TESTING THE USE OF MOBILE TECHNOLOGY TO IMPROVE SMALLHOLDER SESAME CULTIVATION

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FARM AFRICA

This paper aims to contribute to the emerging evidence base on the role of ICT within agriculture by summarising Farm Africa's initial experience of testing mobile technology in the sesame value chain.

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Summary

Delivering high quality extension services, training in improved agricultural practices and better access to information for smallholder farmers is central to Farm Africa's work. The way we do this has important consequences for the cost effectiveness of our projects.

Farm Africa tested the use of mobile technology as a possible alternative to the traditional 'farmer field school' approach in our sesame marketing project in northern Tanzania.

Farmers viewed interactive training modules in their local language, containing locally-produced videos and images on tablet computers.

Initial results indicate that farmers trained using tablets were able to achieve similar increases in knowledge of sesame cultivation as those trained by demonstration plots, but for around a third of the cost.

A new phase of our sesame work will build on these findings, looking in particular at how mobile technology can improve the livelihoods of women and young people; in addition to assessing different business models for ensuring the long term sustainability of ICT-based extension services.

Background

Technological improvements in the 21st century have allowed for greater global connectivity and provided a platform for information dissemination on an unprecedented scale. Research shows Africa to be the world's fastest growing telecommunications market.

Mobile phone usage has grown from less than 2 million subscriptions in 1998 to over 778 million users or 70% of the population in 2013 (Chavula, 2014 & Informa Telecoms, 2014). Improving mobile network connectivity and smartphone availability are set to enhance the accessibility of technology and information across Africa (Deloitte, 2012).

For remote and underserved rural communities, these developments bring new opportunities to access agricultural extension services and information, which were previously out of reach. For example, ICT has enabled the Ethiopian Commodity Exchange to transmit commodity prices to farmers in real time via mobile phone, message board or online; similar market based extension services exist in Kenya, Malawi, Uganda and Mozambique amongst others (UNDP, 2012 & USAID, 2011).

ICT-based agricultural extension may allow development agents to better tackle issues of gender bias within extension services and the marginalisation of smallholders from decision making processes through greater flexibility and the decentralisation of information (Christoplos, 2010 & USAID, 2013).

However, the role of ICT in agricultural extension services is still relatively untested and some key questions remain around its optimal use. Almost all ICT based extension services are subsidised and the sustainability of this model falls within the larger debate of public-private partnerships and responsibility for service delivery (APPG, 2014).

Multiple text and voice-based information management networks are increasingly available to smallholder farmers (Nyirenda-Jere & Kazembe, 2014); little research has been done however to test the effectiveness of ICT as a training tool.

This paper aims to contribute to the emerging evidence base on the role of ICT within agriculture by summarising Farm Africa's initial experience of testing mobile technology in the sesame value chain.

Though small scale, our research demonstrates the potential benefits ICT can bring to smallholders through flexible training adjusted to the learner's pace and provides a comparison against a traditional non-ICT training approach.

When incorporated into participatory and government-supported initiatives, the adoption of ICT as a platform for smallholder training can contribute to the equalisation of access to information; supporting all smallholders, men and women, to make informed decisions about their livelihoods.

The Tanzania Smallholder Sesame Production and Marketing Project

Farm Africa's Sesame Marketing Project supports smallholder farmers in the Babati District of Tanzania to improve sesame cultivation and food security and increase household incomes.

Farm Africa delivered training to agricultural extension agents, contact farmers ('trainers-of-trainers') and other sesame farmers through workshops and demonstration farms and promoted cultivation of improved sesame varieties[1]. Information provided included advice on the right sesame seeds to suit individual farmer's requirements; improved agronomy practices to maximise potential yields; effective post-harvest handling and marketing.

A recent evaluation found that "average incomes accrued from sesame had been increasing significantly" each season. "Before 2009, sesame was grown as a traditional crop where most farmers harvested less than one bag (85kg) per acre", whereas some project villages are now seeing productivity at an "average of three bags per acre."

The project has now entered a third phase.

The current approach

Many agricultural development projects, including Farm Africa's, implement a Farmer Field School approach. This generally involves training contact farmers (CFs) intensively in relevant agronomic skills, and supporting them to pass on these skills and knowledge to a larger pool of adopter farmers using demonstration plots.

