RESPONDING TO FALL ARMYWORM OUTBREAKS IN AFRICA

A Case Study of One Acre Fund’s Experience in the Field

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Introduction

Fall armyworm is a potentially devastating crop pest that has been quickly gaining ground in Africa since its arrival on the continent only a few years ago. Native to the Americas, the pest was first reported in Nigeria in 2016 and is now present in almost every country in sub-Saharan Africa.¹ It moves rapidly from location to location, with moths capable of flying as much as 100 kilometers (62 miles) a night and female armyworms laying up to 2,000 eggs in their lifetime.² It feasts on a range of crops, but is particularly destructive to maize—a primary staple food crop across much of the region.

The spread of fall armyworm is especially problematic in sub-Saharan Africa, as the region is home to tens of millions of subsistence farmers who depend on their crops as their sole means of survival. Many small-scale farmers already live a precarious existence—limited access to high-quality seeds and other farming inputs means that crop yields are low, and many families consume everything they produce without any additional harvest left to sell for income. Millions also experience an annual hunger season, a period of meal skipping and substitution before the harvest when food from the previous season has run out. Within this context, smallholder farmers are particularly vulnerable to shocks, and any reduction in crop yields in any given season can have severe consequences for food security. Fall armyworm outbreaks, when left unaddressed, can exacerbate hunger in rural communities and drive families deeper into poverty.

Founded in 2006, One Acre Fund is an East Africa-based nonprofit organization that is working with more than 800,000 smallholder farmers in eight African countries to increase crop yields and improve food security. We provide every family with a “market bundle” of services: 1) financing, 2) farm input distribution, 3) agricultural training, and 4) market education. We deliver this solution to within walking distance of our clients, and they repay their loans in full 97% of the time. On average, One Acre Fund farmers increase their incomes significantly each year on supported activities—even after repaying their loans—and they invest productively on nutritious foods, children’s school fees, and new business ventures. By 2020, we expect to reach over 1 million smallholder families in Africa.

One Acre Fund has encountered fall armyworm in all of the countries where we operate, and we have been working over the past two years to enable our clients to mitigate yield impacts. The purpose of this report is to share learnings from One Acre Fund’s on-the-ground experience working to address fall armyworm outbreaks in Eastern and Southern Africa. Ultimately, we hope this report will provide stakeholders with some meaningful context and actionable advice, as we work together to improve smallholder resilience especially in the face of changing climatic and agronomic conditions.

One Acre Fund currently offers services in Kenya, Rwanda, Tanzania, Burundi, Uganda, and Malawi, as well as operating a large pilot in Zambia and a small pilot in Nigeria. We first began to hear reports from our clients about fall armyworm infestations in 2017. Because the insects often migrate in unpredictable patterns, the frequency and intensity of these outbreaks have been highly variable from district to district, and sometimes even from farm to farm. One Acre Fund’s approach to data collection and monitoring has varied somewhat in the different countries where we operate, so it is difficult for us to make an overall estimation about how many farmers have been affected across our entire program over the past two years. We can, however, make a few country-level assessments. In a 2017 survey in Uganda, 79% of One Acre Fund farmers reported fall armyworm in their fields, with 36% saying they experienced some yield damage. More recently, a survey of more than 2,500 farmers last year in Kenya indicated that 58% had encountered fall armyworm in their fields, but only 10% of those affected reported having more than 100 infested plants in a single field.

The full extent of damage to crop yields and overall food security has also been somewhat difficult to ascertain, as harvests are affected by a host of different factors, including the weather and timing of planting and other fieldwork. In Rwanda, one of our largest and most mature country programs, our team has had the capacity to conduct more detailed surveys and yield modelling to try to isolate the effect of fall armyworm on farmers’ harvests. In 2017, this research showed that about 40% of our Rwandan clients may have been affected by fall armyworm, and this was associated with maize yield losses ranging from 8% to 13%, depending on the type of farming practices (e.g. whether farmers planted solely maize or intercropped fields with other crops) and interventions used (e.g. whether or not farmers applied insecticides).

