural transformation in sub Saharan Africa, foreign agricultural investments need to resist the temptation to isolate themselves from host communities and become more accessible while observing the necessary biosecurity measures. Regular guided farm visits by neighbouring host communities coupled with programs that encourage on site learning are some of the possible options that could be explored to increase exposure and interaction between these new investments and local host communities.

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**Author contributions**
BB and DT had a significant role in the conceptualisation, design and implementation of the study and data cleaning and processing. BMB and TN guided and supervised quantitative data collection and preliminary cleaning. BB, BMB and AT conceptualized the present analysis, analysed the data and drafted the paper. BB had primary responsibility for the final content. All authors have read and approve the final manuscript.

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**Availability of data and materials**
The authors hereby declare that they can submit the data at any time based on the publisher's request. The data set used and/or analysed during the current study will be available from the authors on request.

## Declarations

**Ethics approval and consent to participate**
Ethical clearance and approval was given by the Makerere University College of Agricultural and Environmental Sciences for both the study participants and the research team. During fieldwork, official letters of introduction were sent to each of the participating districts seeking for permission and clearance to undertake the research. Informed verbal consent was obtained from each of the foreign farm owners/managers and all household respondents. Confidentially was further enhanced by assigning codes for each respondent instead of recording their names. Respondents were fully informed of the study objectives and their rights to discontinue the interview at any point during the process.

**Consent for publication**
Not applicable.

**Competing interests**
The authors hereby declare that they have no competing interests.

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