This approach can be highly effective in bringing new knowledge and information to many more farmers than project staff could reach directly, and builds capacity for farmers to take ownership of continued development.

Our Sesame Marketing Project, for example, delivered training and information in improved sesame cultivation to a total of 5,520 farmers by directly training only 920 CFs. Despite these successes, this conventional approach has some challenges that limit its ability to deliver at scale. These include:

- **Timing:** To be effective, training and extension services must be provided to CFs at an appropriate time in the agricultural season – it is no use learning how best to prepare your land once you have already planted. This means, firstly, CFs have to participate in several learning events at key stages in the season; with the associated time requirements and logistical costs of doing so.

Secondly, there is a relatively small window in which the conditions are right to (a) bring the CFs together for training in a particular technique, (b) have them each go back and demonstrate it to adopters on demo plots, and (c) have suitable conditions for adopters to put acquired knowledge into practice on their own plots. Consequently, adopter farmers may have to wait until the next season to implement new techniques, by which time they may have forgotten some of the training.

- **Lack of flexibility in training**: In the conventional approach, adopters have to physically travel to demo plots at a predefined time to take part in training. This can be particularly challenging for women farmers, who generally have many other household responsibilities and may be less able to devote a whole day to travelling for training. The approach also provides limited opportunity to revise learning once the particular stage in the agricultural season has passed.

- **Quality assurance:** It is difficult to ensure all adopter farmers are receiving the same complete and high quality information as the CFs. Spot checks and follow-ups are usually built into these programmes, but it can take time to identify CFs who are consistently underperforming; by which time the adopters may have missed one or more seasons.

1 "Lindi white," "Naliendele" and "Ziada" cultivars

Why mobile technology?

In considering how to mitigate these challenges, Farm Africa identified a potential role for mobile technology as a learning tool. The expected benefits included greater control over the quality of material reaching farmers, as training content featuring input from local experts could be seen by anyone and revisited if required to refresh knowledge.

Adopter farmers would not have to travel to a fixed site at a specific time, but could rather learn more flexibly at a time that suited them, through shorter but more frequent sessions. CFs would effectively become knowledge portals, rather than teachers, and need only be trained in the effective operation of the tablet, requiring far less time than a conventional schedule of technical training.

Furthermore, as new knowledge emerges, such as suitable responses to a new local pest or disease, tablets could be updated with new content far more easily, and at lower cost, than bringing CFs physically together.

Hypothesis

As the Sesame Marketing Project was already demonstrating increases in production and revenue for farmers undertaking training, the pilot was designed to focus on the knowledge impacts of ICT-based training. This assumes that if the knowledge could be imparted and retained, improved productivity would follow.

Additionally, we were not attempting to directly compare the relative effectiveness of the two approaches, but rather to find out whether the knowledge gains seen from the conventional approach could be mirrored without the use of fixed demo plots, and their particular constraints. So, the evaluation was designed to test the following hypothesis:

Using ICT allows us to reach large numbers of farmers at the right time with high quality training and extension services, increasing knowledge in a similar way to conventional training methods.

Methodology

Farm Africa worked with the Cambridge Malaysian Education and Development Trust and the Malaysian Commonwealth Studies Centre to design and implement a small pilot using tablet computers instead of demonstration plots in two of the project villages. Ten CFs and two government extension agents were trained in operating the tablets, which were loaded with locally-produced videos explaining best practice for each stage of the production cycle.

Between November 2013 and April 2014, tablets were given to 10 CFs to take around to sesame farmers within their community as 'portable demo plots'. The farmers viewed training modules relevant to key milestones in the agricultural season, testing their understanding with inbuilt learning questions. Each farmer was visited several times as new modules were developed, giving them the chance to go back and repeat sessions, as desired.

The ten contact farmers collectively reached 499 sesame farmers. Of these, 49 farmers were selected[2] and interviewed to gather data on (i) their knowledge of key aspects of sesame cultivation, and (ii) their experiences of using the tablets.

2 To test the potential of the approach in general, rather than the efficacy of the initial pilot itself, we focused our limited resources on interviewing farmers trained by the best performing contact farmers. First, the subset of farmers trained by the top 3 performing CFs was selected, giving a pool of 143 farmers. From this group, 49 were randomly drawn for interview. While this approach clearly does not allow us to draw any conclusions about actual knowledge gain of the total population of farmers reached by all contact farmers trained in the use of tablets, it does provide an assessment of the potential of this approach.