While the severity and impact may vary country by country, we know that smallholder farmers across sub-Saharan Africa already face many challenges resulting from chronic poverty and food insecurity, and even moderate losses in crop yields can lead to increased hunger for rural families. It is important to closely monitor for fall armyworm and respond quickly to outbreaks. International organizations, governments, and other stakeholders that work with smallholder farmers need to be well informed and able to react to changing situations at they occur. In the next section, we will outline our methodology for developing fall armyworm action plans. Ultimately, any intervention should balance potential health, safety, and environmental effects with the need to promote sustained food security.

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³ The average size of a One Acre Fund farmer’s maize field in Kenya is about 0.6 an acre. More information about our field scouting guidance to farmers is found on page 6.
Developing a Fall Armyworm Response Plan

Following reports of fall armyworm in 2017, One Acre Fund developed a series of action plans designed to respond to outbreaks in each of our program countries. As much as possible, our interventions were tailored to specific local conditions, but they also depended on the level of staffing and resources we had available in each country. For example, our most mature programs in Kenya and Rwanda serve hundreds of thousands of farmers each, and both employ PhD agricultural scientists capable of conducting more extensive research trials and impact monitoring. We are using the learnings that we’ve developed in Kenya and Rwanda, as well as some of our smaller program countries, to continuously fine-tune our interventions program-wide, in an effort to improve our services to farmers every season.

Broadly speaking, One Acre Fund’s fall armyworm interventions can be divided into two main categories: training and products. In the sections below, we discuss our methodology for developing both types of offerings, and how we rolled out these interventions to hundreds of thousands of farmers in the field.

**Trainings**

The first step toward addressing fall armyworm outbreaks is to ensure that farmers know how to properly identify the insect and scout for infestations in their own fields. Our surveys have shown that in some cases, farmers have misidentified other insects, such as maize stemborer, as fall armyworm, which can lead to improper or ineffective responses. In order to prevent this, all farmers in all One Acre Fund country programs are offered trainings before the start of each season on how to properly identify fall armyworm and distinguish it from other pests. These trainings often include handouts with pictures of fall armyworms and damaged maize plants, as well as descriptions of the insects at various development stages.

One Acre Fund also provides farmers with guidance about how to prevent fall armyworm from attacking their fields and how to respond to serious outbreaks if they occur. These trainings follow the principles of Integrated Pest Management (IPM), an approach that involves using a holistic set of farming practices to suppress pest outbreaks while minimizing potential harm to people and the environment. Our advice to farmers draws from USAID and UN Food & Agriculture Organization guides for using IPM to address fall armyworm outbreaks in Africa, as well as a number of other sources.

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All One Acre Fund farmers are offered weekly or bi-weekly in-person trainings that cover a range of agricultural techniques, including on topics that fall under the IPM umbrella. Farmers attend these trainings in groups with their neighbors, and sessions are led by One Acre Fund staff field officers who speak local language dialects. Trainings are interactive, with field officers physically demonstrating recommended practices, and include question-and-answer sessions designed to help farmers retain information. Farmers also receive printed handouts with training guidance that they can take home for later reference.

One Acre Fund’s IPM training sessions that address fall armyworm prevention and treatment methods vary somewhat in our different program countries, depending on local needs. Below are some examples of topics that our training sessions may cover:

