Food Security

Nudging the adoption of improved crop varieties: Evidence from a large randomized controlled trial in Uganda

--Manuscript Draft--

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Abstract:	To achieve agricultural transformation in developing countries in the face of challenges such as climate change, the use of improved crop varieties needs a jumpstart. Using a randomized controlled trial in Uganda, we test how nudge theory can be harnessed to deliver increased adoption of improved crop varieties. We find a 7% treatment effect, though the effect is not robust to alternative specifications. We find compelling evidence for heterogeneous treatment effects, with robust treatment effects among those who experienced a stronger emotional connection to the nudges that we deployed. A key concept to help explain this is nostalgia: farmers prone to nostalgia responded more strongly to the traditional farming imagery used to nudge the adoption of improved varieties.

Response to Reviewers:	Reviewer 1: General comments This study implements a field experiment, working with model/progressive farmers to set up sales points for improved sweetpotato varieties in 120 villages in Uganda. In a random sub-sample of the 120 villages (the treatment group), a poster was displayed at high traffic areas/points to explain/show the losses that result from planting poor quality sweetpotato vines and emphasizing the benefits of growing good quality vines including presenting traditionally popular food made from sweetpotato among the study community. In addition, only farmers who bought improved sweetpotato vines in the first season received a reminder message at the beginning of the second season. In the control villages, the study worked with model farmers to set up selling points, but no poster was displayed. The topic is relevant. Finding ways to nudge the adoption of improved agricultural innovations is important. I have some specific comments. Specific comments: 1) Although a minimum distance of 5km was imposed, placing the sales points at high traffic areas means that people traveling to other villages or even main roads would typically pass through the sales points and learn about the intervention. The 5km minimum distance approach, therefore, may not work to minimize contamination. Response: We thank the reviewer for this comment and apologize that we didn't give sufficient details in the manuscript about how exactly this was done. The phrase "high traffic area" applies for village residents and not for outsiders. It means a place easily accessible by the co-villagers of the host farmer (salesperson). Indeed, we took all possible measures to ensure that the salespoint is not located in a place frequently visited by or used by people outside the village such as places of worship (e.g., church, mosque), school, health facility, market or shopping center as explained in pg 15 line 342-346 of the marked manuscript. In all the cases, the salespoint was usually placed in the host farmer's homestead, and away from a main road connecting multiple villages, for two reasons: i) to prevent vines being stolen (i.e., security), ii) to ensure that there was always someone attending to the vines or available to meet a customer. Accessibility was in all cases ensured by selecting a person that is well known, respected and easy to reach when needed. In order to avoid future confusion, we have revised line 856-859 in pg 44 of the tracked/marked manuscript to read: "Both groups of villages however received quality seeds of improved sweetpotato varieties that were provided at salespoints manned by a host farmer (salesperson) and located in an area within each study village that is easy to access by the co-villagers." Comment: I suggest that the authors conduct a formal test to assess the potential for spillover effects. This should be feasible especially if the authors have the GPS data. Response: As recommended by the Reviewer we have conducted the test for potential spillover effects and presented the results in a new appendix referred to in Section 3.2 when discussing how we attempted to minimize the chances of contamination. In particular, we calculated the distance between each control village and its nearest treatment village. In a next step, we kept only control villages, regressed the purchase dummy on the distance calculated in the first step, with controls and fixed effects added. The results show that there is no negative effect of the distance variable. This indicates that for control villages, being closer to the treatment village does not increase the likelihood of purchasing the improved vines, indicating no spillover effects. 2) The main intervention, i.e., the poster has the losses part lumping all the problems including the diseases, pests, and poor yields in one picture but occupies only a small part of the poster. The nostalgia pictures are also a very minor part of the poster. On the other hand, the benefits part occupies the largest part of the poster. It is therefore possible that the two nudges (nostalgia and loss aversion) were not emphasized by the poster. Response: We thank the reviewer for this very discerning comment. It is indeed the case that the benefits section of the poster was more amplified. This was by design, and was intended to trigger action/a response. Our idea was to emphasize that using quality vines will reverse the sharp decline in yield (exemplified by thin roots) farmers expressed during the study design stage, and the bumper harvest would result in surplus (after domestic use and sale) that is converted into amukeke (the dried chips) for off-season use. Regarding "lumping" diseases, pests and yield loss together, which is again correctly noted by the Reviewer, this had to be the case because poor-quality

vines will typically harbor diseases (virus, bacterial and/or fungal) and pests (weevil or whitefly, typically as eggs or larvae) that then depress yield (making roots thin or fewer – for the case of diseases) and damaged (for the case of pests). Indeed, at the time of designing our study, farmers were dealing with an outbreak of white fly pest in the district and therefore could relate to what the poster portrayed. These losses combined were in our design intended to activate feelings of loss aversion. The big harvest was when combined with peeling/chipping into amukeke, according to our design, intended to induce feelings of nostalgia.

Comment: More importantly, presenting loss aversion together with benefits and nostalgia on the same poster makes it impossible to disentangle the effects of the different nudges. While there is not much that could be done at this stage about the design, discussing these issues is important.
Response: The reviewer is right that our study does not permit us to disentangle the effects. Lack of funds prevented us from adopting a design that would enable us to estimate individual effects of nostalgia and loss aversion because such a design would have required a much larger sample to detect effects. We therefore opted for a bundled intervention as indicated in line 139-141, pg 7 and line 230, pg 10 of the marked manuscript.

3) Comment: The motivation for sending a reminder message to only those who had bought vines in season 1 should be explained. If the intention was to nudge purchase behavior, why was the reminder message not sent to all farmers in the treatment group? In addition, as this was an important part of the design, it would help to see the results of heterogeneous effects comparing farmers that received the reminder to those that did not.
Response: The reminders were sent only to previous purchasers and were intended to inform them that the quality vines they had purchased were again available at the salespoints in their villages. They were sent out to REMIND previous purchasers only of the same good quality vines and test sustainability/longevity of the nudges measured in terms of repurchase of seed in subsequent seasons. The analysis of the effects of reminders is beyond the scope of the current paper and is reported in a separate paper by Okello et al (2025). We have added this information in pg 16 para 1 line 349-352 of the marked revision.
4) Comment: It is great that meetings with the model farmers were organized separately in the treatment and control group. What information was provided to the salespersons/model farmers during the training?
Response: Information provided was i) about quality seed to be brought; ii) that the seed was certified (disease/pest-free); iii) that seed will be of 4 varieties (2 local and 2 new introductions, but all of high quality); iv) that seed was to be sold at pre-determined price and specified bundle sizes; v) there will be 2 rounds of distribution per season, separated by 1 week break to allow first round to sell out; vi) all sales transactions should be captured in a form provided by the research team.
IN ADDITION, the model farmers from treatment villages were informed that they would have a poster that is to be hung on the sales point, and that the poster had information about different types (quality and local/recycled) of seed.
We have added an endnote in the paper providing this information to interested readers.

Comment: How was the purpose of the study explained to them?
Response: Both groups (treatment and control) of model farmers were informed that the project intended to address the issue of access to quality seed from certified sources by bringing quality seed to their villages. And that they were selected by their agricultural extension workers to serve as hosts of salespoints where such seed would be displayed for sale. No information that would link such seed to what is displayed in the poster/treatment (i.e., depressed/increased yield, low/big harvest, income effect, amukeke, etc) was provided to both groups of farmers. We have added this information on page 16, lines 360-368.
Comment: Were they informed about the nudges?
Response: NO. No model farmer or even the local extension officers were informed about the nudges. We have added this information on page 16, lines 366-368.

Comment: The study worked with existing model farmers who usually are famous and would work in several villages. Is it possible that the model farmers are a source of

contamination?
Response: This is a very good comment. However, we believe that this is not the case – namely that model farmers in treatment villages may have shared information about the treatment with farmers in other villages. This is because treatment information (i.e., the nudges) was not disclosed to them.
5) Comment: The intervention includes convenience, model farmer, and the poster (which has aspects of loss aversion, benefits, and nostalgia). In the same way that nostalgia and loss aversion are analyzed as heterogeneous effects, the analysis of the convenience effects should be presented as part of the heterogeneous effects.
Response: We understand where the reviewer is coming from but should clarify the point of the heterogeneity analysis. Nostalgia and loss aversion are activated through the poster, and proneness (in general) to these two psychological tendencies is measured in the survey, which permits the analysis of the effect of the poster among those who display, respectively, above and below median proneness to the tendencies that the poster intends to appeal to. So for instance, if the poster was successful in appealing to loss aversion, then those with higher than average proneness to loss aversion would have a stronger response to the poster. Ditto for nostalgia. For convenience there is no such rationale, and indeed we don't have a hypothesis for how ease of access interacts with the poster. We would therefore prefer not to conduct analysis that may come across as arbitrary.
6) Comment: I suggest focusing throughout on the results of the analysis that clusters standard errors at the village level. The null results are still relevant and insightful. The interpretation of the results in Table 2 is not correct. For example, the treatment did not cause 6.5% increase in the likelihood of buying quality seed. The correct interpretation is that the treatment increased the likelihood of buying quality seed by 6.5 percentage points. The authors should check throughout the manuscript and correct accordingly.
Response: We have updated our discussions to focus on the village level clustered standard errors, and corrected our improper percentage references.
7) Comment: On page 22, the results of the relationship between socioeconomic factors and purchase decision should be interpreted as correlations and not causal.
Response: Thank you for catching this. We have corrected our language to indicate correlations.
8) Comments: On page 25: The authors explain underreporting of sales as a possible explanation for the weak effect of the nudges. Was there a mechanism to monitor the behavior of the model farmers e.g., by asking them to return all unsold vines? Where did the unsold vines go?
Response: Yes, there were two levels of monitoring. First, project/study research assistants went around to monitor salespersons/model farmers and the capturing of sales transactions, and finally to collect money from sales. Second, the extension workers were also paid to make random visits/checks of salespoints to ensure compliance with study stipulations. Unsold vines were, however, not collected because each round of supply of vines to the salespoint was given one week of selling. After such period, sweetpotato vines would be too desiccated/spoilt to sell or use for planting. In fact, most farmers preferred planting vines that are fresh-looking.

Reviewer 3:
Dear Authors,
Comment: I like the core idea you have here, but the writing is a bit confusing, and I think the econometrics and results could be simplified to make a shorter and "punchier" paper. I have given you a series of suggestions geared towards that goal.
Response: Thank you for this suggestion. We have indeed revised the paper to simplify the econometrics by dropping Eq 2 and editing Eq 4 of the original manuscript, and thoroughly edited the text to make it punchy.

Comment 1. In your introduction, your research question should come much sooner, ideally in the second paragraph. You could then, AFTER introducing your question and overviewing your RCT, provide the overview of nudges in ag economics.
Response: We thank the reviewer for this excellent comment. We have now moved the study objectives and hypotheses up to the first page as suggested and turned to reviewing the use of nudges in agriculture after specifying these.

2. Comment: More importantly, your RCT is not clearly explained anywhere in the introduction. In your second paragraph where you explain your research question and your intervention, I would explain the RCT succinctly in phrasing something like this:

We disseminated improved sweet potato varieties in every village we worked in, by setting up lead farmers to sell high-quality cuttings. In control villages that is all we did. In treatment villages we additionally posted signs that used imagery to (1) address the quality of the cuttings (reducing informational constraints), (2) warn about the harvest loss associated with poor quality potato (activating loss aversion), and (3) encourage an “old fashioned” use of the sweet potato (leveraging a sense of nostalgia).

This phrasing makes it clear that the “control” was treated with dissemination too, clearly names your actual treatment intervention is (a sign), and delineates the aspects of the sign that you think are nudges. None of this is very clear in the current introduction.
Response: This is another excellent suggestion that we greatly appreciate. We have incorporated this suggestion in pg 7 line 139-146 of the tracked version.

3. In general, your introduction is too long and meandering. Will pack a much better punch if you cut down on the review.
Response: Thank you for pointing this out. We have confined the review largely to scholarly endnotes, which we hope has led to an introduction that “packs a punch”.
4. Comment: When you discuss low adoption of improved varieties, please mention the two, I think) World Bank papers that show that African farmers are not knowledgeable about the varieties they grow – this is important because the statistics you are citing are all from farmer-self reports, and thus likely inaccurate. Similarly, in section 2 when you cite Walker and Alwang (2015), please also cite the SPIA-generated statistics on adoption of OFSP and other improved sweet potato in Uganda, gathered through the 2021 UHIS survey and published in their recent country report. These are the most relevant background statics to your paper – actually measured via genotyping rather than relying on self-reports! – so it’s odd that you don’t mention them.

Response: Done for SPIA report of 2025. However, we could not identify the World Bank paper referred to the reviewer even though we agree in principle that farmers in Africa often are unable to identify varieties they grow based on recent DNA fingerprinting work. We cite 2 recent references below about this:
1.Abay, K. A., Wossen, T., & Chamberlin, J. (2023). Mismeasurement and efficiency estimates: Evidence from smallholder survey data in Africa. Journal of Agricultural Economics, 74(2), 413-434.
2.Opata, P. I., Okorie, O. J., Iwuchukwu, J. C., Ume, C. O., & Oyinbo, O. (2021). Adoption of improved cassava varieties in Nigeria: Insights from DNA fingerprinting versus self-reporting varietal identification approaches. Outlook on Agriculture, 50(3), 269-276.