The evaluation combined household surveys and interviews with the project crops officer[3] and two of the most effective CFs[4].

The surveys were developed in the local language (Kiswahili) and administered by trained enumerators using the same tablet computers. To minimise the likelihood of respondents discussing the answers to the knowledge-testing questions, all household data collection was completed in a single day.

Initially, a 'difference-in-difference'[5] approach was planned; using a comparison group trained through demo plots to compare against those receiving tablet-based training. Two comparison villages were selected on the basis of being similar to the tablet villages, in terms of key socio-economic, geographic and ecological parameters.

Farmers in the comparison group answered knowledge questions prior to undertaking training and again some months after training was complete. These were administered by independent enumerators using paper surveys.

For the tablet training group, the same knowledge questions were uploaded to the tablets and answered before viewing the first training module. However, this approach proved insufficient for establishing a baseline, as the modules were not always completed by individual farmers operating the tablets alone.

In many cases, the CFs worked with the adopter farmers to complete the modules, such that the knowledge questions were in fact a collective effort and it was not possible to isolate the baseline knowledge of individual farmers.

Instead, to estimate knowledge gains in the tablet group, participating farmers were visited by independent enumerators on a one-on-one basis and their knowledge gains were derived by comparing what they had learned with the baseline group. We judged that this provided a reasonable approximation, since they had been selected on the basis of socio-economic and geographic similarity.[6]

Results

At baseline, knowledge questions were correctly answered by, on average, 36% of respondents. After the training, the proportion of questions answered correctly in the comparison villages was 71%, while the proportion of correct answers was 78% in the tablet group.

While the test in the comparison villages was done immediately after the training, the test in the tablet villages took place 3-4 months after the farmers last accessed the course, indicating that knowledge was being retained.

Before joining the project, about a third of farmers interviewed knew that different seed varieties had different characteristics, and only half thought the crop should be planted in rows (as opposed to broadcasting seeds).

The majority of farmers responded incorrectly to technical questions regarding seed spacing; plant management; and storage after harvesting, at baseline only.

After taking the tablet course, 71% recognised that different sesame varieties had different resistances to disease, and 86% identified the correct planting methods.[7]

3 Farm Africa staff member

4 Selected on the basis of having reached the most farmers regularly at appropriate points in the agricultural season.

5 This refers to comparing the difference between the changes in a key variable experienced by two groups – e.g. comparing knowledge gains, rather than absolute knowledge levels.

6 Furthermore, none of the sites selected had received prior training on improved sesame production practices and none had access in the past to improved seed varieties. The sites were also isolated from each other, so no lateral transmission of knowledge was likely to have occurred.

7 We cannot directly compare knowledge outcomes between the two groups, as (i) the interviews took place much sooner after the initial training for the demo plot group and (ii) the tablet users were purposively sampled to include those trained by the best performing CFs, see footnote 2. However, to give a sense of comparison, the same questions were answered correctly by 92% and 98% of demo plot respondents, respectively.

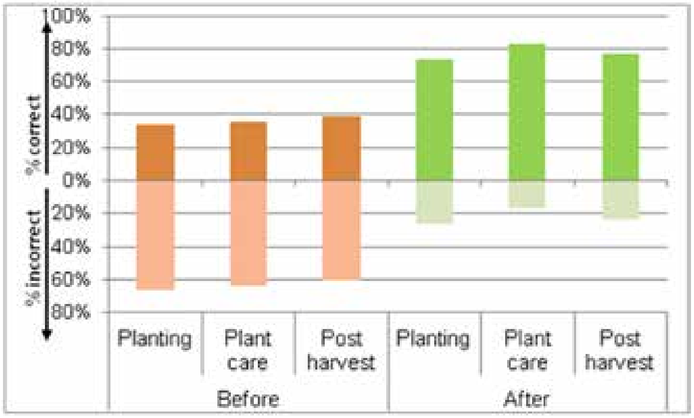


Figure 1: Responses to knowledge questions before and after training

A summary of the tablet group's performance in three of the main production stages is shown in Figure 1, with baseline performance for comparison.[8]

After the tablet training, the proportion of correct answers increased and the majority of questions were answered correctly by over 70% of respondents. Improvements were seen to varying degrees, providing important information about the topics that require more emphasis or a different learning approach in the course.