<table>
<thead>
<tr>
<th>EXAMPLE TRAINING TOPICS</th>
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<tbody>
<tr>
<td><strong>Crop Rotation</strong></td>
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<td>Farmers are advised to plant different crops in their fields in alternating seasons. We also teach farmers which crops are vulnerable to the same pests (e.g. fall armyworm is known to attack both maize and sorghum), and we recommend not planting these varieties in the same field in adjacent seasons.³</td>
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<tr>
<td><strong>Intercropping</strong></td>
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<td>This training demonstrates how to plant different crops in the same field in alternating rows, which can benefit soil health while increasing the total volume of food production. Some combinations, such as intercropping maize with beans or cassava, are known to significantly reduce fall armyworm infestations.</td>
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<tr>
<td><strong>Timing of Planting</strong></td>
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<td>Farmers learn to avoid late planting, which can minimize the availability of younger, more vulnerable maize plants during peak periods when fall armyworm feeds.</td>
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<tr>
<td><strong>Fieldwork best Practices</strong></td>
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<td>Farmers are advised about how to plough their fields to expose fall armyworm pupae and when to weed their crops in order to inhibit the spread of pests.</td>
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<td><strong>Variety Selection</strong></td>
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<td>This training informs farmers about different crop varieties, including some that may be more resistant to pest outbreaks. It also covers how to use of a mix of different crop varieties within one field or area.</td>
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<td><strong>Manual Control Methods</strong></td>
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<td>Because One Acre Fund clients farm on very small plots of land (usually less than 1 acre, on average), it is often possible to control fall armyworm outbreaks manually by regularly walking through fields and crushing egg masses and young larvae by hand. This training covers the best practices for mechanical control, including removing and burning the hearts of dead maize plants.⁵</td>
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<tr>
<td><strong>Balanced Fertilizer &amp; Lime Application</strong></td>
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<td>Improving soil fertility can lead to healthier and more viable maize plants, which are generally better able to tolerate biotic stress.</td>
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<td><strong>Preventing Spread Through Sanitation Measures</strong></td>
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<td>This training covers best practices for cleaning of equipment to avoid spreading crop pests between fields.</td>
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<tr>
<td><strong>Ecological Approaches</strong></td>
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<td>Trainings under this umbrella vary somewhat among different program countries. Examples may include how to provide habitats for natural predators to fall armyworms through residue retention, planting trees or flowering species, or how to repel pests through planting of grass barriers around fields or intercrops.</td>
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One Acre Fund staff field officers pay regular visits to farmers at their homes and in their fields, so there is opportunity for farmers to ask questions and for individual follow-up. In some cases, our Monitoring and Evaluation team also conducts client surveys to determine the level of farmer knowledge retention and compliance with One Acre Fund trainings. We use this information to tailor and improve our training regimens (e.g. by adjusting how trainings are presented to make them easier for farmers to understand, or by reiterating important information in future sessions to improve knowledge retention). Overall, most farmers are keenly aware of the potential risks that fall armyworm poses to their crops, and they are receptive to implementing new farming practices that can help them address this challenge.

Products

The above interventions are often successful in keeping fall armyworm under control, but there still may be some cases when severe outbreaks on individual farms warrant an additional response. There are a number of insecticides available on the market in Eastern and Southern Africa for treating fall armyworm. Because of the devastating impact that outbreaks can have on families’ food security and livelihoods, many farmers will seek these products out on their own. Because of this fact, One Acre Fund has sought to guide farmers toward products that are both effective and known to have lower levels of risk for human safety and the broader environment. We do this first and foremost by providing farmers with training about what products are available locally that have relatively low risks to human and environmental health, and how to apply them safely and in proper amounts. In some of our country programs, such as Kenya, farmers also have the opportunity to order recommended products directly from One Acre Fund if they have determined that fall armyworm levels in their fields meet thresholds that indicate yield losses are imminent. More information about this is found in our Kenya case study on page 9.

Overall, One Acre Fund believes that insecticides should only be used as part of a broader IPM strategy. Our guidance to farmers for using these products adheres to the following steps:

1. **Determine whether insecticides are necessary.** In many cases, farmers experience only minor infestations of fall armyworm in their fields, and these can usually be resolved using IPM methods that don’t involve insecticides. In all of our program countries, we teach farmers how to monitor their fields regularly and address smaller outbreaks as they occur. In Kenya, for example, we tell farmers to regularly walk through their maize fields during the plant’s early growth stages, and manually inspect 50 plants from different parts of their field. We advise them to consider talking to their One Acre Fund field officer about ordering an insecticide only if they find fall armyworm present in their field on 10 different plants or more.