5. Comment: In both section 1 and 2 you talk about the RCT but don’t spell it out clearly so by the end I am confused about what you actually did. I suggest that: (a) you discuss the RCT very clearly and briefly in your 2nd para of the intro as I spelled out above.
Response: This is done, as indicated above

Comment: then (b) you do NOT go into the RTC at all in section 2, but merely provide this background on the relevance of quality cuttings, nostalgia, and loss aversion in the context of sweet potato. 1 paragraph each. Right now, in section 2, you do NOT address the importance of quality of cuttings (which is 1 aspect of the signs, right? Addressing informational constraint?) but you DO discuss geographic access -- which is NOT part of the signs, and not part of “treatment” since geographic access to cuttings is addressed identically to both control and treatment villages. So, this ends up further confusing what your RCT is actually studying. Note that if I’m right, most economists would consider the second two nudges, but addressing informational constraints is not generally considered a “nudge.” It’s fine if you use this “nudge” language a bit sloppily, though, in my opinion, since this is not an economics journal.
Response: We apologize, this was indeed confusing. We have now clarified throughout Sections 1, 2 and 3 that we study (1) a composite information nudge that activates feelings of loss aversion and nostalgia, using a poster administered to a treatment group only; and (2) a convenience nudge that brings quality vine cuttings to all farmers in our sample through sales points manned by model farmers. Clarifying this has led to a very substantial rewrite of these three sections.

6. Comment: I suggest that you skip equation 2 and move straight to equation 3, and modify equation 4 to include THREE groups rather than 4. My reasoning here is a few things. a. Firstly, Equations 2 and 3 do the same thing with different specifications, which is unnecessary. Equation 3 is the better specification: more sparse, more flexible, more intuitively shows the inverse U shape. So, no point in Equation 2.

Response: We agree. We have omitted the previous equation 2. The new equation 3 (previous 4) includes only 3 dummy indicators of quantiles.

Comment b. Because you see an inverse U shape, it makes sense to divide your farmers into 3 groups: close (low purchasing), medium (high purchasing), and far (low purchasing), based on the location within the inverse U. Probably you could divide based on terciles of distance.
Response: We now include three groups as you suggest. When we divide into thirds based on quantiles, and treat the first group as the reference group, the differences are significant, but they are all increasing in distance. The declining value is only observed for those who are farther away than the cutoff for the upper third. See pg 34 para 2 for the results.
Comment c. Moreover, you HAVE to provide the coefficient in distance squared to an accuracy where we see at least 1 non-zero digit. Right now you show a highly significant zero, and if it was truly zero, this would not be an inverse U, it would be a straight line. The shape of the inverse U will seriously change if this is, say, 0.0002 vs. 0.0008. So please provide the number.

Response: We agree this is important and have now included the coefficient in the table.

Comment 7. Then in the results section you can probably combine the results (1 column each) for those 2 equations into 1 table. This will cut down on the number of tables and the complexity of discussion, and help you keep your results section more succinct.

Response: We have followed your suggestion, and all results now appear in Table 3.

Comment 8. You do not discuss the importance of absolute risk aversion in the set up, nor do you provide an equation for estimating its impact in the empirical strategy section. So Table 5 sort of comes out of left field; I have no idea why it is being run or what the results tell me that is conceptually useful. You don't see any impact of absolute risk aversion, and it is NOT correct (as stated atop of page 31) that treatment ecect significantly or "crucially" changes when you control for ARA for low distance farmers… while 0.084 is not stat signif in col 2, and 0.126 is stat signif, the two coefficients are not statistically significantly different from one another. (This is my best guess based on the t-statistics; it would be easier for me to see if you had standard errors rather than t-statistics, but I'm pretty sure this is correct). So I don't see any value of the ARA specification of Table 5. I suggest cutting the whole thing.
Response: This is a fair assessment, and we have eliminated Table 5, and the corresponding discussion. We were relying on prior literature relating adoption to risk aversion, and the close connection with loss aversion in behavior. In the end, however, this table did not advance our knowledge of how the treatment was received.

Comment 9. Column 1 and 2 of Table 6 are interesting, but I don't see where the other 3 mediating factors (connection to ancestors, fondness for agricultural, and fondness for crops) are motivated. Why are you splitting by these factors? How do they relate to your hypotheses? I would have expected you to instead split by 3 factors that relate to your "nudges" – for instance, by access to information about quality potato cuttings at baseline (since the poster is meant to address informational constraints), about their propensity for nostalgia as you do (since poster designed to activate nostalgia) and by their loss aversion or absolute risk aversion as you do in Table 7 (since the poster was meant to active lost aversion). I suggest replacing Tables 6 and 67 with 1 Table that does this – basically, keeping cols 1-2 of Table 6, adding 2 columns on baseline informational access if you have that in your dataset, ditching Cols 3-8 of Table 6 completely as they seem irrelevant, and then adding EITHER the loss aversion or the ARA results from Table 7 (not both, you don't need 2 identical, non-significant results that say the same thing), so that you have only 1 table for heterogeneous treatment

	effects with 6 columns total, 2 columns per nudge. Response: We have largely followed the Reviewer's suggestion and consolidated the table (current Table 4) and the discussions. This has significantly shortened and simplified the discussion. We have deviated in one respect: our priors regarding the composite information nudge administered through the poster only relate to above and below average proneness to loss aversion and nostalgia, so we have limited the consolidated table to these two things.

Nudging the adoption of improved crop varieties: Evidence from a large randomized controlled trial in Uganda

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[c]The Norwich Institute for Sustainable Development, University of East Anglia, Norwich, England

[d]International Potato Center, Nairobi, Kenya

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[f]International Potato Center, Lima, Peru

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Abstract

To achieve agricultural transformation in developing countries in the face of challenges such as climate change, the use of improved crop varieties needs a jumpstart. Using a randomized controlled trial in Uganda, we test how nudge theory can be harnessed to deliver increased adoption of improved crop varieties. We find a 7% treatment effect, though the effect is not robust to alternative specifications. We find compelling evidence for heterogeneous treatment effects, with robust treatment effects among those who experienced a stronger emotional connection to the nudges that we deployed. A key concept to help explain this is nostalgia: farmers prone to nostalgia responded more strongly to the traditional farming imagery used to nudge the adoption of improved varieties.

Keywords: agricultural technology adoption; sweetpotato; improved varieties; nudges; nostalgia

JEL codes: D91, O13, O33, Q16

Responses to Reviewers' comments on manuscript FOSE-D-24-00908: "Nudging the adoption of improved crop varieties: Evidence from a large randomized controlled trial in Uganda "

Reviewer 1:

General comments

This study implements a field experiment, working with model/progressive farmers to set up sales points for improved sweetpotato varieties in 120 villages in Uganda. In a random sub-sample of the 120 villages (the treatment group), a poster was displayed at high traffic areas/points to explain/show the losses that result from planting poor quality sweetpotato vines and emphasizing the benefits of growing good quality vines including presenting traditionally popular food made from sweetpotato among the study community. In addition, only farmers who bought improved sweetpotato vines in the first season received a reminder message at the beginning of the second season. In the control villages, the study worked with model farmers to set up selling points, but no poster was displayed.

The topic is relevant. Finding ways to nudge the adoption of improved agricultural innovations is important. I have some specific comments.

Specific comments:

1) Although a minimum distance of 5km was imposed, placing the sales points at high traffic areas means that people traveling to other villages or even main roads would typically pass through the sales points and learn about the intervention. The 5km minimum distance approach, therefore, may not work to minimize contamination.

***Response**: We thank the reviewer for this comment and apologize that we didn't give sufficient details in the manuscript about how exactly this was done. The phrase "high traffic area" applies for village residents and not for outsiders. It means a place easily accessible by the co-villagers of the host farmer (salesperson). Indeed, we took all possible measures to ensure that the salespoint is not located in a place frequently visited by or used by people outside the village such as places of worship (e.g., church, mosque), school, health facility, market or shopping center as explained in pg 15 line 342-346 of the marked manuscript. In all the cases, the salespoint was usually placed in the host farmer's homestead, and away from a main road connecting multiple villages, for two reasons: i) to prevent vines being stolen (i.e., security), ii) to ensure that there was always someone attending to the vines or available to meet a customer.*

Accessibility was in all cases ensured by selecting a person that is well known, respected and easy to reach when needed.

In order to avoid future confusion, we have revised line 856-859 in pg 44 of the tracked/marked manuscript to read:

"Both groups of villages however received quality seeds of improved sweetpotato varieties that were provided at salespoints manned by a host farmer (salesperson) and located in an area within each study village that is easy to access by the co-villagers."

Comment: I suggest that the authors conduct a formal test to assess the potential for spillover effects. This should be feasible especially if the authors have the GPS data.

Response*: As recommended by the Reviewer we have conducted the test for potential spillover effects and presented the results in a new appendix referred to in Section 3.2 when discussing how we attempted to minimize the chances of contamination. In particular, we calculated the distance between each control village and its nearest treatment village. In a next step, we kept only control villages, regressed the purchase dummy on the distance calculated in the first step, with controls and fixed effects added. The results show that there is no negative effect of the distance variable. This indicates that for control villages, being closer to the treatment village does not increase the likelihood of purchasing the improved vines, indicating no spillover effects.*

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5) **Comment**: The intervention includes convenience, model farmer, and the poster (which has aspects of loss aversion, benefits, and nostalgia). In the same way that nostalgia and loss aversion are analyzed as heterogeneous effects, the analysis of the convenience effects should be presented as part of the heterogeneous effects.

Response: *We understand where the reviewer is coming from but should clarify the point of the heterogeneity analysis. Nostalgia and loss aversion are activated through*

the poster, and proneness (in general) to these two psychological tendencies is measured in the survey, which permits the analysis of the effect of the poster among those who display, respectively, above and below median proneness to the tendencies that the poster intends to appeal to. So for instance, if the poster was successful in appealing to loss aversion, then those with higher than average proneness to loss aversion would have a stronger response to the poster. Ditto for nostalgia. For convenience there is no such rationale, and indeed we don't have a hypothesis for how ease of access interacts with the poster. We would therefore prefer not to conduct analysis that may come across as arbitrary.

6) **Comment**: I suggest focusing throughout on the results of the analysis that clusters standard errors at the village level. The null results are still relevant and insightful. The interpretation of the results in Table 2 is not correct. For example, the treatment did not cause 6.5% increase in the likelihood of buying quality seed. The correct interpretation is that the treatment increased the likelihood of buying quality seed by 6.5 percentage points. The authors should check throughout the manuscript and correct accordingly.

Response*: We have updated our discussions to focus on the village level clustered standard errors, and corrected our improper percentage references.*

7) **Comment**: On page 22, the results of the relationship between socioeconomic factors and purchase decision should be interpreted as correlations and not causal.

Response: *Thank you for catching this. We have corrected our language to indicate correlations.*

8) **Comments**: On page 25: The authors explain underreporting of sales as a possible explanation for the weak effect of the nudges. Was there a mechanism to monitor the behavior of the model farmers e.g., by asking them to return all unsold vines? Where did the unsold vines go?

Response*: Yes, there were two levels of monitoring. First, project/study research assistants went around to monitor salespersons/model farmers and the capturing of sales transactions, and finally to collect money from sales. Second, the extension workers were also paid to make random visits/checks of salespoints to ensure compliance with study stipulations. Unsold vines were, however, not collected because each round of supply of vines to the salespoint was given one week of selling. After such period, sweetpotato vines would be too desiccated/spoilt to sell or use for planting. In fact, most farmers preferred planting vines that are fresh-looking.*

Reviewer 3:

Dear Authors,

Comment: I like the core idea you have here, but the writing is a bit confusing, and I think the econometrics and results could be simplified to make a shorter and “punchier” paper. I have given you a series of suggestions geared towards that goal.

Response*: Thank you for this suggestion. We have indeed revised the paper to simplify the econometrics by dropping Eq 2 and editing Eq 4 of the original manuscript, and thoroughly edited the text to make it punchy.*

Comment 1. In your introduction, your research question should come much sooner, ideally in the second paragraph. You could then, AFTER introducing your question and overviewing your RCT, provide the overview of nudges in ag economics.

Response*: We thank the reviewer for this excellent comment. We have now moved the study objectives and hypotheses up to the first page as suggested and turned to reviewing the use of nudges in agriculture after specifying these.*

2. **Comment**: More importantly, your RCT is not clearly explained anywhere in the introduction. In your second paragraph where you explain your research question and your intervention, I would explain the RCT succinctly in phrasing something like this:

We disseminated improved sweet potato varieties in every village we worked in, by setting up lead farmers to sell high-quality cuttings. In control villages that is all we did. In treatment villages we additionally posted signs that used imagery to (1) address the quality of the cuttings (reducing informational constraints), (2) warn about the harvest loss associated with poor quality potato (activating loss aversion), and (3) encourage an “old fashioned” use of the sweet potato (leveraging a sense of nostalgia).

This phrasing makes it clear that the “control” was treated with dissemination too, clearly names your actual treatment intervention is (a sign), and delineates the aspects of the sign that you think are nudges. None of this is very clear in the current introduction.

Response*: This is another excellent suggestion that we greatly appreciate. We have incorporated this suggestion in pg 7 line 139-146 of the tracked version.*

3. In general, your introduction is too long and meandering. Will pack a much better punch if you cut down on the review.

Response*: Thank you for pointing this out. We have confined the review largely to scholarly endnotes, which we hope has led to an introduction that "packs a punch".*

4. **Comment**: When you discuss low adoption of improved varieties, please mention the two, I think) World Bank papers that show that African farmers are not knowledgeable about the varieties they grow – this is important because the statistics you are citing are all from farmer-self reports, and thus likely inaccurate. Similarly, in section 2 when you cite Walker and Alwang (2015), please also cite the SPIA-generated statistics on adoption of OFSP and other improved sweet potato in Uganda, gathered through the 2021 UHIS survey and published in their recent country report. These are the most relevant background statics to your paper – actually measured via genotyping rather than relying on self-reports! – so it's odd that you don't mention them.