Three-quarters of the farmers accessed the course at least twice, and just under a quarter accessed the course more than four times. The questionnaire also confirmed that the use of the tablets was mostly a communal experience, with around half taking the course with other farmers.

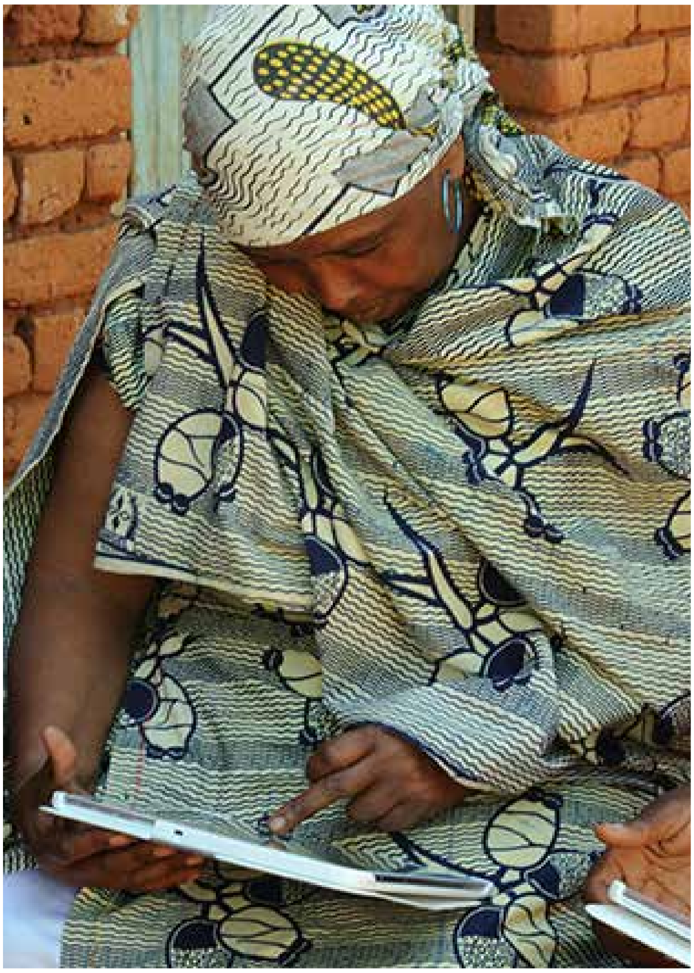
The farmers interviewed were overwhelmingly positive about using the tablets.(Fig 2)[9] Reasons quoted by farmers for preferring the tablet course to demo plots included: being able to access the course at a time that suited them and in their own home and being able to view the modules multiple times.

An additional advantage mentioned by respondents was that information is available in enough time to change production practices in the same season. Demonstration plots often only show the effects of modified practices after it is too late for farmers to implement the changes. Conversely, reasons cited by farmers for preferring demos over tablets included being able to see the plots first hand and being able to ask questions.

The learning application used supports student feedback and tutorial functions, and we will consider incorporating these in future versions.

8 Note that the exact wording of the questions was not always identical at baseline and endline, as some of the original questions were refined to make them less leading. This means that baseline knowledge levels may actually have been overestimated, such that the gains brought by training are even higher than appears.

9 This may indicate some degree of response bias if respondents felt that decisions about whether Farm Africa would continue supporting their village rested on their answers.



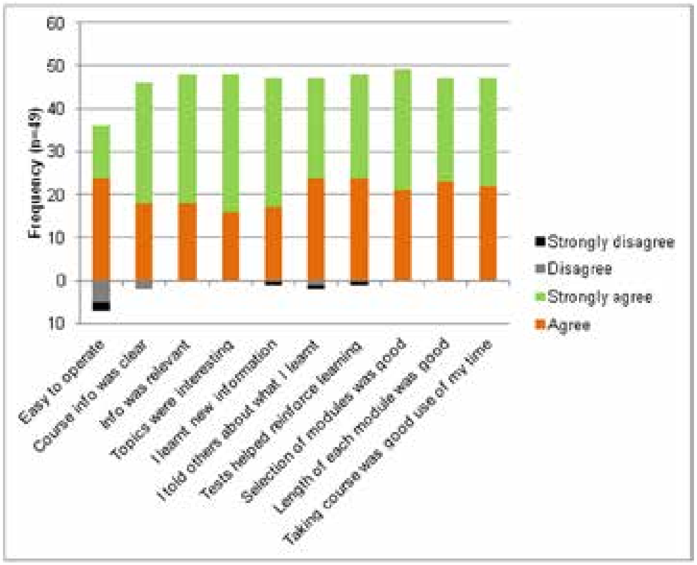


Figure 2: Farmer perspectives on using the tablet computer course

Nearly all farmers interviewed (96%) introduced changes to their farming practices after viewing the tablet course, however most changes were confined to the land preparation and planting stages. 76% of respondents believed this change led to an increase in their income from sesame farming.