2. **Select which product to use.** Before recommending or distributing any insecticide to farmers, we put all potential products through a rigorous screening process. The criteria for this takes into account:
   - **Safety:** Farmers should avoid insecticides classified as highly or extremely hazardous by the World Health Organization, or restricted under international conventions (acute oral LD50 < 50, or acute dermal LD50 <200). Products with LD50 between 50 and 2,000 should only be selected in the absence

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1. Our crop rotation recommendations for fall armyworm were informed by the Insecticide Resistance Action Committee (IRAC)’s mode of action classification system.
of acceptable alternatives and with appropriate programmatic safeguards.

- **Ecological risk:** Selection should favor products with a lower Environmental Impact Quotient (EIQ), which quantifies the potential damage to organisms that benefit agriculture. The EIQ that One Acre Fund uses takes into account risks to bees, beneficial insects, and birds. We also account for potential risks to local water quality. We reviewed a large number of peer-reviewed publications for determining the best applicable methods for the areas where we work in Africa, and ultimately developed formulas for calculating risk based on recommendations published by the Cornell University College of Agriculture and Life Sciences.\(^8\)

- **Efficacy:** We consulted published, peer-reviewed research to help us select the most effective products, and in some cases we have also conducted trials at our research stations to confirm efficacy under local agronomic conditions. By and large, we recommend products with active ingredients that have been demonstrated to reduce pest populations or crop damage by >60% within 14 days. We also seek to ensure that different active ingredients are used on a rotating basis to prevent insects from developing resistance.

- **Farmer economics:** Products need to create a high return on investment, as most farmers don’t have income to spare for treatments that may only have minimal impact. Product selection decisions should take into account affordability under recommended application rates, as well as packaging sizes. Many companies sell insecticides in large-volume packaging that is inappropriately sized for smallholder fields. Recommending or distributing products that are available in smaller sizes can help prevent insecticide overuse, waste, and improper disposal.

Most countries in Eastern and Southern Africa have government-approved lists of insecticides for treating fall armyworm. However, some products may not meet international standards for health and ecological risks, or lists may not be up-to-date with newer and safer products. Current regulations in some countries mean that companies often have little incentive to invest in registering their newer products, because the registra-

\(^6\) Although labor intensive, this approach can be a sensible alternative in situations where farmers have limited opportunities for off-farm employment (i.e. the opportunity cost is close to zero), and where there is limited availability of safe, effective insecticides in smallholder-appropriate package sizes, or little access to safety equipment.

\(^7\) We used the Extension Toxicology Network, EXTOXNET, as a source for obtaining LD50 values. EXTOXNET is a cooperative of extension offices from Cornell University, Michigan State University, Oregon State University, and University of California at Davis.


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**LEARNING FROM EXPERIENCE**

Our fall armyworm response strategy was partially informed by our previous experience with maize lethal necrosis disease (MLND), a virus that inhibits maize growth and can lead to significant crop loss. In 2012, approximately 50% of our Kenyan clients’ fields were affected by MLND, so we dramatically overhauled our product offerings in 2013 to stem further outbreaks. This included introducing a package of alternate crops (sorghum, millet, cassava, sweet potato, and beans), and providing training about the importance of crop diversification for food security. Farmers experienced strong yields with their alternative crop mixes, and we saw high repayment rates in 2013, with 99% of our Kenyan clients repaying in full and on time. In following seasons, we were able to resume our maize offerings after rolling out new disease surveillance trainings and supporting research into MLND-tolerant maize varieties, which we now offer in our areas of operation. While fall armyworm has been its own unique challenge, our experience with MLND taught us important lessons about how to rapidly respond to crises and design interventions with farmers’ best interests in mind.
tion process can be difficult and they are still allowed to sell older, more outdated products. We encourage governments to update their lists of approved insecticides so that farmers have access to products that offer the best possible balance of efficacy, safety, and cost.

3. **Ensure proper application.** We provide farmers with repeated trainings about how to use insecticides properly, to better ensure safety and prevent overuse. We also promote the use of safety materials, such as backpack sprayers, masks, and gloves, and in some countries we offer these items directly to farmers who don’t already have them available. Our trainings include demonstrations that take farmers through the process from beginning to end, including covering safety procedures, dosing and mixing, spraying, and cleaning. In addition, we teach our clients how to dispose of leftover products and packaging as safely as possible, and we encourage governments to update their disposal mechanisms to promote good practices among farmers.