Response*: Done for SPIA report of 2025. However, we could not identify the World Bank paper referred to the reviewer even though we agree in principle that farmers in Africa often are unable to identify varieties they grow based on recent DNA fingerprinting work. We cite 2 recent references below about this:*

1. *Abay, K. A., Wossen, T., & Chamberlin, J. (2023). Mismeasurement and efficiency estimates: Evidence from smallholder survey data in Africa. Journal of Agricultural Economics, 74(2), 413-434.*
2. *Opata, P. I., Okorie, O. J., Iwuchukwu, J. C., Ume, C. O., & Oyinbo, O. (2021). Adoption of improved cassava varieties in Nigeria: Insights from DNA fingerprinting versus self-reporting varietal identification approaches. Outlook on Agriculture, 50(3), 269-276*.

5. **Comment**: In both section 1 and 2 you talk about the RCT but don't spell it out clearly so by the end I am confused about what you actually did. I suggest that: (a) you discuss the RCT very clearly and briefly in your 2nd para of the intro as I spelled out above.

Response*: This is done, as indicated above*

Comment: then (b) you do NOT go into the RTC at all in section 2, but merely provide this background on the relevance of quality cuttings, nostalgia, and loss aversion in the context of sweet potato. 1 paragraph each. Right now, in section 2, you do NOT address the importance of quality of cuttings (which is 1 aspect of the signs, right?

Addressing informational constraint?) but you DO discuss geographic access -- which is NOT part of the signs, and not part of “treatment” since geographic access to cuttings is addressed identically to both control and treatment villages. So, this ends up further confusing what your RCT is actually studying. Note that if I’m right, most economists would consider the second two nudges, but addressing informational constraints is not generally considered a “nudge.” It’s fine if you use this “nudge” language a bit sloppily, though, in my opinion, since this is not an economics journal.

Response*: We apologize, this was indeed confusing. We have now clarified throughout Sections 1, 2 and 3 that we study (1) a composite information nudge that activates feelings of loss aversion and nostalgia, using a poster administered to a treatment group only; and (2) a convenience nudge that brings quality vine cuttings to all farmers in our sample through sales points manned by model farmers. Clarifying this has led to a very substantial rewrite of these three sections.*

6. **Comment**: I suggest that you skip equation 2 and move straight to equation 3, and modify equation 4 to include THREE groups rather than 4. My reasoning here is a few things. a. Firstly, Equations 2 and 3 do the same thing with different specifications, which is unnecessary. Equation 3 is the better specification: more sparse, more flexible, more intuitively shows the inverse U shape. So, no point in Equation 2.

Response*: We agree. We have omitted the previous equation 2. The new equation 3 (previous 4) includes only 3 dummy indicators of quantiles.*

Comment b. Because you see an inverse U shape, it makes sense to divide your farmers into 3 groups: close (low purchasing), medium (high purchasing), and far (low purchasing), based on the location within the inverse U. Probably you could divide based on terciles of distance.

Response: *We now include three groups as you suggest. When we divide into thirds based on quantiles, and treat the first group as the reference group, the differences are significant, but they are all increasing in distance. The declining value is only observed for those who are farther away than the cutoff for the upper third. See pg 34 para 2 for the results.*

Comment c. Moreover, you HAVE to provide the coefficient in distance squared to an accuracy where we see at least 1 non-zero digit. Right now you show a highly significant zero, and if it was truly zero, this would not be an inverse U, it would be a

straight line. The shape of the inverse U will seriously change if this is, say, 0.0002 vs. 0.0008. So please provide the number.

Response: *We agree this is important and have now included the coefficient in the table.*

Comment 7. Then in the results section you can probably combine the results (1 column each) for those 2 equations into 1 table. This will cut down on the number of tables and the complexity of discussion, and help you keep your results section more succinct.

Response: We have followed your suggestion, and all results now appear in Table 3.

Comment 8. You do not discuss the importance of absolute risk aversion in the set up, nor do you provide an equation for estimating its impact in the empirical strategy section. So Table 5 sort of comes out of left field; I have no idea why it is being run or what the results tell me that is conceptually useful. You don't see any impact of absolute risk aversion, and it is NOT correct (as stated atop of page 31) that treatment ecect significantly or "crucially" changes when you control for ARA for low distance farmers… while 0.084 is not stat signif in col 2, and 0.126 is stat signif, *the two coefficients are not statistically significantly different from one another*. (This is my best guess based on the t-statistics; it would be easier for me to see if you had standard errors rather than t-statistics, but I'm pretty sure this is correct). So I don't see any value of the ARA specification of Table 5. I suggest cutting the whole thing.

Response: *This is a fair assessment, and we have eliminated Table 5, and the corresponding discussion. We were relying on prior literature relating adoption to risk aversion, and the close connection with loss aversion in behavior. In the end, however, this table did not advance our knowledge of how the treatment was received.*

Comment 9. Column 1 and 2 of Table 6 are interesting, but I don't see where the other 3 mediating factors (connection to ancestors, fondness for agricultural, and fondness for crops) are motivated. Why are you splitting by these factors? How do they relate to your hypotheses? I would have expected you to instead split by 3 factors that relate to your "nudges" – for instance, by access to information about quality potato cuttings at baseline (since the poster is meant to address informational constraints), about their

propensity for nostalgia as you do (since poster designed to activate nostalgia) and by their loss aversion or absolute risk aversion as you do in Table 7 (since the poster was meant to active lost aversion). I suggest replacing Tables 6 and 67 with 1 Table that does this – basically, keeping cols 1-2 of Table 6, adding 2 columns on baseline informational access if you have that in your dataset, ditching Cols 3-8 of Table 6 completely as they seem irrelevant, and then adding EITHER the loss aversion or the ARA results from Table 7 (not both, you don't need 2 identical, non-significant results that say the same thing), so that you have only 1 table for heterogeneous treatment effects with 6 columns total, 2 columns per nudge.

Response: *We have largely followed the Reviewer's suggestion and consolidated the table (current Table 4) and the discussions. This has significantly shortened and simplified the discussion. We have deviated in one respect: our priors regarding the composite information nudge administered through the poster only relate to above and below average proneness to loss aversion and nostalgia, so we have limited the consolidated table to these two things.*

Nudging the adoption of improved crop varieties: Evidence from a large randomized controlled trial in Uganda

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Conceptualization, Data curation, Investigation, Methodology, Project administration, Software, Supervision, and Writing - review & editing. **Janet Mwende Mutiso**: Conceptualization, Methodology, and Writing - review & editing. **Chalmers Kyalo Mulwa**: Investigation, Methodology, Project administration, and Writing - review & editing. **Chenyan Gong**: Data curation, Formal analysis, Writing - original draft. **Sam Namanda**: Investigation, Methodology, Project administration, Resources, and Writing - review & editing. **Srinivasulu Rajendran**: Methodology, and Writing - review & editing. **Reuben Tendo Ssali:** Methodology, Resources, and Writing - review & editing. **Moses Okim**: Investigation, Methodology, Project administration, and Writing - review & editing. **Hugo Campos**: Conceptualization, Funding acquisition, and Writing - review & editing

Abstract

To achieve agricultural transformation in developing countries in the face of challenges such as climate change, the use of improved crop varieties needs a jumpstart. Using a randomized controlled trial in Uganda, we test how nudge theory can be harnessed to deliver increased adoption of improved crop varieties. We find a 7% treatment effect, though the effect is not robust to alternative specifications. We find compelling evidence for heterogeneous treatment effects, with robust treatment effects among those who experienced a stronger emotional connection to the nudges that we deployed. A key concept to help explain this is nostalgia: farmers prone to nostalgia responded more strongly to the traditional farming imagery used to nudge the adoption of improved varieties.

Keywords: agricultural technology adoption; sweetpotato; improved varieties; nudges; nostalgia

JEL codes: D91, O13, O33, Q16

1. Introduction

A reluctance to adopt improved crop varieties in low-income countries is a potential barrier to climate adaptation as well as improved farmer incomes. Often, improved varieties have demonstrated advantages in terms of yield and profitability relative to traditional varieties. Certain types of these varieties outperform traditional ones even under environmental stresses caused by weather, pests, and diseases. Reluctance to adopt them in this case demonstrates that key pieces of the climate adaptation and poverty puzzles are behavioral. It is therefore important to find ways to make adoption of improved seeds and technologies more persuasive, even among farmers who may have a strong sense of tradition in their agricultural work.

One behavioral approach, referred to as a "nudge", seeks to prompt changes in behavior by reframing the choices available to decision makers. Instead of offering direct monetary or other incentives, nudges can leverage psychological biases in decision-making and perception to encourage specific decisions - for example, the choice to purchase improved seed. In this paper, we test the effect of a bundle of nudges on the adoption of quality seed of improved sweetpotato varieties by smallholder farmers in Uganda. The nudges leverage key insights from behavioral economics to provide information in a manner expected to lead to desired behavioral change. We specifically test the effect of these nudges on the purchase of disease- and pest- free seeds[1] of improved sweetpotato varieties by smallholder farmers. The study then tests two hypotheses relating to the mediating effect of (1) proneness to nostalgia, and (2) loss aversion on the adoption of quality seed of improved sweetpotato varieties by smallholder farmers. For both of these factors, we hypothesize that they influence in a predictable direction the effectiveness of the behavioral nudges.

The use of nudges in agriculture is rapidly expanding, driven by evidence from other sectors of the economy that nudge theory bears promise in effecting desired positive behavior change.[2] Agriculture is the latest sector to attract the application of the nudge theory.[3] A few

notable studies have used nudges in a developing-country agriculture context, including the effect of present bias nudges on fertilizer use in Kenya (Duflo, 2011), social incentive nudges on climate smart farming in Malawi (Ben Yishay and Mobarak, 2021) and Uganda (Shikuku et al., 2019), and loss aversion nudges in the diffusion of agricultural information under poor public information supply (Balew et al., 2023). However, there are yet many areas where the role of nudges in agriculture remains unexplored. One key area, a major pillar and lever of agricultural development, is how nudge theory can be harnessed to deliver increased adoption of improved crop varieties in developing countries to achieve the elusive sustained agricultural productivity increases in the face of increasing challenges such as climate change.[4] Low use of improved crop varieties has led to stagnation in agricultural productivity and production in these countries (Macours, 2019; Takahashi et al., 2020; Suri & Udry, 2022), with cereal yields in Africa, for example, remaining below 0.5 tons/ha since the 1960s (Suri & Udry, 2022). The latest estimates by Fuglie and Marder (2015) show equally low rates of adoption of other improved crop varieties across Africa. They estimate that only 15% of the total land planted with food crops is under improved varieties. Across Africa, the adoption of improved varieties has remained disappointingly low, averaging[5] 17.8 % in West Africa, 21.7% in Central Africa, 24% in East Africa, and 31.2% in Southern Africa – giving an average rate of 23.3% for sub-Saharan Africa. Progress in agriculture and its contribution towards meeting the global development objectives (and Sustainable Development Goals (SDGs)) of poverty reduction and zero hunger (SDGs 1 and 2 by 2030), on the other hand, depend on rapid productivity increases in these countries. Can nudge theory be deployed to spur the adoption of improved crop varieties and jumpstart productivity growth?

To address this question we conducted a randomized controlled trial involving a composite information nudge combining invoking nostalgia and an appeal to loss aversion. We specifically disseminated quality seed of improved sweetpotato varieties in every study village

by setting up lead farmers to sell the quality seed. In addition to disseminating quality seed, in the treatment villages, we displayed a poster that used imagery to (1) warn about the harvest loss associated with poor quality potato (activating loss aversion), and (2) encourage an "old fashioned" use of sweetpotato (leveraging a sense of nostalgia).

Our main findings regarding the information nudge are twofold. First, we find a respectable 7% increase in the adoption of seed due to the treatment, though this effect is noisy and not significant in specifications clustering the error terms at village level but significant when the clustering is done at sub-county level. When compared to the relatively low cost of implementing the nudge, the intervention shows some potential for efficiently influencing seed adoption decisions.

Second, we find that proneness to nostalgia mediates the treatment effect. We test whether the information nudge has different effects among those with, respectively, above and below median levels of proneness to nostalgia and loss aversion (both measured using a survey instrument). We do not find evidence suggesting that loss aversion influences the effectiveness of our nudge treatment, but we do find evidence that proneness to nostalgia matters, with those more prone to it responding more strongly to the nudge. This is potentially important as such nostalgia may be a key factor in reluctance to adopt new varieties generally. Overall, the evidence that we find suggests a treatment effect for a targeted subgroup of the population who arguably experienced a stronger emotional connection to the nudges that we deployed, and who may be particularly resistant otherwise.

In addition to the information nudge, we deploy a convenience nudge. An expanding body of literature indicates that smallholder farmers' adoption of technology is constrained by information and market imperfections that hinder access to productive farm inputs (Macours, 2019; Suri & Udry, 2022).[6] In this study, we relax the input market access constraint by providing quality seed of improved crop varieties at the village level through a dedicated sales

point thus reducing transaction costs by easing the access to quality seed. We test whether convenience of access has an effect on adoption and find that it does so in a non-linear way.

The remainder of the paper is laid out as follows. In Section 2, we describe the importance of the challenge of increasing rates of adoption of improved sweetpotato varieties in our case study country and motivate the nudges we designed to encourage this adoption. Section 3 contains details of the design and implementation of our randomized controlled trial, as well as the empirical strategy for testing the effectiveness of nudges overall and for heterogeneous effects in line with our three key hypotheses. Section 4 presents and discusses the results, and Section 5 summarizes them and reflects on their implications.