On a scale of 1 to 5 (with 5 best), 69% rated the overall experience of the tablet module 4 or 5, and all respondents agreed or strongly agreed with the statement, "taking the course was a good use of my time".

As well as gathering data on knowledge gains, the evaluation also increased our understanding of the potential for ICT to deliver high quality, timely information and advice to remote smallholder farmers.

Through in-depth discussion with those participating, a number of important lessons for improving the sustainability of this approach have emerged. These will shape how we design and implement similar projects in the future and include:

- Regardless of the quality of the learning platform, identifying and supporting a network of strong-performing CFs is critical to achieving desired results. This applies to the conventional and ICT-based approaches, simply adopting ICT is not sufficient to ensure all target farmers receive the desired quality of service. Mobile devices can help ensure that farmers reached are receiving high quality information, but it still requires a motivated CF to ensure those farmers are reached in the first place.

- The pilot project managed to secure the support of the whole community. This buy-in is essential particularly in societies where there are cultural barriers for members of the youth teaching elders, or for women teaching.

- It is important to establish a clear remuneration system for CFs, and be transparent about expectations from the outset. During the pilot, the reward system was adjusted from a fixed monthly fee to a payment structure based on number of farmers reached, when it became clear that some CFs were performing much more strongly than others.

- Wi-fi only devices were used to keep costs down, but this made it more challenging to download new content and upload data from the field. In future, 3G devices or smartphones may be more appropriate to allow two way information exchange.

Comparing costs

A preliminary analysis of potential cost savings indicates that using mobile technology could dramatically reduce cost per farmer reached and bring greater economies of scale.
With demo plots, the main cost is CF training. These costs increase broadly in line with the number of farmers reached. With mobile technology, on the other hand, regardless of whether we reach 1,000 or 100,000 farmers, some of the costs (e.g. creating the training modules and maintaining the software) remain largely the same. This means, as the number of users increases, the total cost per person will fall. The chart below shows our initial estimates of cost per farmer[10].

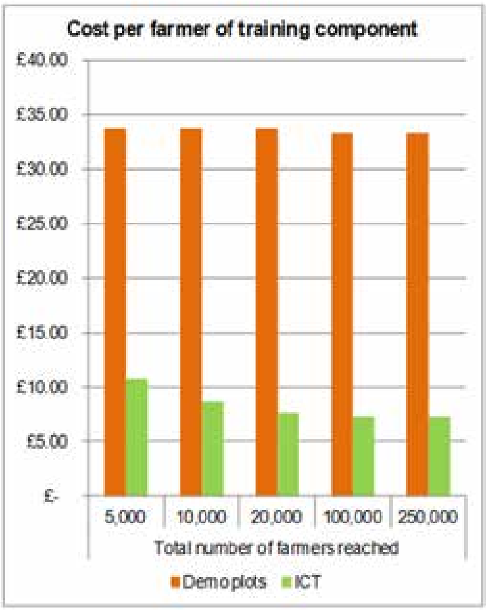


Figure 3. Cost per farmer reached

The ICT method is estimated to reach farmers at around a third of the cost per head of the demo plot approach.

This implies that, with the same resources, delivering training with ICT could allow us to reach 3-5 times as many farmers compared to using demo plots. Whether these cost savings can be maintained when implemented on a larger scale remains to be seen and we will be monitoring this closely in the next phase of our sesame project.

10 Note this is not a full cost-benefit analysis, it simply compares direct financial costs associated with providing agronomic training to farmers. It does not include all project implementation costs or non-financial costs e.g. farmers' time or the benefits - e.g. through improved training quality.