Unfortunately, smallholder farmers in many areas are facing an increasing number of external shocks—not only from pest infestations, but also from challenges such as erratic weather, water shortages, crop and livestock disease outbreaks, and political unrest. Programs like One Acre Fund that enable farmers to increase their assets, diversify incomes, and build community cohesion, as well as those that provide disaster-related assistance (such as crop or health insurance), will be critical for helping families become more prepared for future challenges. Overall, when families have sufficient harvests year after year and are able to build a foundation of prosperity, they will be more resilient and better able to withstand shocks.
Over the past several years, One Acre Fund has been exploring how to leverage the country's high mobile penetration to deliver improved services to families in rural areas. After extensive testing, we rolled out a digital repayments system to all of our Kenyan clients in 2016, in which farmers repay their loans using their mobile phones instead of with cash. The service, now in its fourth year, has been quite successful and popular among both our clients and staff. Farmers enjoy the convenience and security of the service, and mobile money has enabled One Acre Fund to process transactions faster, prevent fraud, and reduce overall costs. In addition to our mobile repayments system, we also use phone networks for farmer training. Today, we send a number of SMS messages to our clients throughout the growing
season, reminding them about when to conduct fieldwork such as planting, top-dressing, and weeding. These messages can help ensure that farmers are implementing good practices in their fields, which ultimately can lead to improved crop yields.

Following outbreaks of fall armyworm in 2017, we decided to leverage our mobile program once again to deliver tailored services to our clients. The Kenyan government’s list of approved insecticides includes a relatively larger number of safe and effective products, compared with some of our other countries of operation. We wanted to make the safest, most efficient products available to our clients at the local level, and ensure that they were being used properly and in the correct amounts. Through our mobile platform, we developed a new system in which farmers who experienced severe fall armyworm outbreaks could use their mobile phones to order products directly and on demand from One Acre Fund. Our treatment thresholds for Kenya are discussed above, on page 6 of this report under the “Determine whether insecticides are necessary” heading.

On-demand ordering can help prevent overuse of insecticides and encourage other IPM strategies as a first response, because clients are instructed only to buy products when fall armyworm outbreaks are severe. This on-demand system works separately from One Acre Fund’s regular input delivery, which provides farmers with a supply of seeds, fertilizer, and other products (e.g. trees, solar lights) up-front before the start of the growing season. On-demand orders can take place at any time during the season, and products are delivered directly to individual clients by their local staff field officer, who can then reinforce training guidance and answer any questions that arise. Delivering products directly to our clients can also help ensure that farmers aren’t using the same insecticides year after year, which can reduce overall effectiveness as pests develop resistance. We offer different products in different seasons on a rotating basis, and we set limits about how much each farmer can order relative to the size of his or her land, to prevent overuse.

Overall, One Acre Fund’s mobile system has enabled us to address fall armyworm challenges as they occur, proving that digital technology can be a powerful tool for implementing response plans in rapidly changing environments. Average maize yields in Kenya have fluctuated somewhat over the past two years, with strong harvests for our clients in 2017, followed by smaller crops in 2018.11 Very dry weather last year, in addition to pest outbreaks, likely accounts for much of this variability. Looking forward, we plan to continue monitoring the fall armyworm situation in future seasons, and remain nimble so that we can refine our program offerings as needs change.

Digital technology can be a powerful tool for implementing response plans in rapidly changing environments.
It should be noted that fall armyworm yield damage has been somewhat less severe in our Rwandan clients’ fields than we had originally expected, albeit with great variation over time and within different seasons (our yield observations in Rwanda are discussed on page 3 of this report). We hypothesize that this may have to do with the country’s unique growing cycle, as well as wetter weather conditions that have occurred in recent seasons, particularly when compared with other countries, such as Kenya.
Tanzania, and Malawi, which experienced drought in 2018. In Rwanda, heavy rains after planting may have helped wash away fall armyworm eggs, and flight conditions during wet weather are less suitable for adult moths. Greater crop diversity and more frequent rotation may also help prevent insects from spreading. Rwandan rainfall patterns mean that farmers can harvest two crops per year, and many prefer to use the second growing season to plant beans – a crop that is less susceptible to fall armyworm. Field observations also indicate that natural predators such as birds and ants are adapting to prey on fall armyworm.