2. Using nudges to jumpstart the adoption of improved sweetpotato in Uganda

Sweetpotato is a major staple crop grown by smallholder farmers in all the districts of Uganda. It has the advantage of being climate-resilient and low-input intensive (Kosmowski et al., 2020; Heck et al., 2021). Uganda is among the top producers of sweetpotato globally (Alwang et al., 2019) and is also a secondary center of diversity of sweetpotato (Okello et al., 2022). There are more than 3000 varieties of sweetpotato in cultivation in Uganda and most farmers maintain at least four varieties in their field. Most of these varieties are landraces or the so-called farmer varieties. At the same time, Uganda has greatly benefited from several years of promotion of improved sweetpotato varieties (ISVs), especially the orange-fleshed sweetpotato (OFSP) varieties which have a specific focus on nutritional benefits, food security, and farm income (Low & Thiele, 2020; Mulwa et al., 2025). However, adoption of ISVs in Uganda remains very low[7], estimated nationally at 12% (Walker & Alwang, 2015). This share of improved sweetpotato varieties has not changed for the last decade with Ilukor et al (2025) finding that only one in ten farmers grow improved sweetpotato varieties released by the national program. Long-term trends show that Uganda, which used to be the second leading sweetpotato producer in Africa after Nigeria and fifth globally, has fallen behind other

154 countries, including countries in the East Africa region such as Ethiopia and Tanzania. Food
155 and Agriculture Organization (FAO) statistics indicate that sweetpotato yield in Uganda
156 declined by 7% between 2010 and 2020 while the area harvested decreased by 17% over the
157 same period.

158 Our study focuses on a composite information nudge for encouraging the adoption of ISVs.
159 Information nudges are low-cost interventions that provide information in a manner that uses
160 insights from behavioral economics to bring about desired behavioral change. Specifically, we
161 encourage farmers to adopt quality seed by using a poster that is inspired by the literatures on
162 loss aversion and nostalgia.

163 Our first nudge leverages a sense of nostalgia. Nostalgia, originally studied mainly in
164 psychology has recently gained widespread usage in food and product marketing (Zhou et al.,
165 2012; Rana et al., 2020; Sedikides & Wildschut, 2022). It is broadly defined as a sentimental
166 longing or wistful affection for one's past that reflects fondly on personally important events
167 often associated with childhood experiences and relationships. Sedikides and Wilschut (2022)
168 identify food and advertising as the key triggers of nostalgia and argue that it serves two
169 important functions in marketing: firstly, it elevates social connectedness or a sense of
170 belonging and acceptance; and secondly, nostalgia provides meaning to life or the sense that
171 one's life is significant. Cui (2015) reviews the literature on the use of nostalgia in marketing
172 and concludes that it tends to be effective. Much like agriculture, food is heavily dependent on
173 family production practices which are key in building the sense of nostalgia. Indeed, much of
174 the marketing connecting food and nostalgia focuses on connecting foods to those prepared by
175 or with parents or grandparents as a child (Renko and Bucar, 2014; Vignolles and Pichon, 2014;
176 Simpson et al, 2024) .

177 Similarly, nostalgia in an agricultural setting may be connected with the seasonal production
178 practices engaged in with parents as a child. In this study, we explore how fondness for

traditional/ancestral farming practices can be deployed to promote technology adoption. Based on local knowledge of imagery associated with ancestral farming, we use a traditionally popular food made from sweetpotato among the study community, dried sweetpotato chips known as *amukeke*, combined with an advertisement placed within the community/village to activate nostalgia.[8] Specifically, we display a poster (see Appendix A) that depicts *amukeke* accompanied by a short and simple narrative (more on this below) in two vernacular languages used in the study villages each accompanied by an English translation. The poster also displayed a picture of a happy mother and child preparing sweetpotato for use in making *amukeke*. The picture was intended to reinforce the nostalgic feelings that are invoked by seeing the traditional sweetpotato food displayed. We therefore used common techniques from the comparative advertising literature (Anderson et al., 2016) as well as branding. This study is the first to apply a nostalgia nudge in a field experiment with smallholder farmers.

Our second nudge is designed to trigger the experience of loss aversion. The narrative on the poster made salient the potential losses resulting from not purchasing clean and improved varieties. Specifically, selecting alternate sources for sweetpotato seed was framed as a decrease in yield as a result of planting disease- and pest-infected seed. This framing was intended to activate feelings of loss aversion. Losses can occur in two ways. First, the diseased planting material/seed results in thin/slender roots, referred to by agronomists as "pencil roots". These roots are of very low economic value, that is, non-marketable. Farmers mainly use them for making crushed dry flakes – known as *inginyo*[9] – which are non-tradable. Losses can also occur when the pest, harbored in the seed as eggs, after hatching, attacks roots causing dark spots and holes in the flesh and on the skin. We also include an emoji depicting a feeling of shock at the depressed yield and root damage to reinforce the feelings of loss. The losses from using infected seed are compared with those from using quality seed. Prospect theory postulates that because of a decision-maker's loss aversion, gains increase utility less than comparable

losses decrease utility, which has been often confirmed empirically (e.g., Novemsky & Kahneman, 2005; Balew et al., 2023). Balew et al. (2023) suggest additionally that farmers associate loss aversion with a feeling of shame, while Bulte et al. (2020) demonstrate in a field experiment that loss aversion can be leveraged to increase the productivity of workers. We hypothesize that a behavioral nudge that increases the salience of losses will have a larger effect among farmers more prone to loss aversion.

In addition to a composite information nudge effected through a poster, we consider the convenience of access, i.e. nudging farmers to adopt quality planting materials by making them easily available. Convenience nudges improve access to a product by making it easier to obtain (Cadario & Chando, 2020). Difficulty in obtaining quality planting materials of vegetatively propagated crops such as sweetpotato has been a pervasive problem and a major bottleneck to the adoption of improved varieties (Okello et al., 2020; Schulte-Geldermann, 2022). Farmers are thus forced to use seed from the previous season crop with the same material recycled repeatedly, often over many years, which depresses the yield (Okello et al, 2025). In response, there has been an extensive effort to establish a functional and effective seed system that facilitates farmer access to quality seed of improved varieties, which includes an initiative devoted to this by the Consultative Group for International Agricultural Research (CGIAR[10]). In this study, we facilitate farmer access to quality seed (also known as vine cuttings) of improved sweetpotato varieties described in the next section.

3. Research design, data and empirical strategy

In this section, we describe the randomized controlled trial for evaluating the effectiveness of the nudges described above, as well as the complementary data collection and empirical strategy for testing our key hypotheses.

3.1. Study site and sample selection

The study covered the two counties, and all the 15 sub-counties and 91 parishes/wards of Amuria district, a major sweetpotato growing district in eastern Uganda. In each parish, a list of all the villages was drawn. Next, 120 villages were randomly selected from the 91 parishes proportional to the size of each parish. In each selected village, we obtained a household list from the Local Council/village Chairperson and randomly selected 10 households that had grown sweetpotato in the year preceding the study. This yielded 1,200 households, which prior power calculations had deemed to be sufficient.[11]

We used a cluster-randomized controlled trial to prevent contamination of various kinds, especially treatment village effects spilling over to nearby control villages. We randomized the selected villages into the treatment and control groups following McCann et al. (2018) whose approach tests the differences in minimum contamination distance separating village clusters allocated to control and treatment arms at 2-, 3-, 4- and 5-kilometer radius. A sufficiently large number of iterations of running the McCann et al (2018) model showed that a 5 km separation radius is optimal for preventing contamination in our study. The layout of treatment and control villages in Amuria district is shown in **Fig. 1**, which shows the 64 villages that implemented the full program described below, and the remaining 56 that served as control villages.

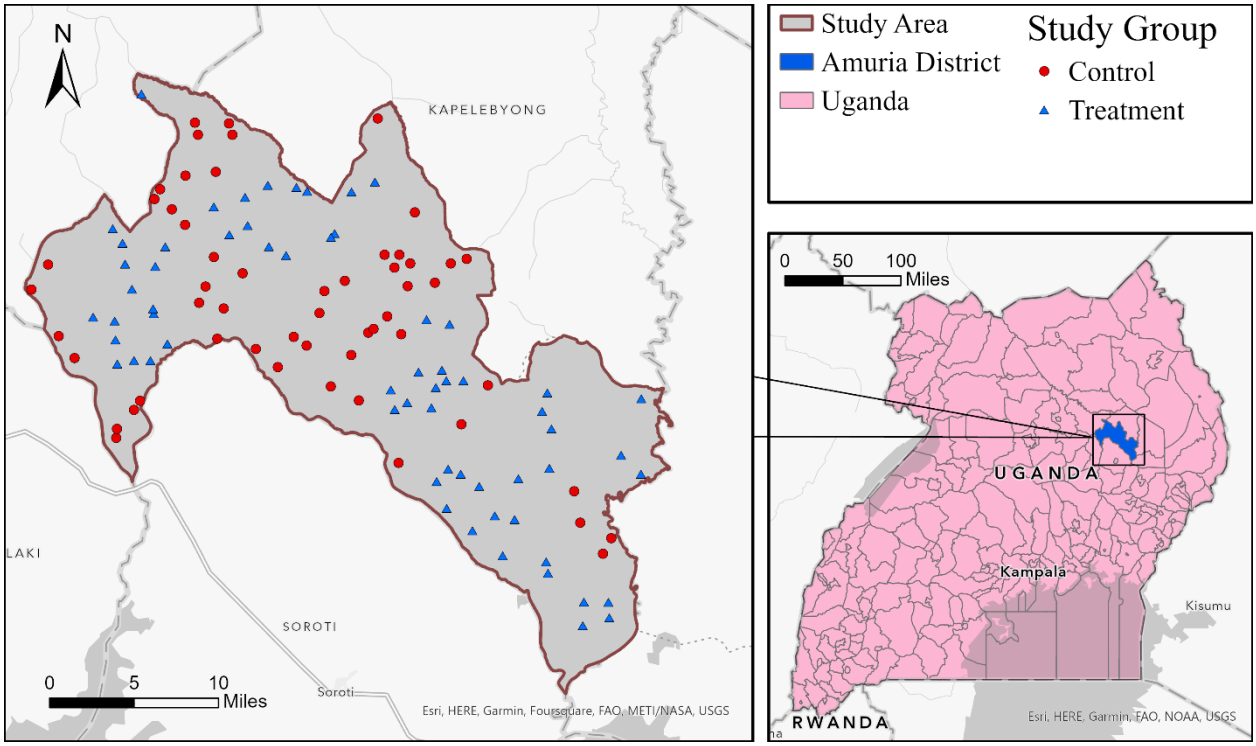

Fig 1 Layout of treatment and control villages in the district. The figure shows the distribution of the treatment and control villages in the study district

3.2. Implementation details of the intervention

In both the treatment and control villages, we set up a salespoint where quality seeds of improved varieties (ISVs) were presented. The salespoints were located in easily accessible[12] areas/points such as intra-village feeder roads, footpaths and intersections/junctions serving a village, hence frequently used by farmers within the village to increase access to, and convenience of obtaining, quality seed of ISVs. Small amounts of inconvenience can often reduce a decision-maker's ability to execute their desired actions (Just and Payne, 2009). Most of the sales points were located in the homesteads of the salespersons (i.e., hosts of salespoints) to secure the vines from theft and for ease of sales transactions. Care was, however, taken to ensure that salespoints were not located on major roads and intersections or in facilities (schools, churches, mosques, markets, and dispensaries) serving multiple villages or parishes to reduce the chances of contamination.[13] In addition to receiving quality seed of ISVs,

treatment villages also received: i) in season one, a poster depicting images that were designed to induce nostalgia and loss aversion, and ii) in season two both the poster and text message reminders. The reminders were sent only to farmers who purchased quality seed of ISVs in the first season. They were designed to test the longevity/sustainability of the nudges whose analysis is beyond the scope of this paper and is reported in Okello et al (2025). Posters were displayed prominently at treatment village salespoints ensuring that those in the treatment group and residing in the village were exposed to the images.

The salespoints were hosted by model/progressive farmers (henceforth referred to as salespersons) recruited from each of the 120 villages with the help of local administration and frontline extension workers. The salespersons were trained on the study purpose and their responsibilities. The training was provided by the Principal Investigator, assisted by a research assistant, and a local government extension worker.[14] Salespersons from treatment and control villages were trained separately. During the training, both groups (treatment and control) of model farmers were informed that: i) the project intended to address the issue of access to quality seed from certified sources by providing quality seed withing their villages, ii) they were selected by their agricultural extension officers to serve as hosts of salespoints where such seed would be displayed for sale. No information that would link such seed to what is displayed in the poster/treatment (i.e., depressed/increased yield, low/big harvest, income effect, amukeke, etc) was provided to both groups of farmers. Neither did the project team discuss the posters/nudges with the model farmers or the extension officers. The details of the nudges were not provided to extension officers to avoid contamination because extension officers served multiple villages.

We used quality seeds of four sweetpotato varieties, namely, Tanzania, Ejumula, NAROSPOT 1 (also known as New Dimbuka) and NASPOT 13 (also known as Joweria). **Fig. 2** provides characteristics of the four varieties used. Ejumula and Tanzania are both widely

grown varieties in the study district. However, due to repeated planting, locally available seeds of these varieties accumulate a heavy load of pests and diseases, especially the sweetpotato weevil (a pest) and sweetpotato virus disease (SPVD). The former is responsible for the dark spots in the root flesh and holes on sweetpotato skin while the latter results in the "pencil roots" described above. Infection with sweetpotato weevil and SPVD leads to greatly reduced yields which in turn reduces the amount of *amukeke* farmers can prepare in a season and lowers income earned from sales. It is, for instance, estimated that SPVD can cause up to 98% yield losses in sweetpotato (Gasura & Mukasa, 2010). Unlike locally available seeds, the quality seed presented in the village salespoints were inspected by a trained government inspector and certified to be free of sweetpotato weevil and SPVD[15]. NAROSPOT 1 and NASPOT 13 were new introductions in the study district. Seeds of these varieties presented at salespoints were also inspected and certified as sweetpotato weevil and SPVD-free.