Limitations of the study

As noted, the pilot focused only on testing the link between training method and knowledge retention – it was not possible to evaluate any subsequent impact on sesame production or revenue. Moreover, we recognise that ICTs are enablers, and that the impact on both knowledge retention and any consequent behaviour change is as likely to be influenced by the nature of the learning materials and environment as the medium itself. It was not possible to assess the pedagogic aspects of the tablet course in this pilot, but this is something we will consider in more depth in our subsequent work.

Conclusion and next steps

While initial indications that mobile technology can deliver similar learning outcomes at a third of the cost of traditional approaches is highly encouraging, we still have a lot to learn about using ICT to reach smallholders at scale.

We are delighted to have secured funding from Comic Relief for a new phase of our work in the sesame sector, which will allow us to deepen our experience in this area.

In particular, we hope to learn more about:

(i) whether and how ICT can increase access to knowledge and information for women and young people;
(ii) how the approach can best become self-sustaining, without the need for NGO support; and
(iii) the optimal pedagogic approach.

Using mobile technology to improve the lives of smallholder farmers is an exciting and rapidly evolving field, and we hope to continue to explore new opportunities.

We welcome opportunities for collaboration and joint learning to help us contribute to the growing evidence base and support more African smallholders to grow their incomes.

References

All Party Parliamentary Group, (2014). Harnessing the Potential: ICTs and Knowledge Sharing in Agriculture. APPG on Agriculture and Food for Development. London: APPG. Available at http://www.appg-agdev.co.uk/news/68-parliamentarians-highlight-potential-of-icts-to-boost-smallholder-agriculture [Accessed 20 Jan. 2015].

Chavula, H. (2013). The role of ICTs in agricultural production in Africa. Journal of Development and Agricultural Economics, 6(7), pp.279-289.

Christoplos, I. (2010). Mobilizing the potential of rural and agricultural extension. The Global Forum for Rural Advisory Services. [online] Rome: UN FAO. Available at: http://www.fao.org/docrep/012/i1444e/i1444e00.pdf [Accessed 20 Jan. 2015].

Deloitte, (2012). eTransform Africa: Agriculture Sector Study: Sector Assessment and Opportunities for ICT. [online] Deloitte. Available at: http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/282822-1346223280837/Agriculture_FullReport.pdf [Accessed 20 Jan. 2015].

Informa Telecoms & Media, (2014). Africa Telecoms Outlook 2014: Maximizing Digital Service Opportunities. [online] Available at: http://files.informatandm.com/uploads/2013/11/Africa_Telecoms_Outlook_Low_resolution.pdf [Accessed 20 Jan. 2015].

Nyirenda-Jere, T. and Kazembe, J. (2014). Improving Policymaking for Agricultural and Rural Development in Africa: The role of ICTs in Knowledge Management. Food and Agriculture. [online] London: IIED. Available at: http://pubs.iied.org/pdfs/14636IIED.pdf? [Accessed 20 Jan. 2015].

United Nations Development Programme, (2012). The Importance of ICTs in the Provision of Information for Improving Agricultural Productivity and Rural Incomes in Africa. African Human Development Report. [online] UNDP. Available at: http://www.undp.org/content/dam/rba/docs/Working%20Papers/ICT%20Productivity.pdf [Accessed 20 Jan. 2015].

USAID, (2011). ICT to Enhance Farm Extension Services in Africa. USAID Fostering Agriculture Competitiveness Employing Information Communication Technologies. Washington DC: USAID

USAID, (2013). Reducing the Gender Gap in Agricultural Extension and Advisory Services: How to Find the Best Fit for Men and Women Farmers. MEAS Brief. Washington DC:USAID.

Acknowledgements

This work would not have been possible without financial support from the Georg und Emily von Opel Foundation and DFID Programme Partnership Arrangement (PPA) funding.

The pilot was delivered in partnership with the Biosciences for Farming in Africa (B4FA) project, funded by the John Templeton Foundation and the Cambridge Malaysian Education and Development Trust. Farm Africa is entirely responsible for the preparation and content of this document.

We are also grateful for the dedication and committement of the TSSPMP project team and the contact farmers in delivering this work on the ground.

Farm Africa technical review process

This paper has been prepared by Farm Africa's Programmes Department and reviewed and approved for publication by members of our Programmes Advisory Committee (PAC).

The PAC comprises technical experts, responsible for overseeing and advising the Board on all aspects of our programmatic work.

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