In 2019, we are providing farmers with a number of IPM trainings, including many listed on page 5 this report. We are also conducting trials to investigate whether the application of soil or ash to the funnel of maize plants might be effective against fall armyworm.¹² Our Rwanda team has consulted information from a number of sources, including UN FAO, WHO, the International Maize and Wheat Improvement Center (CIMMYT), and agricultural programs at leading universities, when developing guidance for farmers. One Acre Fund is also a member of Rwanda’s national Fall Armyworm Task Force, where we share results from our field trials with government officials, international organizations, and private-sector stakeholders, and discuss new interventions and learnings.

Rwandan farmers harvested their first crops of 2019 earlier this year, and their second harvest will follow in July and August. It is still too early for us to fully gauge the impact of fall armyworm on our clients’ crop yields, but our own field trials from the 2019A season in Rwanda recorded relatively low incidences of fall armyworm (below the recommended threshold for insecticides), indicating yield losses that were probably less than 5%. Continual growth and improvement are among One Acre Fund’s core values,¹³ and as such, we will continue to monitor the impact of our fall armyworm guidance in future seasons, and we may adapt our approach as necessary to respond to farmers’ changing needs.

Greater crop diversity and more frequent rotation may help prevent fall armyworm from spreading.

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³ Maize yields for One Acre Fund Kenyan clients averaged 4,050 kilograms per hectare in 2017 and 3,680 kg per hectare in 2018, representing a 9 percent decline year-over-year.
Fall armyworm represents an ongoing challenge to crop yields and food security in sub-Saharan Africa, and the situation continues to evolve. Based on One Acre Fund’s experience working directly with farmers to address this issue, we would highlight the following lessons learned:

- Fall armyworm is a serious issue in Africa, and smallholder farmers who depend on crops for their livelihoods are particularly vulnerable to outbreaks. Governments, nonprofits, and international organizations should work to improve smallholder resilience, particularly in the face of changing climatic and agronomic conditions that are poised to create further challenges.
- Any interventions against fall armyworm should balance health, safety, and environmental impacts with the need to promote long-term food security and should be science-based.
- Integrated Pest Management (IPM) should be the first line of defense against fall armyworm. Natural interventions such as crop rotation, intercropping, and planting grass barriers around fields can be very effective against fall armyworm, while also promoting healthy farming environments that enable crops to better withstand shocks.
- Organizations that work with smallholders should weigh whether insecticide interventions are necessary and likely to have positive impacts before distributing products to farmers. Rigorous decision criteria must be put into place that considers farmer health and safety, environmental impacts, efficacy, and smallholder farming economics.
- We encourage African governments to update their lists of approved insecticides and streamline registration processes, in order to incentivize private-sector companies to make additional safe, effective products available for farmers.
- Digital technology can be a powerful tool for enabling organizations to respond rapidly to fall armyworm problems and prevent outbreaks from spreading, as we’ve experienced in our Kenya program.
- Every country is different, so there is no one-size-fits-all solution to fall armyworm outbreaks. Stakeholders need to adapt their fall armyworm response plans to fit local conditions and environments.

Now that fall armyworm is established in sub-Saharan Africa, the threat to smallholder farmers’ harvests and livelihoods is unlikely to go away. Going forward, One Acre Fund will continue to monitor the impact of outbreaks in the areas where we work, and we will adapt our interventions as needs evolve. We hope that international organizations, governments, nonprofits, and other stakeholders will continue to be vigilant and work in partnership with farmers to drive long-term solutions. By working together and sharing knowledge, we can enable smallholders to put sustainable practices into place and promote food security and prosperity in rural communities across the region.

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