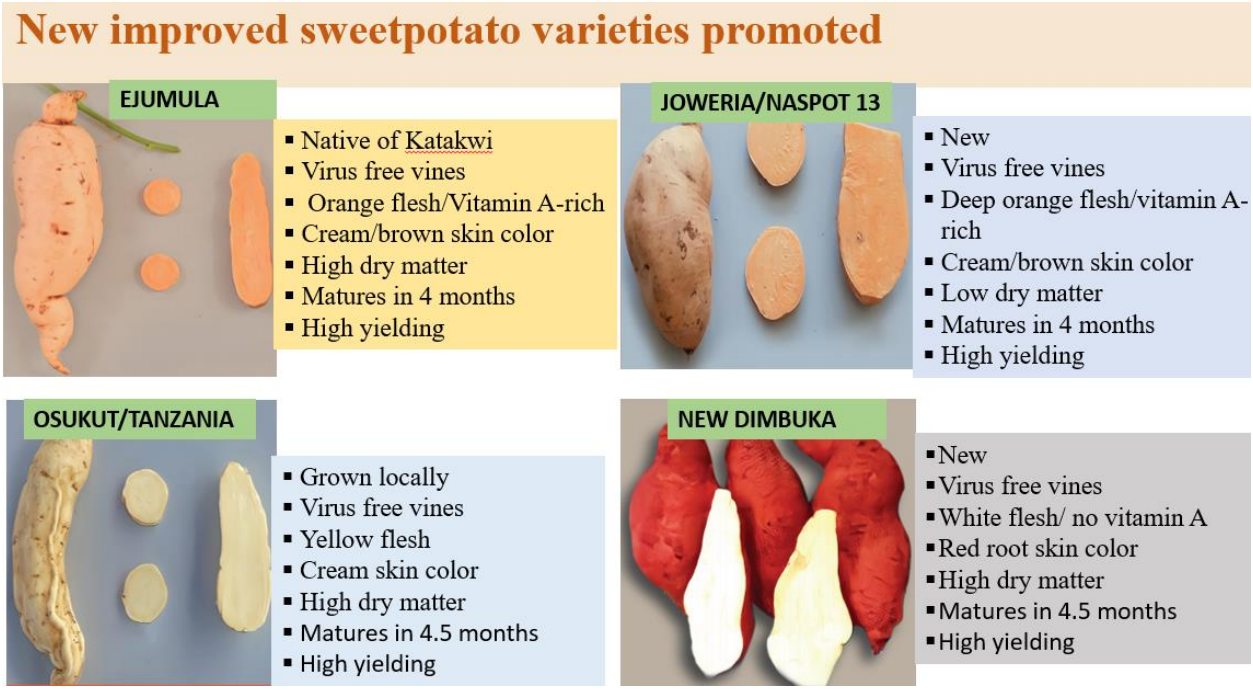

Fig. 1 Varieties of sweetpotato used in the study

At the onset of first season rains (i.e., late April and early May 2022), the quality seeds of the four sweetpotato varieties were delivered to the salespoints. Each salespoint received two

bags[16] of each variety, hence a total of 8 bags. Two weeks later, 4 additional bags (1 bag per variety) were again delivered to each salespoint. Hence, a total of 12 bags of quality seeds of the four varieties were delivered to the salespoint in the first season. The seeds were sold by salespersons in bundles of 25 vine cuttings each for variety. Each bundle was sold at a price[17] of UGX 2000, which was comparable to the price farmers typically pay for vine at the beginning of the first season. The economic situation at the onset of the study (i.e., emergence from long drought and hence food and cash scarcity) dictated against setting prices at a level that would recover costs and include a premium for the quality of the seed presented. Purchase of full bags from the salespoints was discouraged by pricing the bag at a much higher cost. This was meant to make seeds available for smallholders who typically purchase them in smaller quantities and multiply them for root production. The nudge interventions were repeated during the second rain season of 2022 (July/August) but with an added component: reminder text messages to all farmers in treatment villages who purchased seeds during the first season.[18]

3.3. Data collection

Baseline data was collected from 1200 households in November and December 2021. In each village, we obtained purchase data from salespersons and used the information to estimate the impact of nudges on adoption. In addition, we surveyed 10 randomly selected households per village to obtain more detailed information on adoption behavior, including the use of quality seed, demographic information, and exposure to the messaging/interventions. This allows us to estimate the broader impact of the program, and also to examine the populations most impacted. Further, in the follow-up survey conducted in November 2022, we augmented our sample in each village by interviewing four randomly sampled purchasers of quality seed of ISVs.

3.4. Empirical strategy

The main effects in this study are measured by comparing purchase decisions between treated and untreated households. In addition, we measure the impact of convenience by regressing adoption decisions on distance from point of sale in both treated and untreated villages.

To estimate the average impact of the nudge interventions on farmers' seed purchase decisions, we estimate a Linear Probability Model (LPM). Our LPM is given by:

$$Y_{csh} = \beta_0 + \beta_1 Treatment_{csh} + \gamma' X_{csh} + v_c + \varepsilon_{csh} \quad (1)$$

where Y_{csh} is the purchase decision of household h in village s, sub-county c. $Treatment_{csh}$ is a dummy variable that takes a value of 1 if household h lives within the treatment village, v_c is a vector of sub-county fixed effects to control other unobservable sub-county-level characteristics. In some specifications, we include X_{csh} a set of household controls, including the frequency of purchasing seed before the intervention, households' absolute risk aversion (calculated from survey responses), gender and the education level of the respondents, household size, and the size of households' own cultivation lands. The error term is given by ε_{csh}. The coefficient of interest is β_1. A significantly positive value of this coefficient would provide evidence that our suite of nudges successfully encouraged farmers to purchase quality seed.

We present results with both robust standard errors and errors clustered by villages. While the clustered errors are in theory valid given any within-village correlation, due to budget limitations, we have a limited number of clusters to draw from which can inflate clustered standard errors artificially (Cameron & Miller, 2015). While our hypothesis is regarding the sign of β_1, we report symmetric tests as is standard in the field. We note where the symmetric and one-tailed tests may differ in the outcome.

In addition to the impact of our intervention on the purchasing behavior of farmers, we also consider how distance, measured by the minutes required for farmers to walk to the salespoint, directly influences their purchasing decisions. Specifically, to examine how convenience plays a role, we estimated the following two LPM models specified:

$$Y_{csh} = \beta_0 + \beta_1 Distance + \beta_2 Distance^2 + \gamma' X_{csh} + v_c + \varepsilon_{csh} \quad (2)$$

$$Y_{csh} = \beta_0 + \sum_{i=2}^{3} \beta_i Group\ i_{csh} + \sum_{i=2}^{3} \alpha_i Group\ i_{csh} \times Treatment_{csh} + \gamma' X_{csh} + v_c + \varepsilon_{csh} \quad (3)$$

In the first model, we investigate the impact of each additional minute of distance from the salespoint on farmers' purchase behavior by including both the distance and its squared terms in the regression, as displayed in equation (2). Specifically, by incorporating the squared term of the distance variable, we hypothesize the presence of a non-linear effect for distance. In the second model, we categorize the samples into three distinct groups based on the different quantiles of their distance to the salespoint. The group designate *Close* are those who reside with 8 minutes of the salespoint, those designated as *Medium* live between 8 and 20 minutes of the salespoint, while those in *Far* live more than 20 minutes away from the salespoint. We use dummy variables to indicate the group each individual belongs to. We use the closest residing group as the reference group, omitting the dummy for this group in (3).This allows us to use (3) to evaluate the heterogeneous treatment effects across different groups. By including interaction terms between group dummy variables and the treatment variable for groups 2 to 4 in equation (2), the coefficients of interaction terms in equation (3) illustrate the variation in treatment effects among distinct groups.

3.5. Testing of hypotheses about factors mediating nudge effects

The treatment effect indicates the effectiveness of our intervention's promotional material (namely the poster). For the reasons given next, we hypothesize that particular proneness to the psychological tendencies invoked on the poster (nostalgia and loss aversion) will mediate this effectiveness. For testing these two hypotheses, given the limited sample size, we do not use interaction effects between loss aversion or nostalgia and the treatment variable but instead divide the sample into those above and below the median levels of, respectively, proneness to nostalgia and loss aversion, and reproduce the primary regression analysis on each subsample. The primary purpose of this is to determine whether those more prone to either one of the psychological tendencies respond more strongly to its invocation

Hypothesis 1: The treatment effect of behavioral nudges on vine purchases will be more positive among those who display higher proneness to nostalgia.

While not previously discussed in the literature, we propose that individual nostalgia could play an important role in one's willingness to adopt new agricultural technologies. We employ two different approaches to measuring nostalgia. First, we use a validated 7-item psychometric scale of general proneness to nostalgia (Routledge et al., 2008). The 7 questions include the frequency and importance of nostalgic emotions experienced by the respondents. Responses were recorded using a 7-point scale table, with 1 denoting "not at all" and 7 representing "very much." We compute the mean value of these 7 questions as the index of farmers' general nostalgia level. The scale was adapted to the local language and context of the local population. In addition, we were interested in agricultural-specific nostalgia. For this reason, we asked three additional Likert scale questions to determine if they had feelings of nostalgia for: i) the crops their parents or grandparents had grown, ii) the production practices their parents and grandparents had employed, or iii) the connection to their ancestors provided by farming.

Confirming hypothesis 1 would result in a more positive coefficient in those displaying above median proneness to nostalgia than those below. As described by Holbrook and

Schindler (1991) and Sedikides and Wildschut (2022), consumers' nostalgia refers to a preference toward objects that were more common when they were young. Therefore, experiencing high nostalgia, farmers are more likely to have an emotional connection to their ancestors and the past, motivating them to preserve and honor their heritage through agriculture. This may lead to an attachment to older practices including the source and varieties of seed they remember as children. Our intervention is an attempt to use nostalgia to reframe the choice between old and new practices. We do so by demonstrating on the poster that adopting modern farming techniques, here quality seed of ISVs, permits higher production and increased capability to produce and consume *amukeke*, an ancestral food.

Hypothesis 2: The treatment effect of behavioral nudges will be more positive among those who display greater loss aversion.

If our treatment was successful, then lower yields from conventional or local sources of seeds should be seen as a loss. If this is the case, those who are more loss-averse should be more sensitive to the treatment and more likely to purchase the seeds. Loss aversion, as earlier noted, refers to the inclination of people to perceive outcomes in terms of gains and losses relative to a reference point, where individuals are more sensitive to losses than to equally sized gains. This behavioral insight is of great relevance to smallholder farmers since many farm management decisions include the possibility of net losses (Sagemüller & Mußhoff, 2020). Some studies have also uncovered connections between farming households' loss aversion and their adoption of technologies, such as superior crops or new seed varieties (Emerick et al., 2016). We employ a validated 19-item psychometric measure of loss aversion which has been shown in prior literature to be correlated with loss-averse behavior (De Baets & Buelens, 2012). The respondent used a 5-point Likert scale - from "strongly disagree" to "strongly agree" - to evaluate each item. For instance: "*I worry too much over something that really doesn't matter*", or "*I would hate it if a colleague [fellow farmer] thought that I'm not as good in my job*

[farming] now as I was before". These items were adapted to the language and cultural context of the study (as shown by the text in parenthesis). By assessing farmers' agreement on 19 distinct statements, the average value is computed to represent the overall level of loss aversion among farmers.

3.6. Controlling for risk aversion

Risks and risk preferences have long been recognized as key factors determining farmers' management choices, including the adoption of new technologies and choices over production intensity (Quiggin, 1982; Barham et al., 2015). Focusing on the effect of farmers' risk attitude on their decision choices, many studies have shown that risk-averse farmers are less willing to take on activities and investments with higher expected outcomes, but which carry risks of failure (Alderman, 2008; Ullah et al., 2015). We compute the Arrow-Pratt measure of absolute risk aversion, to assess individuals' risk preferences (Pratt, 1978).

Specifically, the coefficient is computed by:

$$A(c) = -\frac{u''(c)}{u'(c)} \qquad (4)$$

where $u(c)$ is the utility function with the payoff c. $u'(c)$ and $u''(c)$ denote the first and second derivatives with respect to the utility function. In order to calibrate this measure on an individual basis, we use responses to hypothetical questions following Holt and Laury (2002). Participants were asked a series of questions in which they had to choose between accepting a specific monetary amount with certainty or opting for a 50% chance of receiving a higher amount and a 50% chance of receiving no money. The certain amount is increased and the amount that induces a switch to a certain outcome can then be used to calculate the respondents' absolute risk aversion.

4. Results and discussion

Table 1 presents the summary statistics, including the mean value for both the control and treatment groups and their mean differences, for key variables. First, it is critical to note that the sample size for the full sample is 1133 instead of 1200. The drop in sample size can be traced back to the failure of 67 respondents from the baseline survey to participate in the follow-up round, representing an attrition rate of 6%. The majority of these absentees were caused by migration, travel, or illness rather than refusal to participate in the study. Second, the findings uncover no significant variation in the demographic and socioeconomic attributes among farmers randoized into the treatment group and those allocated to the control group. Although minor discrepancies were observed concerning the farmers who had not engaged in vine purchases previously and the measure of the loss aversion between the control and treatment groups, the majority of the explanatory variables remained balanced. Third, due to the experimental design of our measurement of absolute risk aversion, a portion of the farmers failed to complete the survey to measure their absolute risk aversion. This happened when their selection in a series of choices between a definite monetary sum or a series of increasingly risky coin-flip chances of receiving a higher amount or nothing always favored the risky choice. In this case, we could not observe the bound of their aversion to risk. This factor led to a reduced sample size among participants who have the measurement of absolute risk aversion.

Table 1: Baseline Randomization Balance Check between Treatment Group and Control Group

	Control		**Treatment**		**Difference**	
Variables	N	Mean	N	Mean	Mean	t-value
Purchased	525	0.446	608	0.442	0.003	0.111
Years of Schooling	525	5.977	608	5.855	0.122	0.546
Respondent Sex (1=Male)	525	0.613	608	0.582	0.031	1.064
Respondent Age (years)	525	41.65	608	41.96	-0.306	-0.316
Household Size (count)	525	7.208	608	7.174	0.033	0.171
Own Cultivable Land (acres)	525	3.303	608	3.341	-0.038	-0.249
Distance to Sales Point (minutes)	379	19.480	459	18.296	1.184	0.826
Frequency of Vine Purchase						
Every Season	525	0.101	608	0.107	-0.006	-0.327
Every Other Season	525	0.109	608	0.138	-0.030	-1.505

Once in a While	525	0.310	608	0.332	-0.022	-0.781
Never	525	0.480	608	0.423	0.057	1.935*
Attitude						
Absolute Risk Aversion	442	7.033	502	6.502	0.531	0.877
General Nostalgia	521	4.953	605	4.934	0.019	0.308
Connection to Ancestors	525	4.236	608	4.313	-0.076	-1.482
Fondness for Agricultural Production	525	4.116	608	4.135	-0.019	-0.290
Fondness for Crops	525	3.960	608	3.885	0.075	1.100
Loss Aversion	525	3.367	608	3.318	0.049	1.966**

Note: Column 6 is the t-value of the difference between the mean value of the control and treatment groups.

Asterisks indicate the following: ***=p<0.01, **=p<0.05, and *=p<0.1

Table 2 presents the baseline results, incorporating both village-level clustered standard error (preferred) and robust standard errors, to examine the combined effect of nudges on the adoption of quality seed of ISVs. The likelihood of households buying quality seed rises by 6.5 percentage points when they are provided with behavioral nudges. This result is not statistically significant when clustering by village. This is perhaps unsurprising as the estimated effect is well below the effect size used for power calculations. Note, however, that the result is significantly

Table 2. Effect of behavioral nudges on the purchase of quality seed of improved sweetpotato varieties

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Parish-Village Level Clustered SE				Robust SE			
Variables	Purchased	Purchased	Purchased	Purchased	Purchased	Purchased	Purchased	Purchased
Treatment	0.065	0.070	0.068	0.071	0.065*	0.070*	0.068*	0.071*
	(1.44)	(1.57)	(1.55)	(1.56)	(1.68)	(1.85)	(1.82)	(1.74)
Absolute Risk Aversion				0.001				0.001
				(0.36)				(0.37)
Respondent Sex		-0.026	-0.030	-0.040		-0.026	-0.030	-0.040
		(-0.84)	(-0.99)	(-1.19)		(-0.81)	(-0.95)	(-1.15)
Respondent Age		-0.000	-0.000	0.000		-0.000	-0.000	0.000
		(-0.22)	(-0.17)	(0.04)		(-0.25)	(-0.20)	(0.05)
Years of Schooling		0.017***	0.017***	0.019***		0.017***	0.017***	0.019***
		(3.62)	(3.57)	(3.75)		(3.83)	(3.78)	(4.02)
Household Size		0.008*	0.007	0.005		0.008*	0.007	0.005
		(1.69)	(1.51)	(1.02)		(1.82)	(1.61)	(1.04)
Own Cultivable Land		0.016***	0.016***	0.019***		0.016***	0.016***	0.019***
		(2.93)	(2.94)	(3.75)		(2.96)	(2.97)	(3.35)
Constant	0.349***	0.166	0.134	0.062	0.349***	0.166*	0.134	0.062
	(3.79)	(1.49)	(1.19)	(0.54)	(4.94)	(1.87)	(1.50)	(0.64)
Observations	1,133	1,133	1,133	944	1,133	1,133	1,133	944
Adjusted R-squared	0.017	0.039	0.039	0.041	0.017	0.039	0.039	0.041
Number of Counties	15	15	15	15	15	15	15	15
Frequency of Vine Purchase	No	No	Yes	Yes	No	No	Yes	Yes
Sub-county FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Columns (1) to (4) show the results from the baseline regression with robust standard error and columns (5) to (8) are results with village-level clustered standard error. $Treatment$, representing whether the household receives the treatment, is interpreted as the average treatment effect of behavioral nudges. All models include sub-county-level fixed effects. T-statistics are shown in parentheses. Asterisks indicate the following: ***=p<0.01, **=p<0.05, and *=p<0.1

positive in all models (at the $p < 0.05$ for robust standard errors and $p < 0.10$ for clustered standard errors) employing a one-tailed test.

Columns (1) through (4) show that we fail to identify significant impacts when the standard error is clustered at the parish-village level, which is the experimental randomization level. In columns (2) to (4), different sets of control variables, including respondents' education, gender, age, household size and asset (i.e., land) endowment, risk attitude, as well as the purchase frequency, namely "Every Season", "Every Two Season", and "Sometimes", are included. The results indicate that socioeconomic factors, particularly education level and asset endowment are significantly correlated with farmers' purchasing decisions. However, there is no observed relationship between households' risk attitude and frequency of purchase. Comparing coefficient estimates between column (1) to column (4) suggests that adding covariates and sub-county-level fixed effects in the regressions does not affect the magnitude of the treatment effect. With various sets of control variables, the coefficients for $Treatment$ in the LPM rise from 0.065 to 0.071, but remain statistically insignificant. Only marginal significance ($p < 0.10$) are obtained even when using robust standard errors, which are likely to exaggerate significance in our case.[19]

The size of the effect relative to the expense of placing posters, etc. is substantive and important in a policy context if it were significant and were to hold in a larger sample. A 6.5 percentage point increase in adoption is relatively large in comparison to baseline sales rates. Moreover, the expense of the treatment is negligible in comparison to the necessary expenses incurred to provide sales points generally. Nevertheless, the results are very noisy and are not robust to specifications. This lack of robustness may be due to the specific challenges faced by the farmers at the time of our intervention. Nevertheless, the effect shows some promise and underscores the need for additional exploration of nudges.

Weather outcomes may have played a role in the relatively noisy and fragile estimated impact of the nudge treatment. At the onset of the treatment period, rains came signaling the beginning of the planting season. However, soon after, a several-day-long period of dry weather followed that discouraged farmers from preparing mounds (heaps) for planting sweetpotato, and, hence, from buying vines of the improved seed. This reduced the variability in purchasing decisions substantially. Consequently, a considerable number of the vines spoiled. This was an especially difficult issue in the second season when the dry period lasted nearly two weeks. Further, the study year was preceded by three consecutive years of very dry weather. As the majority of households struggled to recover from the severe drought, they lacked the financial support to invest in the purchase of quality seeds of sweetpotato varieties, despite their superior attributes. Fig. 3 presents major reasons farmers who were aware of quality seed being sold in their villages but did not purchase them gave for doing so, highlighting that liquidity constraint played a role in the decision to invest in quality seed. If the weather depressed sales in both treated and untreated villages, the result would be a reduced difference in sales between an effective treatment and control. This implies that our results are strongly influenced by seasonality. The effects of nudges could therefore be confounded by the drought conditions preceding the interventions. Moreover, there may have been a problem of underreporting of sales by salespersons. The arrangement was that the salesperson captured sales data, received the sales money from purchasers, and remitted these to the project. Some salespersons, however, used the money to meet personal financial emergencies such as school fees or home needs and struggled to pay back given the economic and drought hardships experienced in the two study seasons. Some salespersons likely underreported their sales after using the money to avoid refunding it.

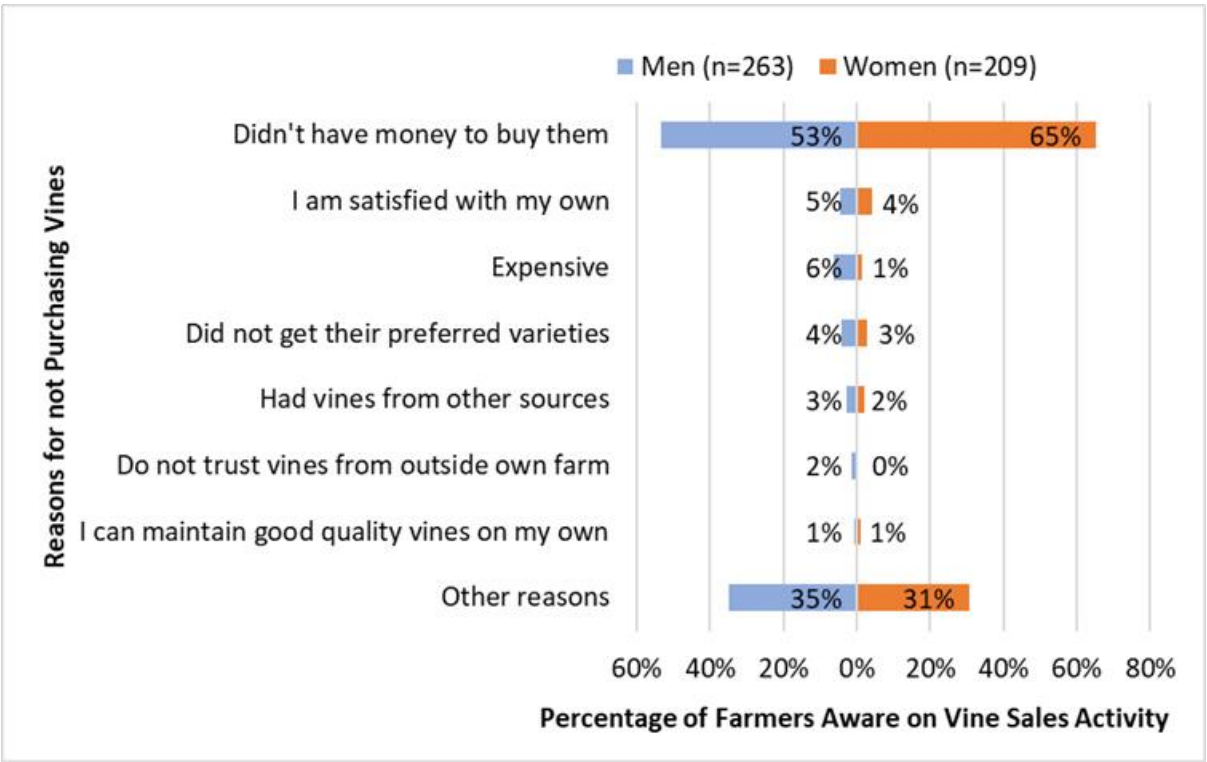

Fig. 3 Reasons for not investing in quality seed

While our initial findings align with our hypothesis that utilizing behavioral nudges will increase the likelihood of farmers purchasing quality seed, the result is noisy underscoring the need for further study.

In addition to examining the treatment effect of behavioral nudges on farmers' purchasing behavior, we investigate the role of convenience in their buying decisions using equations (2) and (3), with the results displayed in **Table 3**. The sample size is reduced due to missing data on location. We present the results of equation (2) in column (1) and (2) of Table 3, where we directly regress farmers purchasing decisions on their distance away from the salespoint, as well as its squared term. Despite the small magnitude, the coefficients for the distance squared term in both columns (2) and (3) are negative and highly significant, suggesting an inverted U-shaped relationship between distance and farmers' purchasing tendencies. These results demonstrate that

as the distance between farmers and sales points increases, the likelihood of farmers purchasing the quality seed of ISVs initially rises, then subsequently declines. In column (1), we add the treatment variable, which is positive but insignificant in this case, to the model, indicating that there might be some mediating effects of distance on the behavioral nudges we provided to the farmers.

In column (3) we estimate equation (3), using quantiles to examine both the effect of distance and interaction with treatments. By using the first group, consisting of farmers living within 8 minutes minutes from the salespoint, as the reference group, the results in column (3) reveal the relationship between distance and farmers' purchasing behavior. Statistically significant at 5% level, the coefficient for *Medium* is 0.103, demonstrating that farmers living in this group are 10% more likely to buy the improved seed compared to those in *Close*. Conversely, the coefficients of *Far* are positive and highly statistically significant, suggesting that for farmers living at least X minutes away from the sales points, the likelihood of purchasing the improved seed increases by 35% points. The outcomes for each of these analyses suggest a more complex effect on farmers' purchasing behavior than initially anticipated, with those living further away from a salespoint being more likely to purchase. This suggest farm characteristics other than distance are likely swamping any convenience effect. Neither of the interaction terms are significant, suggesting that treatment effects were not impacted by distance.

Table 3. Distance effect of farmers purchasing behavior

VARIABLES	(1) Purchased	(2) Purchased	(3) Purchased
Treatment	0.043		0.023
	(0.79)		(0.29)
Distance	0.013***	0.013***	
	(7.12)	(7.05)	
Distance Squared	-6.3×10^{-5}***	-6.3×10^{-5}***	
	(-5.03)	(-5.03)	
Medium			0.144**
			(2.15)
Far			0.383***
			(6.11)
Medium×Treatment			-0.046
			(-0.047)
Far×Treatment			0.015
			(0.15)
Constant	-0.012	0.031	2.23**
	(-0.09)	(0.27)	(2.17)
Observations	685	685	685
Control	Yes	Yes	Yes
Adjusted R-squared	0.144	0.144	0.099
Number of Sub-counties	15	15	15
County FE	Yes	Yes	Yes

To examine the hypotheses that farmers' proneness to nostalgia and loss aversion will mediate their purchase decision, we divide the sample for comparisons. These results are presented in **Table 4**. Columns (1) and (2) separate the sample into two groups by whether they display above or below median sensitivity to nostalgia based upon the administered nostalgia scale. We present the results with standard errors clustered at the village level. Similar results are obtained using the other approaches to standard errors. After adding full sets of control variables and sub-county-level fixed effects, a treatment effect is found of 0.152 for the high nostalgia group. This indicates that within this group, farmers who receive the treatment have a 15.2% higher likelihood of purchasing the quality seed of ISVs. The effect is significant with a p-value of less than 0.05. Those with low nostalgia did not display a response to treatment.

In columns (3) and (4) we display results for those displaying above and below median sensitivity to loss aversion based on the administered index (related to hypoethesis 2 and 3). The coefficient for treatment is almost double among those displaying a high level of loss aversion relative to those displaying a low level. However these coeficients are insignificant, and only suggestive. No heterogeneous significant treatment effects are found. While the nudge treatment effect was expected to be related to sensitivity to nostalgia and loss aversion, we find only a significant relationship with the former.

576 **Table 4**: Mediating effect of nostalgia and loss aversion on behavioral nudges

	(1)	(2)	(3)	(4)
	General Nostalgia		Loss Aversion	
	High	Low	High	Low
Variables				
	Purchased	Purchased	Purchased	Purchased
Treatment	0.152**	0.006	0.092	0.051
	(2.06)	(0.11)	(1.43)	(0.81)
Absolute Risk Aversion	0.001	-0.001	0.003	-0.001
	(0.61)	(-0.48)	(1.24)	(-0.41)
Constant	0.033	0.132	0.076	0.083
	(0.19)	(1.06)	(0.52)	(0.57)
Observations	465	474	435	509
Controls	Yes	Yes	Yes	Yes
Adjusted R-squared	0.054	0.041	0.059	0.029
Number of Sub-counties	15	15	15	15
Sub-county FE	Yes	Yes	Yes	Yes

577 Note: Samples are separated based on the median value of different measures of farmers' nostalgia and loss aversion. Columns (1) and (2) indicate results for general nostalgia.
578 General nostalgia is calculated by aggregating the response to 7 questions including the frequency and importance of nostalgic emotions experienced by the respondents.
579 Columns (3) and (4) present results for an index of loss averse behavior. $Treatment$, indicating whether the household receives the treatment, is interpreted as the average
580 treatment effect of behavioral nudges. All models include full sets of controls and sub-county-level fixed effects. T-statistics calculated by using village-level clustered standard
581 errors are shown in parentheses. Asterisks indicate the following: ***=p<0.01, **=p<0.05, and *=p<0.1

5. Summary, conclusions and implications

The application of nudge theory in agriculture is recent but rapidly expanding. This study is, to our knowledge, the first to test the effect of a suite of nudges relating to nostalgia, loss aversion, and convenience on the adoption of improved agricultural technologies. The study used cluster-randomized controlled trials in which nudges were deployed in clusters of treatment villages during two consecutive seasons. The field experiment covered all the counties and sub-counties of Amuria district in eastern Uganda, and focused on smallholder producers of sweetpotato. The district is one of the leading sweetpotato growing areas in Uganda, a country that is a secondary center of sweetpotato diversity. Per capita production and consumption of sweetpotato in Uganda is among the highest globally.

The study randomly assigned 120 villages to treatment villages (n=64) that received the full suite of nudges including convenience of access and control villages (n=56) that received no nudge other than the convenience of access. Both groups of villages however received quality seeds of improved sweetpotato varieties that were provided at salespoints manned by a host farmer (salesperson) and located in an area within each study village that is easy to access by the co-villagers.

We find that nudges had an effect on the purchase of quality seed of ISVs. Specifically, the likelihood of households purchasing quality seeds of ISVs increased by 6.5% when they were provided with behavioral nudges. This is a large enough effect to be of policy relevance. Moreover, the behavioral nudges are relatively inexpensive to implement and thus show some promise. However, the effect is not robust to all specifications, suggesting the need for continued study and further evidence. The lack of robustness is perhaps in part related to the bad weather (severe drought) at the beginning of the second season, strategic behavior by salespersons, and certainly to sample heterogeneity: farmers prone to high nostalgia were 15% more likely to purchase quality seed when exposed to behavioral nudges (p-value <0.05). These

findings lend support to our first hypothesis and lead us to conclude that behavioral nudges invoking nostalgia have a positive effect on the adoption of improved agricultural technologies among farmers prone to such feelings. This is important as it offers a tool to reach a group that may be particularly difficult to persuade.

The study, however, failed to find evidence in support of the second hypothesis. The effect of loss aversion on the purchase of quality seed of ISVs was not significant at any level. It is too early to take this as a firm result (it may be a false negative) since this outcome may have resulted from the failure of material/pictures used in this study to activate the experience of loss aversion successfully.

In addition to testing the two hypotheses related to nostalgia and loss aversion, we also examined how convenience performs as a nudge. We find evidence that convenience (proxied by distance to salespoint in walking minutes) has a nuanced effect on the purchase of quality seed of ISVs. The results specifically show that distance has a non-linear (i.e., inverted U-shaped) relationship with farmers' purchasing tendencies. This finding demonstrates that as the distance between farmers and sales points increases, the likelihood of farmers purchasing the quality seed of ISVs initially rises, then subsequently declines. The drop in purchases at higher distances could be due to the high transport/transaction costs of moving sweetpotato vines. Moreover, farmers located very far from the sales point are unlikely to have seen and interacted with the nudges. Thus, we conclude that while convenience increases the likelihood of the adoption of agricultural technologies, the effect is rather complex/nuanced.

5.1. Policy implications

First and foremost, the finding that nostalgia nudges significantly influence farmers' purchasing choices provides a viable policy tool. Embedding cultural and historical narratives in quality seed promotion strategies is effective. It ensures our messages not only reach but also resonate with farmers.

On the other hand, our loss aversion nudges were too weak to have an impact. Much of the prior literature on loss aversion frames losses using strong and clear wording and generally in numerical terms, while ours relied on a more visual approach because of the low literacy levels among smallholder farmers the study targeted. This approach doesn't sufficiently influence farmers' behaviors. Improving the accessibility of quality seeds through strategic placement of salespoints and exploring diverse distribution methods is also vital. Our policy approach needs to be both adaptive and continuously evolving to meet the varied and dynamic needs of smallholder farmers. The nuanced findings emphasize the fact that agricultural policy interventions need to be structured in a way that is both empirically informed and empathetically crafted to be effective.

Conflict of interest statement

The authors declared that they have no conflict of interest

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869 **Appendices**

870 *Appendix A: Poster used to activate feelings of nostalgia and loss aversion among*

871 *treatment farmers*

872

873

Appendix B: Text message reminders sent to purchasers of quality vines of ISV at the beginning of Season 2

English language

1. Did you know that vines from local sources often contain many pests and diseases?
2. Did you know that planting quality vines found at your village sales stand leads to higher yields?
3. Hurry! Get quality sweetpotato vines at your village sales stand.
4. You get more, bigger and better roots when you use quality vines in your village sales stand local vines.
5. Farmers who plant quality vines sold in your village sales stand worry less about sweetpotato pests and diseases.
6. Farmers who are planting quality vines from your village sales stand are getting more, bigger and better roots.
7. Planting quality vines sold at your village sales stand gives you more sweetpotato to cook and sell, and more *amukeke*.

Ateso language

1. Kijeni lem ijo ebe, akwii nu acok nu itocununete amisirin wok etapit duc ajaut keda ikur ka adekasinei nu acok.
2. Kijeni lem ijo ebe, aira akwii nu itojokaritai nu ejaasi agwelanaret na ocalo kon einakini acok aimini ejok.
3. Kiwonyuni !, kodum akwii nu acok nu itojokaritai kane egwelanarere kocaalo kon.
4. Icoki bino nywal apol, adito kede abeco ka ipito oboke icok akome yot ame otye acato icalo ni.

5. Akoriok luiraete akwii nuitojokaritai nukwana egwelario ocalokus, mam iyalongongoete kanu ikur ka adekasinei nu acok
6. Akoriok lu iraete akwii nu itojokaritai nu ejaasi agwelanaret na ocalo kon edumunete acok nu ejokuka, koburok ido kominitos ejok.
7. Aira akwii nu itojokaritai nu ejaasi agwelanaret na ocalo kon ijaikini ijo acok nu ipu nu nyaman ka agwelar da. Ka *amukeke* da na epol.

Langi language

1. Onwongo ingoe ni oboke icok me kin paco kom gi pe yot; otye kede kudi apol acamo gi kede two pol?
2. Onwongo ingoe ni pito oboke icok akome yot mio icok nyak adwong?
3. Bunye! Nwong oboke icok akome yot ame two pe iye me apita ame otye acato icalo ni
4. Ikunyu icok apol, adito kede abeco ka ipito oboke icok akome yot ame ber kato pito oboke me kin paco

Icoki bino nywal apol, adito kede abeco ka ipito oboke icok akome yot ame otye acato icalo ni.

5. Oput ame pito oboke icok akomgi yot pe paro ni kudi acamo onyo two amako icok gi
6. Opur ame pito oboke icok akome yot gin kunyu icok apol, adito kede abeco
7. Pito oboke icok akome yot mii inwongo icok apol ame konyi me ateda kede acata, dang mii otere adwong

Appendix B: Additional Results

Table 5: Baseline Regression with County-Level Clustered Standard Error

VARIABLES	(1) Purchased	(2) Purchased	(3) Purchased	(4) Purchased
Treatment	0.065*	0.069*	0.068*	0.071*
	(1.90)	(1.88)	(1.88)	(1.77)
Absolute Risk Aversion				0.001
				(0.42)
Respondent Sex		-0.025	-0.030	-0.040
		(-1.07)	(-1.26)	(-1.70)
Years of Schooling		0.017***	0.017***	0.019***
		(4.20)	(4.16)	(4.44)
Household Size		0.008*	0.007	0.005
		(2.04)	(1.67)	(1.28)
Own Cultivable Land		0.016***	0.016***	0.019***
		(4.09)	(4.16)	(4.92)
Constant	0.349***	0.157***	0.127**	0.063
	(10.22)	(3.74)	(2.34)	(1.03)
Observations	1,133	1,133	1,133	944
Adjusted R-squared	0.017	0.039	0.040	0.042
Number of Counties	15	15	15	15
Frequency of Vine Purchase	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes

Note: Columns (1) to (4) show the baseline results from the LPM. $Treatment$, representing whether the household receives the treatment, is interpreted as the average treatment effect of behavioral nudges. All models include county-level fixed effects. t-statistics calculated by using county-level clustered standard errors are shown in parentheses. Asterisks indicate the following: ***=p<0.01, **=p<0.05, and *=p<0.10.

Appendix C. Analysis of spillover effects

VARIABLES	(1) Purchased	(2) Purchased
Distance to Nearby Treatment	0.022	0.022
	(1.38)	(1.25)
Every Season	0.039	0.039
	(0.44)	(0.40)
Every Two Season	0.197**	0.197**
	(2.34)	(2.52)
Sometimes	0.045	0.045
	(0.80)	(0.82)
Absolute Risk Aversion	0.003	0.003
	(1.01)	(1.01)
Respondent Sex	-0.099*	-0.099*
	(-1.83)	(-1.78)
Respondent Age	-0.001	-0.001
	(-0.83)	(-0.71)
Years of Schooling	0.015**	0.015*
	(2.15)	(1.78)
Household Size	0.013	0.013
	(1.60)	(1.44)
Own Cultivable Land	0.020**	0.020**
	(2.03)	(2.36)
Constant	0.146	0.146
	(0.93)	(0.89)
Observations	436	436
Adjusted R-squared	0.049	0.049
County FE	Yes	Yes

Columns (1) show the results with robust standard error, and columns (2) show the results with village-level clustered standard error. Asterisks indicate the following: ***=p<0.01, **=p<0.05, and *=p<0.1

[1] Henceforth referred to as quality seeds

[2] Ever since the seminal treatise on nudge by Thaler and Sunstein (2009), behavioral scientists have tested the theory in multiple other sectors. These include the health sector (see a review by Nwafor et al., 2021) with the most recent notable application by the British government to respond to the COVID-19 pandemic; education sector – for example Benhassine et al. (2015) work showing that the framing of a cash transfer could be as effective in encouraging investment in education as making the transfer conditional; nutrition program – for instance the Smarter Lunchroom Movement in the United States of America (USA) (Hanks et al., 2013; Greene

et al., 2017); public finance (focusing on taxes) (Antinyan & Asatryan, 2019); environmental management to reduce pollution and waste (Wu et al., 2021); applications in the hotel/hospitality industry (Caris et al., 2018; de Visser-Amundson & Kleijnen, 2020); in the energy sector for reduced electricity waste (Congiu & Moscati, 2022); among many others.

[3] Duflo (2011) was among the first to apply nudges in agriculture in a study that tested the effect of present bias nudges on fertilizer use in Kenya. Since then, the application of the nudge theory in agriculture has expanded (Wuepper et al., 2023). Scholars have specifically sought to demonstrate the wider effect of nudges in many subsectors of agriculture. Wuepper et al. (2023) highlight how farmers in Germany, France and the USA have responded to nudges of different forms. Khanna et al. (2017), in their USA study, find that presenting nudges in the form of framing losses farmers might incur from the non-use of efficient water management practices (i.e., loss aversion) increases the use of efficient water management techniques. Chabé-Ferret et al. (2019) find that social comparison nudges, which compare consumption of the individual farmer with that of others, reduce water consumption of the heaviest water users in southwest France. Peth et al. (2018) assess the effect of a suite of nudges in compliance with environmental restrictions relating to water quality protection from non-point source farm-fertilizer-based pollution among farmers residing near water bodies in Germany. While testing the likelihood of crowding out effect of using multiple nudges in tandem in a UK farm environment, Howley and Ocean (2022) find that a combination of social norm and status signaling nudges increases the intention among farm managers to adopt ICT-based agricultural technologies, suggesting that social (injunctive) norm nudges drive farmers who desire to "fit in" to adopt agricultural technologies. Davidson and Goodrich (2023) examine the role of information nudges in the adoption of farm insurance in the northeast and southeast USA and find that framing insurance as a risk management strategy increased uptake.

[4] Low use of improved crop varieties has led to stagnation in agricultural productivity and production in these countries (Macours, 2019; Takahashi et al., 2020; Suri & Udry, 2022), with cereal yields in Africa, for example, remaining below 0.5 tons/ha since the 1960s (Suri & Udry, 2022). The latest estimates by Fuglie and Marder (2015) show equally low rates of adoption of other improved crop varieties across Africa. They estimate that only 15% of the total land planted with food crops is under improved varieties. Across Africa, the adoption of improved varieties has remained disappointingly low, averaging 17.8 % in West Africa, 21.7% in Central Africa, 24% in East Africa, and 31.2% in Southern Africa – giving an average rate of 23.3% for sub-Saharan Africa. Progress in agriculture and its contribution towards meeting the global development objectives (and

Sustainable Development Goals (SDGs)) of poverty reduction and zero hunger (SDGs 1 and 2 by 2030), on the other hand, depend on rapid productivity increases in these countries.

[6] Market imperfections increase transaction costs and dampen incentives to invest in yield-enhancing technologies (Ogutu et al., 2014; Okello et al., 2020). Specifically, for markets in developing countries, it can be difficult for smallholder farmers to know where to get quality seeds/inputs of desired characteristics (Suri & Udry, 2022). Even when such sources are known, farmers may not trust the credibility of the quality of the input, owing to a widespread perception of adulteration and counterfeiting (Toro, 2014; Michelson et al., 2023).

[7] The low adoption could be due to the fact that these estimates rely on farmers' self-reporting of varieties grown. Recent studies have indicated that such self-reported data is erroneous (Opata et al, 2021; Abay et al, 2023).

[8] *Amukeke* are dried sweetpotato chips used for preparing thick mashed sweetpotato often taken for breakfast or snack. The mash (also known as *amukeke*) is made by boiling dried sweetpotato chips boiled in water and then mashing it along with groundnut paste.

[9] *Inginyo* is made by first peeling the thin roots then crushing them into small flakes which are dried. The dried flakes are turned into flour and used to make porridge after mixing with sorghum or millet flour.

[10] https://www.cgiar.org/initiative/06-seedqual-delivering-genetic-gains-in-farmers-fields/

[11] Power calculations were conducted using the R simR package. The outcome variable of interest in all calculations is the adoption of improved sweetpotato varieties (a dichotomous variable). The other outcome of interest in this study is the extent of adoption measured by the quantity of seed of ISVs purchased, which is a continuous variable. Dichotomous variables generally require larger samples to detect effects than do continuous variables, hence we focused only on the binary adoption variable. We use a base rate of adoption of 9%, which implies a standard deviation of approximately 0.29. Estimates were based upon a mixed logit analysis, with households nested in villages. We assumed a correlation of adoption within a village of 0.10. An economically significant result requires an increase in adoption of approximately 20 to 25 percentage points. We also assume a control and one treatment condition, targeting rejection of the null that the treatment is equivalent to the control. We find that with $n = 1000$ (100 villages, 10 households per village) we would detect an increase in adoption of 20 percentage points with 97% probability and 15 percentage points with 80% probability. To allow for potential attrition and miss outs due to availability, we targeted 120 villages for the study.

[12] Due to fear of theft, some farmers resorted to having the salespoints inside their homes, which may have reduced access by some community members

[13] As recommended by an anonymous reviewer, we have conducted a test for potential spillover effects between treatment and control villages and present the results in Appendix C. In particular, we calculated the distance between each control village and its nearest treatment village. In a next step, we kept only control villages, regressed the purchase dummy on the distance calculated in the first step, with controls and fixed effects added. The results show that there is no negative effect of the distance variable (see Appendix C). This indicates that for control villages, being closer to the treatment village does not increase the likelihood of purchasing the improved vines, indicating no spillover effects.

[14] Information provided during the training was basic: i) about quality seed to be brought; ii) that the seed was certified (disease/pest-free); iii) that seed will be of 4 varieties (2 local and 2 new introductions, but all of high quality); iv) that seed was to be sold at pre-determined price and specified bundle sizes; v) there will be 2 rounds of distribution per season, separated by 1 week break to allow first round to sell out; vi) all sales transactions should be captured in a form provided by the research team. Additionally, the model farmers from treatment villages were informed that they would have a poster that is to be hung on the sales point, and that the poster had information about different types (quality and local/recycled) of seed.

[15] Besides the government inspection, samples of sweetpotato vines/seed from the vine multipliers were also collected by the research team and tested for the SPVD viruses. They were found to be free of SPVD. Further, the research team maintained close control of starter material used by the multipliers to produce supplied seed to ensure that seed were traceable to clean certified source (a lab based in Kampala).

[16] Each bag contained 1000 vine cuttings, each of 30cm length.

[17] The price of a bundle was set after consultations with farmers during a focus group discussion and validated at the training meeting of salespersons.

[18] The messages were written in the vernacular language and sent (one message at a time) each day of the week for 7 days, which was repeated during the second week. The messages, and English translation, are presented in Appendix B.

[19] We also report the results employing a sub-county-level clustered standard error (15 clusters) (See Appendix B). These results are nearly identical to the robust standard error results presented in Table 2, with each coefficient having the same sign and magnitude. Treatment coefficients in the sub-county clusters are all significant at a 10% level.

Biography and photo

Julius J. Okello is an Impact Assessment Specialist at International Potato Center. He has PhD in Agricultural Economics with specializations in International Agricultural Development. He has 25 years of research experience on international agricultural development. His research focuses on the role of behavioural and social sciences in explaining farmer and consumer behaviour, adoption and impact of agricultural innovations including improved crop varieties on farm household welfare and farming system level; the impact of agriculture-nutrition-health interventions; economics of breeding for impact and for the future; market intelligence and breeding program design. His publications on nudges include: "Social incentives as nudges for agricultural knowledge diffusion and willingness to pay for certified seeds: Experimental evidence from Uganda" (Food Policy, 2023); Okello, Julius J., et al. "Do behavioral interventions increase the intake of biofortified foods in school lunch meals? Evidence from a field experiment with elementary school children in Ethiopia." (Curr Dev Nutr. 2022)

David R. Just is the Susan Eckert Lynch Professorship in Science and Business in the Charles H. Dyson School of Applied Economics and Management at Cornell University. He received his PhD and MSc in the field of Agricultural and Resource Economics at the University of California Berkeley in 2001 and 1999 respectively. He has previously served as director of the graduate program and director of professional degree programs in the Dyson School, and as Area Coordinator for Applied Economics and Policy in the S.C. Johnson College of Business. Professor Just has won many national awards for outstanding research including several for *Outstanding Journal Article* in the *American Journal of Agricultural Economics*, as well as *Quality of Research Discovery* both in the Agricultural and Applied Economics Association and the European Association of Agricultural Economists. He was named a fellow of the Agricultural and Applied Economics Association in 2020.

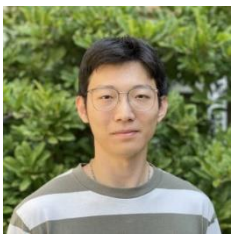
Arjan Verschoor obtained a PhD in economics in 2000 from the Erasmus University Rotterdam, the Netherlands. He then worked as a research officer for the University of Sheffield, UK, and in 2004 joined the School of Global Development of the University of East Anglia in Norwich, UK, where he is currently a Professor of Economics. He is also a research coordinator at the Norwich Institute for Sustainable Development, a transdisciplinary research institute specializing in sustainable food security, where he works closely with crop scientists. His research is aimed towards improving smallholder farmers' livelihoods in the Global South through understanding their investment, insurance, risk-taking, risk-sharing and intrahousehold resource allocation decisions. Towards this end, he has established a track record in organizing multi-site, multi-partner research-for-impact projects in East Africa, West Africa, southern Africa and South Asia.

Sylvester Okoth Ojwang holds an MSc. in Agricultural and Applied Economics from the University of Nairobi, Kenya. He worked with the Emerge Center for Innovations-Africa in 2020 to implement an FAO-commissioned review on livestock resilience initiatives across Africa. He then, in 2021, led the implementation of the USAID-supported Collaborating, Learning, and Adapting (CLA) Innovators Course in Kenya's arid and semi-arid counties. Sylvester currently serves as a research associate at the

International Potato Center (CIP), based at the sub-Saharan Africa regional office in Nairobi. His current work covers product market segmentation for greater potato and sweetpotato breeding investment impacts; behavioral interventions for sustainable innovation adoption; and strategies for scaling the production, processing, and consumption of orange-fleshed sweetpotato (OFSP). His research emphasizes the agriculture-food-nutrition nexus, particularly biofortified crops like OFSP, to improve livelihoods, food security, and nutrition across the region.

Janet Mwende Mutiso is currently a postgraduate researcher at the School of Global Development, University of East Anglia. She holds an MSc in Agricultural and Applied Economics from the University of Nairobi. Before joining UEA, she worked with Kenya's National Treasury on the Africa Economic Research Consortium Capacity Building program, supporting project appraisal and evaluation within the Public Investment Management unit. Previously, as a Monitoring and Evaluation Research Associate at the International Potato Center, she contributed to key projects including Scaling Up Sweetpotato Through Agriculture and Nutrition and Accelerated Value Chain Development. Janet's current research focuses on behavioural interventions to promote the adoption of improved sweetpotato varieties among farmers. Her research interests include food systems, gender, experimental economics, quantitative methods, and impact evaluation.

Chalmers K. Mulwa is an Economist with research interests on inclusive agricultural transformation and climate change economics. He currently works as a Social Scientist at the International Potato Center where he is also a Research Lead on Markets and Value Chains. He has over 15 years of progressive research experience acquired across research centers of excellence, including within the CGIAR, and within the African continent and recently in Southeast Asia. His recent research has focused on utilizing choice modelling to understand consumer choice behavior towards new technology and food safety, and value chain innovations for enhancing access to better diets among the most vulnerable. Chalmers received his PhD in Economics from the University of Cape Town in South Africa in 2020 and is also a Research Fellow at the Environment for Development Initiative (EfD).



Chenyan Gong is a Ph.D. student in Economics at the University of Wisconsin-Madison. He earned his M.S. in Applied Economics and Management from Cornell University's Dyson School and holds a B.S. in Finance from Sun Yat-Sen University. His research covers environmental, resource, and development economics, with a particular focus on climate policy, rural development, and industrial organization. Chenyan's work explores market structures, including monopoly and competition dynamics, and applies empirical methods to analyze real-world industrial and environmental challenges.

Sam Namanda obtained a Bachelor's and Masters in Crop Science in 1998 and 2021 from the University of Makerere, respectively and a PhD in Seed Systems in 2012 from the University of Greenwich, UK. Started working with CIP as a seed systems scientist in 2000. Key research outputs and protocols include the Triple S method seed standards for inspection and certification of seed, basic seed production under net-

protected structures, and training guidelines and manuals. As a seed system consultant, I implemented several research and development projects, including Farmer Field School (FFS) in East Africa and seed system technologies in Tanzania, South Sudan, Burundi, Kenya, Ethiopia, and Ghana. DDBIO, SASHA I and II, SweetGains, Prossiva, Seed Equal, TAAT. In collaboration with humanitarian organizations such as CRS, World Vision, and WFP, food and nutrition security activities for refugees in Uganda, South Sudan, and Burundi resettlements were implemented and scaled out.

Dr. Srinivasulu Rajendran, known as Srini, is an Agricultural Economist at the International Potato Center (CIP), CGIAR, based in Kampala, Uganda. He holds a PhD in Agricultural Economics from Jawaharlal Nehru University (JNU), India, and an executive program Postgraduate Certificate in Business Management from the Indian Institute of Management (IIM), with extensive experience in agribusiness, seed systems, and market assessment. Srini's work focuses on the commercialization of Vegetatively Propagated Crops (VPC) seed, including roots, tubers, and bananas, aiming to strengthen seed delivery system. His current research emphasizes demand creation for quality planting materials and improving the supply chain for VPCs to enhance food security in Sub-Saharan African countries and beyond. Recently, he has led multi-disciplinary teams under the Seed Equal Initiative and PROSSIVA program, contributing to scalable and inclusive approaches in the seed sector. Srini collaborates with key stakeholders, including private sector actors and local governments, to foster innovations that improve smallholder farmer livelihoods.

Reuben Ssali obtained a Bachelor of Science degree and a Master of Science degree in Crop Science in 2001 and 2006 from the University of Makerere, respectively and a PhD in Plant Pathology from Stellenbosch University, South Africa, in 2016. He is a plant breeder with the International Potato Center, CIP, in Uganda, with over 18 years of developing varieties to improve the efficiency of food supply in Africa. He has expertise in product design, population improvement, trait discovery, variety extraction and promotion. He is currently responsible for coordinating the sweetpotato breeding network for East and Central Africa, working with national sweetpotato breeding programs to respond to varietal requirements for the impact opportunities in the region.

Moses Bunsen Okim is a Senior Agricultural Officer serving in Amuria District Local Government as District Agricultural Officer. His work experience in the agricultural sector spans 15 years, 6 years at the district level, coordinating all agricultural programs offered by the state and non-state actors as a coordinator of National Agricultural Advisory Services and later as a sub-county Agricultural Officer. Furthermore, for three years, He served as an Agriculture and Environment Facilitator for the United Nations Office for Project Services under the Millennium Promise Alliance, collaborating with the government of Uganda on a food security and economic empowerment project for agropastoral households in Karamoja subregion. He holds a PGD in project planning and management and a BSC in agriculture (MAK). He awaits graduation with a Master of Crop Science (MAK). He is passionate about agricultural research, skills development, and working to promote the economic empowerment of rural farmers.

Hugo Campos is Deputy Director General for Science and Innovation at the International Potato Center (CIP), and a plant breeder by training. He has +25 years of international experience working in several regions of the globe including Latin America, Asia and Sub-Sahara Africa. Most of his professional career has focused on managing large international breeding teams in multiple crops such as potato, sweetpotato, sugarcane, maize, canola and wheat. He is an advanced practitioner of innovation and entrepreneurship and ardent supporter of behavioral sciences. Hugo has published six books, out of which "The Innovation Revolution in Agriculture" features behavioral sciences prominently. He is a Chilean national and holds a Ph.D. from the John Innes Centre, UK, a MBA from Universidad del Desarrollo, Chile, and a Professional Certificate in Innovation and Entrepreneurship from Stanford University, USA.

Title page

Declaration